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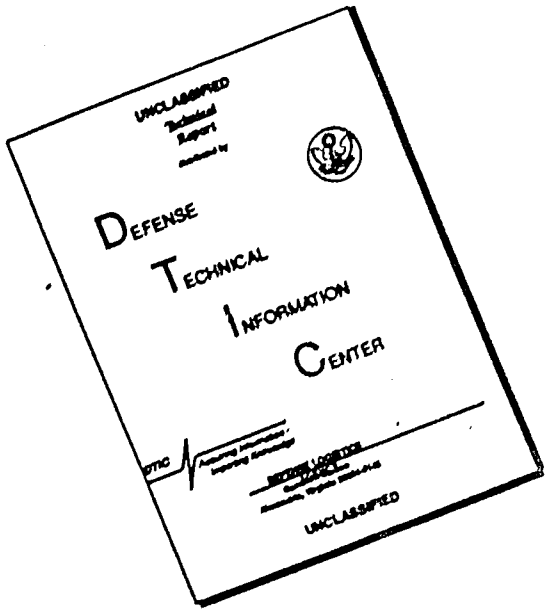
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FOREWORD

The Air Force Scientific Research Bibliography is part of our way of doing business. The Air Force Office of Scientific Research has the job of supporting fundamental research relevant to the Air Force operating mission. AFOSR regards this as a responsibility to document and make accessible the written results of the research it supports.

Volume V covers the year 1961, the beginning of the second decade of research results to be surveyed in this series. Volume I abstracted those publications produced from 1950 to 1956. That task was undertaken barely in time to produce reasonable completeness in view of the tendency of files to be retired, records to be stored, and items to simply disappear from shelves.

These compound bibliographic and abstracting challenges are no doubt the reason why, in publishing a work of this kind, AFOSR stands alone among Federal agencies supporting basic research. That AFOSR began in time to begin at the beginning is only because of the initiative and foresight of Harold A. Wooster, Director of Information Sciences, who set up this project and continues to guide it.

With this volume, perhaps more than 25,000 separate research publications have been catalogued and abstracted. Volumes for subsequent years are in preparation, and with each the difference becomes less between survey year and appearance of a volume.

With a printing of 3,000 copies, this edition will be distributed, as were earlier volumes, to libraries, universities and research centers the world over. There researchers and research managers may have direct access to a large body of scientific investigation directed along highly specific lines of relevance and potential application. This demand for the series is further evidenced by additional distribution by the Defense Documentation Center and sales by the Superintendent of Documents, U. S. Government Printing Office.

Aside from the very real contribution of augmenting scientific information centers, The Air Force Scientific Research Bibliography packages in final form, thus far, 11 years of research support and accounts for the use of about $160 million of public funds.



Ivan C. Atkinson, Col., USAF
Executive Director, Acting
Air Force Office of Scientific Research

PREFACE

Prolegomenon

Ten years ago, when work on this series of bibliographies started, basic research was in a parlous state. Concern for the national debt ceiling had prompted reduction of research expenditures; research contracts were cancelled to maintain this ceiling. Despite this austere regime, this Directorate devoted a substantial portion of its resources to starting work on these bibliographies, on the grounds that library research cost less than laboratory research, and that the collecting into a series of easily accessible volumes of the results of research already supported by the Air Force Office of Scientific Research was a necessary (if not sufficient) first step towards ensuring efficient use of scant research resources.

Shortly after this work was started Sputnik flew; basic research became a summum bonum, and entered into a period of unprecedented prosperity. But now, ten years later, the cycle seems to have come full swing. The talk these days is of coupling, and of technology transfer, and of hindsight, and of applying what we already know, but the results seem to be the same as in the black August of 1957. And the arguments for continuing this slow, patient, complete and accurate compilation of the results of all research supported by the Air Force Office of Scientific Research seem as valid today as they did ten years ago when this work was started.

Scope

This is the fifth 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 1961. Previous publications in this series have been:

Vol. I (1950-1956), issued in 1961
Vol. II (1957-1958), issued in 1964
Vol. III (1959), issued in 1965
Vol. IV (1960), issued in 1966

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

Sources Searched

References, reports, and clues to the existence of reports were found by searching the indexes and report collection of the Air Force Office of Scientific Research Technical Library, and the collection of the Defense Documentation Center. Detailed searches were made of each contract file in the several AFOSR Directorates. In addition, cover-to-cover searches were made of over 300 scientific journals issued mostly in the time period 1961-1964.

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, and a special subject classification for mathematics, have been provided. In addition, there are a contract index, an AFOSR control number index, and a personal author index for this volume. Finally a cumulative personal author index for the first five volumes has been added.

Acknowledgments

Many people have shared in the production of this volume. The work has been fostered and nurtured by the previous Commanders and Executive Director of Air Force Office of Scientific Research: Brigadier Generals H. F. Gregory and B. G. Holzman; Colonels A. P. Gagge and Jack L. Deets; Dr. Knox Millsaps and the present Executive Director, Dr. William Price. During the period of compilation of this volume (not the period of the literature covered) much of the responsibility for documentation within AFOSR was transferred to the Office of the Assistant Executive Director for Research Operations, Lt. Col. Carl S. Jennings, Jr. He, his administrative assistant for documentation, Miss Arlene 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, drew the chapter end plates (with the usual disclaimer about resemblances to persons living or dead being purely coincidental).

The bibliographic team has worked under the guidance and leadership of Dr. Clement R. Brown, Head of the Special Bibliographies Section, Science and Technology Division, Library of Congress. The chief bibliographers have been G. Vernon Hooker, Doris C. Yates, Harvey D. Brookins, Joan E. Halpin, Parthenia A. Patrick, Carl Kirksey, and Jeanne D. Weber. 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.



Arlington, Va.
October 1967

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

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

DETERMINANTS OF A CERTAIN CLASS OF NON-HERMITIAN TOEPLITZ MATRICES, by G. Baxter and P. Schmidt. [1960] [7]p. (AFOSR-232) (AF 61-(052)42 and AF AFOSR-61-4) AD 611295 Unclassified

Also published in Math. Scand., v. 9: 121-128, 1961.

An elementary identity is established between 2 determinants and its use is illustrated as a tool for investigating a certain class of Toeplitz determinants. The feature of the identity which makes it useful in such investigations is that it equates a determinant of large order n to one fixed small order k. Thus, using only elementary techniques, precise information can be obtained on the asymptotic behavior of certain n x n Toeplitz determinants as n becomes infinite. Consider the function $f(z) = z^{-k}\Sigma_0^{\infty} a_m z^m$, where $k \geq 0$, $\Sigma_0^{\infty}|a_m| < \infty$, and $\log f(e^{i\theta}) = \Sigma_{-\infty}^{\infty} h_m e^{im\theta}$, with $\Sigma_{-\infty}^{\infty}|h_m| < \infty$. The corresponding Toeplitz matrix is non-Hermitian, but the authors derive the following analogue of classical theory. If $D_n(f)$ is the determinant of the n^{th} section of the Toeplitz matrix, then $\lim D_n(f)/\exp nh_0 = \exp(\sum_0^{\infty} mh_m h_{-m})$.

2

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

ON THE RATE OF GROWTH OF THE PARTIAL MAXIMA OF A SEQUENCE OF INDEPENDENT IDENTICALLY DISTRIBUTED RANDOM VARIABLES, by O. Barndorff-Nielsen. [1961] [12]p. (Technical scientific note no. 5) (AFOSR-1339) [AF 61(052)42] AD 264846 Unclassified

Also published in Math. Scand., v. 9: 383-394, 1961.

Let $X_1, X_2, \cdots, X_n$ be a sequence of independent, identically distributed random variables defined on a probability field (Ω, A, P) and let F denote their (common) distribution function so that $F(x) = P(\{X_n \leq x\})$ for all $x \in (-\infty, \infty)$ and $n = 1,2,\cdots$. The main result is the following: Let $\{\lambda_n\}$ be a non-decreasing sequence of real numbers, such that the sequence $\{(F(\lambda_n))^n\}$ is non-increasing. Then $P\left(\left\{\max_{1\leq k\leq n} X_k \leq \lambda_n \text{ for infinitely many } n\right\}\right) = \begin{cases} 0 \\ 1 \end{cases}$ if $\sum_{n=3}^{\infty} (F(\lambda_n))^n \frac{\log\log n}{n} \begin{cases} < \infty \\ = \infty \end{cases}$. The result is established by means of a generalization of the convergence part of the Borel-Cantelli lemmas.

3

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

ON A GENERALIZATION OF THE FINITE ARCSINE LAW, by G. Baxter. [1961] [12]p. (AFOSR-2877) (In cooperation with Minnesota U., Minneapolis) [AF 61-(052)42] AD 428404 Unclassified

Also published in Ann. Math. Stat., v. 33: 909-915, Sept. 1962.

A generalization of the arcsine law for infinitely divisible stochastic processes is found. The generalization method consists of finding a pair of differential equations for the generating functions of quantities like those in the distribution of N which is the number of positive partial sums considered. These equations are solved and the generating functions inverted. The sequence X consists of independent, identically distributed random variables with continuous and symmetric distributions; the probability that 2 of the partial sums are equal is zero.

4

Aberdeen U. Dept. of Chemistry (Scotland).

THE SYSTEM CaO-Ga_2O_3, by J. Jeevaratnam and F. P. Glasser. [1961] [4]p. incl. diagr. tables. (AFOSR-2374) (Sponsored jointly by Air Force Office of Scientific Research under [AF 61(052)276] and United Kingdom Government) AD 611454 Unclassified

Also published in J. Amer. Ceram. Soc., v. 44: 563-566, Nov. 1, 1961.

CaO and Ga_2O_3 form 3 compounds: $3CaO{\cdot}Ga_2O_3$, $CaO.Ga_2O_3$, and $CaO.2Ga_2O_3$. $3CaO.Ga_2O_3$ melts incongruently to CaO plus liquid at 1263°C; $CaO.Ga_2O_3$ and $CaO.2Ga_2O_3$ melt congruently at 1369° and 1504°C respectively. Eutectics are located at the following temperatures and composition (in mol % Ga_2O_3): between $3CaO.Ga_2O_3$ and $CaO.Ga_2O_3$, 1245°C and 37.5%; between $CaO.Ga_2O_3$ and $CaO.2Ga_2O_3$, 1323°C and 57%; and between $CaO.2Ga_2O_3$ and β-Ga_2O_3, 1457°C and 68%. There is a peritectic at 1263°C and 36%. Three polymorphs of $CaO.Ga_2O_3$ are described. Compositions from approximately 35 to 70 mol % Ga_2O_3 can be quenched to yield homogeneous glasses. (Contractor's abstract)

5

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-2716) [AF 61(052)276] Unclassified

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

$Ca_2BaSi_3O_9$ was prepared by heating weighed quantities of reagent grade $CaCO_3$, $BaCO_3$, and SiO_2. Large (0.2 - 1.0 mm) single crystals of $Ca_2BaSi_3O_9$ were readily prepared by heating the composition just at or below the temperature of incongruent melting (1320°C). The unit-cell parameters were refined by using the indexed powder pattern. The powder pattern was indexed down to about d = 1.6A by direct comparison of the powder photograph with single crystal rotation photographs. Results show that $Ca_2BaSi_3O_9$ is triclinic, a = 6.72A, b = 6.73A, c = 9.62A, α = 88°22', β = 111°03', γ = 102°20', space group $P\bar{1}$, Z = 2.

6

Aberdeen U. Dept. of Chemistry (Scotland).

HEXAGONAL HIGH TEMPERATURE POLYMORPH OF CALCIUM CHROMITE, by F. P. Glasser and L. S. D. Glasser. [1961] [2]p. incl. table. (AFOSR-2848) [AF 61(052)276] Unclassified

Also published in Inorg. Chem., v. 1: 428-429, May 1962.

Calcium chromite exists in 2 polymorphic forms. The low temperature modification, β-$CaCr_2O_4$, is isostructural with $CaFe_2O_4$ and CaV_2O_4. The high temperature form, stable above 1570°, was designated α-$CaCr_2O_4$ by Ford et al, (Trans. Brit. Ceram. Soc., v. 48: 291, 1949). A powder pattern was reported and a tetragonal unit cell with a = 5.53A, c = 19.16A deduced from it. A single crystal study indicates that the unit cell is hexagonal. (Contractor's abstract)

7

Aberdeen U. Dept. of Chemistry (Scotland).

SILICATE TRANSFORMATIONS: RHODONITE-WOLLASTONITE, by L. S. D. Glasser and F. P. Glasser. [1960] [5]p. incl. diagrs. refs. (AFOSR-4067) (AF 61(052)276) Unclassified

Also published in Acta Cryst., v. 14: 818-822, Aug. 1961.

Details of the oriented transformation rhodonite - wollastonite have been studied. The results show conclusively that the cation-oxygen skeleton is preserved during the change, at the expense of silicon-oxygen bonds. This provides direct evidence of the migration of silicon during thermal transformations of silicates. (Contractor's abstract)

8

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

LOW TEMPERATURE PLASMA JET (Abstract), by H. F. Calcote. [1960] [1]p. (AF 49(638)300) Unclassified

Presented at Third AFOSR Contractors' meeting on Ion and Plasma Propulsion, Republic Aviation Corp., Farmingdale, N. Y., Mar. 22-24, 1960. (AFOSR-TN-60-405; AD 235949)

The low temperature plasma jet is a device for producing a non-equilibrium supersonic stream of partially dissociated and partially ionized gas. The vacuum system utilized by this research has been increased from 400 cfm (1 to 10 mm Hg) to 3,000 cfm (1μ to - 10 mm Hg) and the capacity of the power supply has been increased so the range over which measurements can be made is greater. Further evaluation of the differential catalytic probe for measuring atom concentrations shows that it can be brought into agreement with the chemical titration. This requires assuming a surface activity of 0.07 to 0.08 for platinum at 1100°K. The effect of secondary air and argon shows that the catalytic probe and chemical titration are both measuring the same thing, assumed to be nitrogen atoms. Experiments with greater power density indicate the increasing power requirements necessary to increase the atom concentration, i.e., with present geometries and discharge characteristics, the point of diminishing returns is being approached. Discharge characteristics have been obtained for air, nitrogen, argon and helium over a range of pressures. There are marked differences in behavior between the diatomic and monatomic gases. (Contractor's abstract, modified)

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

STEADY STATE SURFACE TEMPERATURES OF RADIATION COOLED BODIES IN DISSOCIATING ATMOSPHERES, by D. E. Rosner. Feb. 1961 [15]p. incl. diagrs. (Rept. no. TP-26) (AFOSR-697) (AF 49(638)300) AD 257862 Unclassified

The conditions under which the skin temperature of a radiation cooled vehicle in a dissociating atmosphere can exceed that in an inert atmosphere at the same vehicle velocity are investigated. If the Lewis-Semenov

number for atom diffusion is greater than unity, this is found to be possible for both radiation-cooled active catalytic surfaces in the chemically frozen regime and solids of arbitrary catalytic activity in the chemical equilibrium region. (Contractor's abstract)

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

DIFFUSION AND CHEMICAL SURFACE CATALYSIS IN A LOW-TEMPERATURE PLASMAJET. THE DETERMINATION OF ATOM CONCENTRATIONS IN NONEQUILIBRIUM SUPERSONIC STREAMS OF ACTIVATED NITROGEN, by D. E. Rosner. [1961] [9]p. incl. diagrs. tables, refs. (AFOSR-913) [AF 49-(638)300] Unclassified

Presented at Winter annual meeting of the Amer. Soc. Mech. Eng., New York, Nov. 26-Dec. 1, 1961.

Also published in Jour. Heat Transfer, v. 84: 386-394, Nov. 1962.

Chemical and thermal methods have been used to estimate the free atom concentration in a nonequilibrium supersonic jet of activated nitrogen emerging from a direct-current, high pressure, glow discharge. Emphasis is given to differential catalytic probe techniques, several variations of which are discussed. For nonequilibrium dissociated streams of low stagnation enthalpy, a differential catalytic thermometer is described which, in principle, offers the advantages of: (a) Linearity of probe response; (b) sensitivity independent of catalyst activity, details of gas dynamic environment, and catalyst geometry. A simple thermometric probe has been constructed and its output has been studied over a small range of electrical power dissipation. Evidence is given in support of the view that the probe responds principally to the same component of activated nitrogen that is depleted by chemical reaction with ethylene and propylene. Both catalytic probe measurements and the limiting amount of hydrogen cyanide production yielded about the same atom concentration (mol fractions of about 2%). For electrical discharges operating at higher power densities, radiation losses from the catalytic thermometer surfaces necessitate design compromises which reduce the potential accuracy of the thermometric technique applied herein. This difficulty can be circumvented by using cooled catalytic probes (calorimeters), 1 type of which is currently under investigation. In general, it appears that the aerodynamic uncertainties involved in the catalytic probe theories presented are minor compared to the physicochemical questions raised by the use of such probes in nonequilibrium environments. Particular attention must be devoted to the role of excited species (other than ground state atoms) on the accuracy of both differential thermal detectors and chemical reactivity methods of analysis. (Contractor's abstract)

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

GENERATION OF SUPERSONIC DISSOCIATED AND IONIZED NONEQUILIBRIUM STREAMS. ENERGY UTILIZATION AND THE DETERMINATION OF ATOM CONCENTRATIONS, by D. E. Rosner. July 1961 [64]p. incl. illus. diagrs. tables, refs. (Rept. no. TP-31) (AFOSR-1360) (AF 49(638)300) AD 264973 Unclassified

Three distinct methods to determine atom concentrations in the nonequilibrium supersonic jet of activated N emerging from an unconventional direct current glow discharge are evaluated. The accuracy of each method is discussed and compared, both as to the ability to predict trends as well as absolute values. The first is based on over-all power and pressure measurements alone and is capable only of setting an upper limit to the actual atom concentration. The second is classified as differential catalytic thermometry, and relies on the use of differential thermochemical effects for atom recombination reactions on surfaces as a basis of inferring local atom concentrations in the gas phase. The results of a series of upstream mixing experiments support the view that the catalytic probes respond to the same component of active N that is depleted by chemical reaction with unsaturated hydrocarbon gases (ethylene, propylene), the most likely of these species being ground state N atoms. Finally, measurements of the limiting amounts of HCN produced by the reaction of active N with propylene have been used to estimate the dissociation level in the discharge products. Each of the methods leads to dissociation levels of the order of 1% (by mass) in N. (Contractor's abstract)

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

SURFACE TEMPERATURES OF HIGH SPEED, RADIATION COOLED BODIES IN DISSOCIATING ATMOSPHERE, by D. E. Rosner. [1961] [3]p. incl. diagrs. refs. (AFOSR-1661) (AF 49(638)300) Unclassified

Also published in ARS Jour., v. 31: 1013-1015, July 1961.

On the basis of this brief examination of radiation cooled surface temperature, it is concluded that operating surface temperatures in an initially undissociated environment can exceed those encountered in an inert environment at the same stagnation enthalpy but only if the average Lewis-Semenov number Le_f exceeds unity.

This condition is, however, not sufficient. A temperature overshoot is found to be possible both for catalytically active radiation cooled solids in the chemically frozen (nonequilibrium) boundary layer regime, and radiation cooled solids of arbitrary activity in the local thermochemical equilibrium boundary layer regime only if, in addition, the nondimensional convection-radiation parameter $\Re$ is sufficiently large to cause the equilibrium

atom concentration corresponding to the interface temperature to be negligible compared to the atom concentration at the outer edge of the boundary layer. Thus the temperature overshoot phenomenon should be considered the exception rather than the rule. If non-catalytic, high temperature coatings are available, and the boundary layers are in practice chemically frozen, then operating surface temperatures of radiation cooled vehicles can be considerably lower than would be encountered in an inert atmosphere for all values of the convection-radiation parameter.

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

PRELIMINARY OBSERVATIONS ON THE EFFUSION COOLING OF CATALYTIC SOLIDS EXPOSED TO PARTIALLY DISSOCIATED NONEQUILIBRIUM GAS STREAMS, by D. E. Rosner. Oct. 1961, 22p. incl. diagrs. tables, refs. (Rept. no. TN-37) (AFOSR-1841) (AF 49(638)300) AD 269000 Unclassified

The consequences of gas phase chemical reaction between an effusion coolant and chemically reactive species present in the free stream are discussed with regard to convective energy transfer to catalytically active solids. A porous Cu surface was exposed to a supersonic stream of activated N. The relative effectiveness of ethylene, NH_3, N, and NO_2 as coolants was markedly altered by the effects of specificity in their gas phase chemical behavior. This suggested that differences in gas phase chemical reactivity could be used in selecting effusion coolants for catalytically active solids exposed to high temperature partially dissociated streams. (Contractor's abstract)

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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. Aug. 1, 1961 [51]p. incl. diagrs. tables, refs. (Rept. no. TP-35) (AFOSR-1994) (AF 49(638)300) Unclassified

Presented at Amer. Inst. of Chem. Engineers Symposium on Transport and Kinetic Factors in Heterogeneous Catalysis, New York, Dec. 7, 1961.

If the temperature level of free stream reactant concentration is deliberately changed, the resulting change in the observed global reaction rate on a catalytic surface in a flow system will not necessarily reflect the true chemical kinetics at the fluid/solid interface. General expressions, reminiscent of those applicable to a static system, are derived for the relation between the falsification of the activation energy and reaction order in terms of a logarithmic derivative of the isothermal diffusion correction (effectiveness factor). Approximate solutions are given for the case of the thin, non-turbulent diffusion layer which develops along a non-porous, catalytic flat plate, for arbitrary values of the true reaction order and Prandtl number for diffusion (Schmidt number). Comparisons with exact solutions to the boundary layer equations and alternate approximate methods are given for the special case of first order surface reactions. Of the various quantities of interest in the diffusional theory of heterogeneous reactions in flow systems, it is shown that the accuracy of the Prandtl-Kamenetzkiĭ quasi-stationary method can become unacceptably poor for the calculation of these falsification parameters. The physico-chemical conditions under which these errors are likely to be largest are discussed. Applications are given to the study of the chemical kinetics of fast surface reactions. (Contractor's abstract)

15

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

CATALYTIC PROBES FOR THE DETERMINATION OF ATOM CONCENTRATIONS IN HIGH SPEED GAS STREAMS, by D. E. Rosner. [1961] [9]p. incl. diagr. refs. (AFOSR-3209) (AF 49(638)300) Unclassified

Also published in ARS Jour., v. 32: 1065-1073, July 1962.

Whereas spectroscopic and chemical methods of determining free atom concentrations in the gas phase tend to average over comparatively large stream tube areas, catalytic probe measurements can be made locally and with good sensitivity. For low stagnation enthalpy supersonic streams of nonequilibrium dissociated gases, continuum differential catalytic thermometers (uncooled) can be designed which, in principle, offer the advantages of an output that is (1) linearly proportional to free-stream atom concentration regardless of the true kinetic order of the interfacial reaction; (2) insensitive to small changes in the catalytic activities of the probe surfaces; and (3) insensitive to the details of the gasdynamic environment (Mach number, Reynolds number) and catalyst shape. However, for high stagnation enthalpy applications, the last of these features is forfeited by having to go to internally cooled catalytic probes, since it is shown that, even in the absence of a materials problem, the required thermometer diameters become prohibitively large and, hence, the radiation errors excessive. Rational formulas are derived for each basic probe type, and some physicochemical questions raised in using catalytic probes in nonequilibrium environments are discussed.

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

ATOM CONCENTRATIONS IN SUPERSONIC STREAMS (Abstract), by D. E. Rosner and A. Fontijn. [1961] 2p. [AF 49(638)300] Unclassified

Presented at Second AFOSR Contractors' meeting on Chemical Kinetics of Propulsion, Illinois Inst. of Tech., Armour Research Foundation, Chicago, Sept. 11-12, 1961. (AFOSR-1417; AD 265513)

Experimental studies of some chemical and thermochemical properties of high-speed, non-equilibrium streams of activated nitrogen are described, with emphasis on the determination of: (1) steady state nitrogen atom concentrations, and (2) effects of excited species other than ground state atoms on energy transfer rates to catalytic solids from the products of a dc glow discharge. Gases with different chemical reactivity were passed through a porous catalyst exposed to the supersonic stream of active nitrogen. For making detailed comparisons with the results of a new transient thermal detector, a quartz chemical sampling probe was developed. This probe samples a small central portion of the supersonic stream. From the measurements made, the atom concentration in the supersonic flow at the point of sampling is determined. Finally the results of recent theoretical studies of the apparent kinetics of heterogeneous reactions in flow systems are described, with emphasis on the diffusional falsification of activation energy and reaction order.

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Aerojet-General Corp., Azusa, Calif.

A PROPOSED MECHANISM FOR THE DISAPPEARANCE OF OH RADICALS IN IRRADIATED ICE, by S. Siegel, S. Skolnik, and J. M. Flournoy. [1961] 9p. (Contribution no. 211) (AFOSR-469) (AF 18(603)110) Unclassified

A mechanism is proposed to explain the observed 3/2 order concentration dependence found for the decay of stabilized OH radicals in ice above 77°K. The essential assumption made is that OH in ice undergoes equilibrium dissociation as an acid. (Contractor's abstract)

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Aerojet-General Corp., Azusa, Calif.

RADICAL FORMATION AND TRAPPING IN TRITIUM-ENRICHED ICE, by J. M. Flournoy, S. Siegel, and H. S. Judeikis. Sept. 1961 [9]p. incl. diagrs. (Rept. no. TN-41) (AFOSR-1481) (AF 18(603)110) AD 265956 Unclassified

Also published in Fifth Internat'l. Symposium on Free Radicals; Preprints of Papers, Uppsala U. (Sweden) (July 6-7, 1961), New York, Gordon and Breach, Science Publishers, Inc., 1961, p. 19-1 — 19-10.

Electron-paramagnetic-resonance (EPR) spectrometry was used to follow quantitatively the formation of trapped OH radicals at 77°K in a sample of ice containing 1 curie/ml of tritium-labeled water as a source of internal beta-radiation. The results are compared with the results of studies of gamma-irradiated ice.

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Aerojet-General Corp., Azusa, Calif.

LOW-TEMPERATURE KINETIC BEHAVIOR OF HYDROGEN ATOMS IN GAMMA-IRRADIATED ICE, by J. M. Flournoy, L. H. Baum, and S. Siegel. Nov. 1961 [21]p. incl. diagrs. refs. (Rept. no. TN-42) (AFOSR-1541) (AF 18(603)110) AD 266438 Unclassified

The rate of disappearance of trapped hydrogen atoms in gamma-irradiated ice has been studied at temperatures up to 60°K. H atoms produced by gamma-irradiation of ice at 4.2°K appear to be trapped in a variety of different sites, with activation energies for de-trapping ranging from less than 1.0 to more than 2.0 kcal/mol. The results are discussed in terms of various models; the preferred model involves an initially non-isotropic spatial distribution. (Contractor's abstract)

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Aerojet-General Corp., Azusa, Calif.

KINETICS OF ENERGETIC SPECIES AT LOW TEMPERATURES, by H. S. Judeikis, M. K. Barsh and others. Final rept. Nov. 1961 [44]p. incl. diagrs. tables, refs. (Rept. no. 2121) (AFOSR-1758) (AF 18(603)110) AD 268034 Unclassified

Research on the stabilization and chemical reactions of energetic free radicals is summarized. Studies were made on the irradiation of ice, solid N_2F_4, solid NH_3, EtBr, MeI, MeOH, and tetramethyltetrazene. H atoms, OH radicals, and other normally unstable chemical species produced by ionizing radiation and by electric charges were stabilized at low temperature and investigated. The disappearance of OH in irradiated ice at 100°K followed a 3/2-order reaction rate law; the activation energy is 6 kcal/mol. H atoms produced by irradiation of wet pyrex recombined rapidly at 100°K and followed a second-order reaction rate law with an activation energy of 4 kcal/mol. Tests designed to trap NH_2 radicals at 77°K yielded inconclusive results.

Stabilization of H atoms was observed on the surfaces of quartz vessels used for UV studies of MeI, MeOH and tetramethyltetrazine. The rates of formation and disappearance of some of these radicals were measured by electron paramagnetic-resonance techniques.

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Aerojet-General Corp., Azusa, Calif.

KINETICS OF ENERGETIC SPECIES AT LOW TEMPERATURES (Abstract), by M. K. Barsh. [1961] [1]p. [AF 18(603)110] Unclassified

Presented at Second AFOSR Contractors' meeting on Chemical Kinetics of Propulsion, Illinois Inst. of Tech., Armour Research Foundation, Chicago, Sept. 11-12, 1961. (AFOSR-1417; AD 265513)

The kinetic behavior of free radicals formed by ionizing irradiation at temperatures between 4 and 110°K has been the subject of investigation on this program. The kinetics of the disappearance of the OH radicals was found to follow a 3/2 order rate law in OH radical concentration between 92 and 110°K. This rate law was obeyed regardless of the nature or duration of the irradiation or of the manner of preparation of the sample. The rate constant can be represented by the expression $k = 3 \times 10^{11} \exp(-6000/RT)(m/l)^{-\frac{1}{2}} sec^{-1}$. A mechanism was proposed for the disappearance of the OH radical assuming that the fractional-order behavior of the radical was attributable to a sequence of chemical reactions involving the equilibrium dissociation of the OH radical as an acid followed by the rate determining, irreversible reaction of the anion O^- with a second OH radical to give HO_2^-. The mechanism is subject to question as a result of attempts to confirm the kinetics by measuring the disappearance rates of the OH radical in the presence of acidic and basic additives in the irradiated ice.

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Aerojet-General Corp., Azusa, Calif.

THERMAL DECOMPOSITION OF GASEOUS DIMETHYLNITRAMINE, by J. M. Flournoy. [1961] [2]p. incl. diagr. [AF 18(603)110] Unclassified

Published in Jour. Chem. Phys., v. 36: 1106-1107, Feb. 15, 1962.

The pyrolysis of gaseous dimethylnitramine was investigated at temperatures from 165° to 200°C and at initial pressures from 200 to 750 mm Hg. Mass spectrometric analysis showed that the principal product of the reaction was dimethylnitrosamine, in 80% yield, plus smaller amounts of low-molecular-weight oxidation products. $(CH_3)_2HNO_2 \rightarrow (CH_3)_2HNO$ + secondary products. The reaction was found to be homogeneous, kinetically first order with respect to the concentration of dimethylnitramine, and unaffected by addition of nitric oxide. The proposed mechanism was: $(CH_3)_2NNO_2 \rightarrow (CH_3)_2N. + NO_2$ (the rate determining reaction), $NO_2 + (CH_3)_2NNO_2 \rightarrow NO$ + oxidation products, and $(CH_3)_2N. + NO \rightarrow (CH_3)_2NNO$.

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Aerojet-General Corp., Azusa, Calif.

THERMAL DECOMPOSITION OF GASEOUS 2,2-DINITROPROPANE, by J. M. Flournoy. [1961] [2]p. incl. diagr. [AF 18(603)110] Unclassified

Published in Jour. Chem. Phys., v. 36: 1107-1108, Feb. 15, 1962.

The pyrolysis of gaseous 2,2-dinitropropane (DNP) was investigated in 10 experiments at temperatures from 175° to 210°C. Preliminary results offer evidence for a chain mechanism involving the 2-nitropropyl radical and an intermediate nitro-nitrite. The results of five mass-spectrometric analyses of the products of the first 2-7% of the reaction indicated that the initial products are acetone, NO, and NO_2, in equimolar amounts. As acetone and NO_2 accumulate, the NO_2 is rapidly reduced to NO by reaction with acetone to yield H_2O, CO, CO_2, etc. It is suggested that the C-O bond may be formed through an intermediate nitro-nitrite, $(CH_3)_2C(ONO)(NO_2)$, which decomposes by loss of NO and NO_2 to form acetone. The mechanism was explained as $(CH_3)_2C(NO_2)_2 \rightarrow (CH_3)_2C(NO_2) + NO_2$, $(CH_3)_2C(NO_2) + ONO \rightarrow (CH_3)_2C(ONO)(NO_2)$ or $(CH_3)_2C\,NO_2 + (O_2N)_2C(CH_3)_2 \rightarrow (CH_3)_2C(ONO)NO_2 + (O_2N)C(CH_3)_2$, and the final step being $(CH_3)_2C(ONO)(NO_2) \rightarrow (CH_3)_2CO + NO + NO_2$.

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Aerojet-General Corp., Azusa, Calif.

DISAPPEARANCE OF TRAPPED HYDROGEN ATOMS IN GAMMA-IRRADIATED ICE, by J. M. Flournoy, L. H. Baum, and S. Siegel. [1961] [2]p. incl. diagr. [AF 18-(603)110] Unclassified

Published in Jour. Chem. Phys., v. 36: 2229-2230, Apr. 1962.

When ice is subjected to gamma-irradiation at 4.2°K, H and OH radicals are formed and are stabilized in approximately equivalent amounts, with an initial yield of about 0.8 radical pairs/100 ev. When the system is warmed to 77°K, all of the H and a portion of the OH disappear. This paper describes the results of kinetic observations of the disappearance of H in irradiated ice at temperatures between 4.2° and 77° using ESR techniques. In an effort to determine independently the order of reaction and the activation energy, a number of rate measurements were made under isothermal conditions at several temperatures. The dependence of the isothermal rate upon the total H-atom concentration, is much too great to correspond with a normal rate law form. Instead, at each temperature, the initial rapid rate of disappearance seems to approach a very slow, asymptotic value long before all the atoms have disappeared. Comparisons of the rate toward the end of a run at one temperature with the rate at the beginning of the run at the next higher temperature yield apparent activation energies ranging from somewhat less than 1 kcal/mol near 30°K to nearly 2.5 kcal/mol near 50°K. The temperature dependence of the apparent activation energy suggests that the H atoms may be stabilized in a

variety of different trapping sites, with a spectrum of energies for de-trapping and reaction. An alternative explanation for the kinetic behavior is that the reactions occurring in irradiated ice between 4.2° and 77°K may be primarily intra-spur reactions rather than isotropic processes.

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Aerojet-General Corp., Azusa, Calif.

HIGH-FREQUENCY COMBUSTION INSTABILITY, by R. G. Peoples, P. D. Baker, and L. S. Knowles. Rept. for Mar. 15, 1957-Aug. 18, 1961. Nov. 1961 [39]p. incl. diagrs. refs. (Rept. no. 2126) (AFOSR-1802) (AF 49(638)178) AD 269500 Unclassified

Analytical and experimental studies of stable and unstable combustion phenomena were conducted to determine the parameters affecting inherent stability. It was demonstrated that inherent stability is determined by the amount of pressure-sensitive energy available to a given pressure perturbation, and by the relationship between replenishment of this energy and the time period of the perturbation. Analytical concepts describing the support mechanism and experimental data indicating the complexity of a nonlinear perturbation were established. (Contractor's abstract)

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Aerojet-General Corp., Azusa, Calif.

TWO-DIMENSIONAL MOTOR PROGRAM, by P. D. Baker, R. G. Peoples, and T. R. Mills. Jan. 1962 [61]p. incl. illus. diagrs. tables, refs. (Rept. no. 2185; supplement to rept. no. 2126) (AFOSR-1802A) (AF 49(638)178) AD 272062 Unclassified

A 2-dimensional motor was designed, fabricated, and tested to establish improved techniques for measuring the dynamic characteristics of the combustion mechanism in an operating thrust chamber. The criteria on which the design of the motor was based, the experimental equipment, and the tests conducted are described. The methods by which this motor can be used to investigate stable and unstable combustion are discussed and the correlations necessary to relate the observed phenomena to the behavior of full-scale rocket engines are indicated. (Contractor's abstract)

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Aerojet-General Corp., Azusa, Calif.

TANGENTIAL MODE OF COMBUSTION INSTABILITY, by H. C. Krieg, Jr. [1961] [28]p. incl. illus. diagrs. refs. (AFOSR-J912) (AF 49(638)178) Unclassified

Presented at ARS Propellants, Combustion and Liquid Rockets Conf., Palm Beach, Fla., Apr. 26-28, 1961.

Also published in Prog. in Astronaut. and Rocketry, v. 6: 339-366, 1962.

The results of pulse motor investigations into the tangential mode of combustion instability are discussed. Particular emphasis is placed on: The axial and radial distribution of the instability front within the experimental chamber; correlation of luminosity, instantaneous pressure with the front motion; and estimation of the chamber-gas movement during unstable combustion. A combustion model for tangential instability is presented, and its application to combustion systems is discussed. The inherent stability of combustion processes is shown to be dependent on the relationship between cyclic pressure modes and the mechanism for replenishment of pressure sensitive energy. It is shown that the pressure modes are controlled by chamber geometry, whereas the replenishment of energy is a function of the chemical and physical processes. (Contractor's abstract)

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Aerojet-General Corp., Azusa, Calif.

ION ENGINE DEVELOPMENT. I. DIFFUSION TYPE ION SOURCES, by R. J. Sunderland, J. R. Padbill, and R. D. Gilpin. [1960] [32]p. incl. illus. diagrs. table, refs. (AFOSR-TN-60-820) (AF 49(638)214) Unclassified

Also published in Advances in the Astronautical Sciences; Proc. of Third Annual West Coast meeting of the Amer. Astronaut. Soc., Seattle, Wash. (Aug. 4-5, 1960), New York, Plenum Press, v. 7: 148-172, 1961.

The experimental results of investigations in the areas of ionization of gases and vapors upon diffusion through heated metal foils, the ionization of alkali metals upon electrolysis through platinum coated glass membranes, and the ionization of alkali metal vapors upon diffusion through porous tungsten maintained at elevated temperatures are presented. An outline is also given for future work in these areas at the Aerojet Astronautics Lab. The problem evolves around the fact that the nuclear powered rocket will be capable of specific impulses of the order of 1000 sec, but for economical voyages within the solar system and beyond, much higher effective exhaust velocities will be required. Electrical methods of propulsion offer a means of achieving these high velocities, but unfortunately at extremely low thrust levels. Ion propulsion methods depend critically upon the development of suitable ion sources. Results are presented that indicate that a diffusion type ion source may provide the high exhaust velocities and high thrust levels provided problems on interactions between individual beams do not prove too troublesome.

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Aerojet-General [Corp.] Azusa, Calif.

ION-ELECTRON RECOMBINATION KINETICS (Abstract), by C. B. Kretschmer. [1961] [1]p. [AF 49-(638)540] Unclassified

Presented at Second AFOSR Contractors' meeting on Chemical Kinetics of Propulsion, Illinois Inst. of Tech., Armour Research Foundation, Chicago, Sept. 11-12, 1961. (AFOSR-1417; AD 265513)

The rate of disappearance of ionization in gas-discharge plasmas has been studied using Langmuir probes to measure ion concentrations. The following values of the recombination coefficient are obtained from the observed decay probe current: argon 7 x 10^{-7} cm^3/sec; nitrogen 7 x 10^{-7} cm^3/sec; oxygen 2 x 10^{-6} cm^3/sec. These are in good agreement with recent microwave measurements of dissociative recombination coefficients. In other experiments, the following values were obtained for the rate coefficient for formation of molecular ions from atomic ions in 3-body collisions: helium 5.7 x 10^{-32} cm^6/sec; argon 2.4 x 10^{-31} cm^6/sec.

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Aerojet-General Corp., Azusa, Calif.

CHARGED COLLOID PROPULSION (Abstract), by R. D. Schultz, L. B. Becker and others. [1960] [1]p. (AF 49(638)656) Unclassified

Presented at Third AFOSR Contractors' meeting on Ion and Plasma Propulsion, Republic Aviation Corp., Farmingdale, N. Y., Mar. 22-24, 1960. (AFOSR-TN-60-405; AD 235949)

Preliminary results are presented of an attempt to produce electrically charged colloidal-size droplets of oil in high vacuum by means of an electrostatic spray technique such that the resultant beam of particles has an average positive charge to mass ratio over 200 coulombs/kg. It had been possible to electrically atomize unpurified di-octyl phthalate oil from sharp needle tips in vacuum of about +30 kv. It was suspected, however, that some corona discharge was occurring which would produce undesirable light weight extraneous ions in the charged colloid beam. It has now been found possible to electrically atomize purified di-octyl phthalate in high vacuum in the absence of appreciable corona by placing a suitable biased hot-filament in the vicinity of the needle tips. The electrons emitted from the filament and accelerated toward the needle tips provide a substitute for the $(e^-)^*$ (energetic electron) of the corona charging process. The extent of extraneous ion formation in the resultant colloid beam and the average charge to mass ratio of the colloidal oil droplets remain to be determined.

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Aerojet-General Corp., Azusa, Calif.

CHARGED-COLLOID PROPULSION SYSTEM, by R. B. Edmonson, C. B. Kretschmer, and W. C. Miles. Jan. 1961 [10]p. incl. illus. diagr. table. (Rept. no. 0290-01-2) (AFOSR-228) (AF 49(638)656) AD 250587 Unclassified

This report summarizes research on the electrostatic spraying of microscopic droplets of oil. The research is directed toward an understanding of the mechanisms of charge accumulation and electrostatic spraying in high electrical fields. The work during this period has been directed primarily to the measurement of oil droplet size, and to the design and construction of equipment for the measurement of individual particle charge-to-mass ratio. (Contractor's abstract)

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Aerojet-General Corp., Azusa, Calif.

CHARGED-COLLOID PROPULSION SYSTEM, by R. B. Edmonson and W. C. Miles. Quarterly summary rept. Apr. 1961 [7]p. incl. illus. diagrs. (Rept. no. 0290-01-3) (AFOSR-945) (AF 49(638)656) AD 257723 Unclassified

Activity was limited primarily to the design, construction, and evaluation of various feed systems for electrostatic spraying in vacuum. The feed system, utilizing a non-conductive, porous fiber as a spray source was found to have limiting voltage operating conditions. A feed system was constructed where instead of a spray wedge, a convex porous exit surface is provided with a fine-micron porous-metallic element from which an oil-spray tip is pulled upon application of the electric field.

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Aerojet-General Corp., Azusa, Calif.

INVESTIGATION OF HIGH ENERGY OXIDIZER BINDERS FOR SOLID PROPELLANTS (Unclassified title), by S. M. Lee. Feb. 1961 [44]p. incl. illus. diagrs. tables, refs. (Rept. no. 1960) (AFOSR-600) (AF 49-(638)838) Confidential

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Aeronautical Research Inst. of Sweden, Stockholm.

SECOND-ORDER THEORY FOR A THIN WING IN SUPERSONIC FLOW WITH A WEAK SPANWISE ENTROPY GRADIENT, by P. G. Wilby. June 1961, 20p. incl. diagrs. (Rept. no. 88; technical note no. 5) (AF-OSR-1845) (AF 61(052)75) AD 267914 Unclassified

The 3-dimensional perturbation velocities over an infinite thin wing with a sharp leading edge in non-uniform supersonic flow are derived and used to investigate the second-order contribution to the pressure coefficient on a wing surface, due to a spanwise entropy gradient. Pressure distributions are calculated for a wedge section wing at various Mach numbers for probable values of entropy gradient. Results show that entropy gradient effects can be important. Procedure for an application of the theory is given for the case of a wing situated behind the curved shock generated by a blunt nosed body. (Contractor's abstract)

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Aeronutronic, Newport Beach, Calif.

THE INFLUENCE OF PERIODIC PRESSURE VARIATIONS ON CHAIN REACTIONS, by H. M. Wight. [1959] [5]p. incl. diagr. refs. (AFOSR-613) (AF 49(638)311) Unclassified

Also published in Proc. Conf. on Phys. Chem. in Aerodynam. and Space Flight, Pennsylvania U., Philadelphia (Sept. 1-3, 1959), New York, Pergamon Press, 1961, p. 94-98. (AFOSR-TR-60-106)

Also published in Planetary and Space Sci., v. 3: 94-98, Feb. 1961.

A theoretical study is made of the effect of simultaneous periodic variations in temperature and volume for chain reactions, with particular emphasis on the frequency dependence of the perturbation. If a kinetic mechanism is postulated for any given gas-phase chain reaction, a system of first order differential equations describing the time rate of change of the various species can be obtained by applying the Mass Action Law. Such a system is generally nonlinear and can be integrated usually only by successive approximation techniques. Specific calculations are made for the law and high frequency cases for the HBr chain reaction. Numerical evaluation of the rate enhancement for the formation of HBr at intermediate frequencies is performed. A slow fall-off in the rate is predicted with increasing frequency. However, the high frequency rate is still greater than the unperturbed rate. (Contractor's abstract)

36

Aeronutronic, Newport Beach, Calif.

MEASUREMENTS ON MAGNETICALLY DRIVEN SHOCK WAVES (Abstract), by T. A. Bergstralh and J. Worcester. [1961] [1]p. (Bound with AFOSR-582; AD 257892) (AF 49(638)670) Unclassified

Presented at Fourth annual AFOSR Contractors' meeting on Ion and Plasma Acceleration, Beverly Hills, Calif., Apr. 20-21, 1961.

An experimental arrangement is described in which magnetically driven shock waves can be generated and observed under varying conditions of gas type, pressure and transverse magnetic fields. Shock velocities have been measured on intense shocks generated by 50 kv discharges in helium and nitrogen at pressures from 5 to 50 μ of mercury. The maximum velocities observed were 3.4 cm per μsec in helium and 2.5 cm per μsec in nitrogen. The shock front velocity is observed to decay with time as t^{-n} where n is of the order of 0.5. When an 800 gauss transverse field is established across a 2 ft section of the shock tube, the velocity attenuation of the helium shocks is observed to be greater than in the absence of the field. The additional attenuation by the magnetic field has not been observed for shock waves in nitrogen in this same pressure range.

37

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

IMPLICATIONS OF BASIC RESEARCH IN INFORMATION SCIENCES TO MACHINE DOCUMENTATION, by H. [A.] Wooster [Jr.] [1961] [14]p. (AFOSR-492) Unclassified

Also published in Machine Indexing; Progress and Problems; Proc of Third Institute on Information Storage and Retrieval, American U., Washington, D. C. (Feb. 13-17, 1961), [Washington] American U. School of Government and Public Administration, p. 331-344.

The role of the machine and its effect on documentation is discussed. It is known that the speed of the computer is an attractive brute force method for literature searching, but the question that must be faced is will the effects of the machine be qualitative or quantitative. Will it make an impact on the theoretical studies in the information sciences or on the handling practices of good documentation procedures? The answer of course lies in the future. Machines today are used as tools. They can do very fast arithmetic, but need to be told in excruciating detail what to do. One of the implications of the Information Science research program is the possibility that some day computers can be used as mental machines, capable of relieving man of the burdens of routine decision-making. The question then becomes whether the world will recognize this for the value that it obviously is, or whether it will be rejected out of ignorance.

38

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

LONG RANGE RESEARCH IN THE INFORMATION SCIENCES, by H. [A.] Wooster [Jr.]. [1961] 24p. (AFOSR-1571) AD 265265 Unclassified

Presented at Science and Engineering Symposium, San Francisco, Calif., Oct. 3-4, 1961.

A new method for automatically collecting, storing, and retrieving scientific information is described. Further

sophistication of the process enables it to translate, screen, index, and requisition such information. A number of problems are discussed, such as problems of information analysis, problems of people, of computers, and a look is taken at long range research into information sciences. (Contractor's abstract)

39

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

PROCEEDINGS OF THE CONFERENCE ON AERODYNAMICALLY HEATED STRUCTURES, Cambridge, Mass., July 25-26, 1961, ed. by P. E. Glaser. Englewood Cliffs, N. J., Prentice-Hall, Inc., 1962, 363p. incl. illus. diagrs. tables, refs. (AFOSR-3270) (Sponsored jointly by Air Force Office of Scientific Research and Arthur D. Little, Inc.) AD 282452 Unclassified

Papers on the structural and materials requirements of space vehicles exposed to aerodynamic heating, particularly during re-entry, are presented. The current status of insulating problems, especially in lift-flight vehicles, is discussed, as are proposed thermal protection systems for future aerospace vehicles. Reports on new developments of high-temperature thermal protection systems, thermal protection of cryogenic propellants, and structural cooling systems are included. (Contractor's abstract)

40

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

PROCEEDINGS OF AN AEROSPACE SCIENTIFIC SYMPOSIUM OF DISTINGUISHED LECTURERS IN HONOR OF DR. THEODORE VON KÁRMÁN ON HIS 80th ANNIVERSARY, Washington, D. C., May 11, 1961. New York, Inst. of Aerospace Sci., 1962, 127p. incl. illus. diagrs. tables, refs. Unclassified

The papers presented at this symposium included a history of the development of present ideas in buckling shells, magneto-fluid dynamics, flame propagation, cooperation in sciences and future trends. The symposium was named in honor of Dr. Theodore von Karmán whose bold and imaginative thinking led to the development of institutions which now rank among America's most crucial assets in terms of the rational security needs of an aerospace age.

41

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

DIRECT VARIATIONAL METHODS AND BRANCHISTOCHRONE PROBLEMS, by J. R. Foote, T. Butler and others. Jan. 1961, 61p. incl. illus. tables. (AFOSR-101) AD 251008 Unclassified

A direct method in variational calculus was invented and applied to a variety of examples, especially to aircraft flight path optimization, but without numerical results in that case. Advantages and limitations of both this method and indirect methods are discussed. Further lines of research, both theoretical and numerical, are indicated, and a purely numerical technique is described. (Contractor's abstract)

42

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

THE INFLUENCE OF AIR DENSITY ON THE CHARACTERISTIC PARAMETERS OF THE OSCULATING ELLIPSE OF A SATELLITE ORBIT, by R. H. Anderson. Feb. 1961, 15p. incl. illus. (AFOSR-103) AD 251310 Unclassified

The general equations describing the perturbations of an orbit due to air drag were derived. The methods used in their derivation differ from those usually applied to orbit perturbation problems, and it is evident that these methods are applicable to a wide range of trajectory problems. For many practical problems it is necessary to have an estimate of the decrease in the altitude of a satellite whose orbit is nearly circular. For this purpose a very simple equation was developed which quickly gives a good estimate of the variation of the altitude of a satellite after one rotation. (Contractor's abstract)

43

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

ACCURACY LIMITS DUE TO REFRACTION ON ELECTRONIC TRACKING OF SPACE VEHICLES, by F. W. Hoehndorf. Apr. 1961, 27p. incl. diagrs. tables. (AFOSR-107) AD 256327 Unclassified

The investigation was concerned with the refractive index of electromagnetic microwaves coming from a space vehicle in an environment where this index equals unity. Originally, this effort was planned to be a continuation of an earlier effort to merely give the results of the computations for higher altitudes of the observation sites. However, the results obtained with the primary accepted assumptions for the approximation of the refractive index versus altitude showed them to be physically unrealistic, and therefore some modifications had to be made. These modifications, which do not invalidate the conclusions drawn in the earlier effort, are discussed in some detail. The results of the new computations are given and are compared with a long series of astronomical measurements. (Contractor's abstract)

44

Air Force Office of Scientific Research. [Directorate of Research Analysis, Holloman AFB, Alamagordo, N. Mex.]

RECONNAISSANCE OF THE NEARER PLANETS. A SURVEY OF PLANETARY PROBLEMS IN THE SPACE AGE, by G. de Vaucouleurs. Nov. 1961, 141p. incl. illus. tables, refs. (AFOSR/DRA-61-1) AD 276833 Unclassified

This discussion is divided into 2 parts: the first part is a summary of the best present information of the planets Mercury, Venus, and Mars, gained almost entirely from ground-based observatories. The second part outlines how these methods could be extended to observations from balloon observatories, and especially from space probes and orbiters in the immediate vicinity of the planets. (Contractor's abstract)

45

Air Force Office of Scientific Research. [Directorate of Research Analysis, Holloman AFB, Alamagordo, N. Mex.]

PROBABILITY CONSIDERATIONS ON DESTROYING ICBM'S WITH INTERCEPTOR SATELLITES, by H. Knothe. Nov. 1961, 22p. (AFOSR/DRA-61-3) AD 273996 Unclassified

A method is presented for calculating the probability that a certain minimum number of a set of ICBM's can be destroyed by a given number of interceptor satellites. (Contractor's abstract)

46

Alabama U., University.

COLORIMETRIC PROPERTIES OF SOME TRANSITION-METAL GALLATES, by E. L. Grove, L. Maddox, and W. S. Jeffery. [1961] [5]p. incl. diagrs. table. (AFOSR-3805) (AF 18(600)1567) Unclassified

Also published in Jour. Alabama Acad. Sci., v. 32: 25-29, Jan. 1961.

The use of gallic acid in a spectrometric procedure for both tantalum and niobium is investigated. Since it contains 3 phenolic groups, extraction techniques can be avoided. The effect of pH on the absorbance of niobium, tantalum, and vanadium-gallate chelates is presented. Tantalum developed a yellow color at a lower pH than the niobium gallate. At pH 4 and wavelength 390 mu, and at pH 5, wavelength 350 mu, the tantalum gallate showed a definite color while the niobium gallate solutions at the same pH and wavelengths showed no absorbance. The elements that were studied developed no color when the solutions were strongly acidic, except rhenium, which was a pale yellow. Color developed as the solutions were made less acid and became more intense and darker as the pH approached neutral to slightly alkaline. Solutions with pH values from 4 to 8 were studied. At values slightly more acidic a white granular precipitate formed and a gas evolved that appeared to be sulfur dioxide. The optimum pH, maximum, relative absorbance, and molar extinction coefficient for each metal gallate are presented. Most are neutral or slightly acidic. Tantalum chelates with gallic acid to produce a reasonably good color in acid solution, pH 4 and 5, with the maximum at 390 mu and 350 mu. Since the other elements studied are colorless at this pH, except titanium and rhenium, it should be possible to develop a colorimetric procedure without prior separation of these elements. Titanium would have to be separated, but rhenium would be found rarely and only in special alloys.

47

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

DIELECTRIC LOSS AND INTERNAL FRICTION IN IONIC SOLIDS, by D. P. Detwiler. Final rept. Aug. 28, 1961, 3p. (AF 49(638)87) Unclassified

This report summarizes briefly the work performed under this contract. The work involved primarily 2 aspects of the properties on ionic solids, viz. dielectric loss and internal friction. A small amount of corroborative data were obtained on electrical conductivity of Al_2O_3. The results on internal friction are incomplete. Dielectric loss in Al_2O_3 was studied from 80°K to 700°K. Two points of interest arise in this region. At around 600°K a small loss peak is observed, and from about this temperature upwards, the loss rises approximately exponentially to the highest temperature measured. It was observed that at this temperature the peak could be induced or removed at will by controlling the atmosphere to which the sample was exposed and treatment of heat to which it was subsequently subjected. It is believed that the loss arises from the presence of hydrogen on or near the dislocations in the Al_2O_3, and that these experiments demonstrate the mobility of hydrogen on the dislocations.

48

Allied Research Associates, Inc., Boston, Mass.

THE ADJOINT HEAT CONDUCTION PROBLEM FOR SOLIDS, by T. R. Goodman. Apr. 1961, 23p. (AFOSR-520) (AF 49(638)839) AD 254769 Unclassified

A new mathematical method is presented for solving the linear transient heat conduction equation for solids. Its primary advantage lies in the fact that having solved an appropriate adjoint heat conduction problem, the solution to a large class of physical heat conduction problems can immediately be expressed in terms of a

quadrature. A number of results are presented by way of example for 1-dimensional problems. In particular a 3-temperature equation is derived which relates the temperature-time history at 3 successive boundaries of a composite slab. A numerical example using the 3-temperature equation is worked out for the steady case. (Contractor's abstract)

49

Allied Research Associates, Inc., Boston, Mass.

EFFECT OF ARBITRARY NONSTEADY WALL TEMPERATURE ON INCOMPRESSIBLE HEAT TRANSFER, by T. R. Goodman. [1961] [6]p. incl. diagrs. (AFOSR-3691) (AF 49(638)839) Unclassified

Presented at Winter annual meeting of the Amer. Soc. Mech. Eng., New York, Nov. 26-Dec. 1, 1961.

Also published in Jour. Heat Transfer, v. 84: 347-352, Nov. 1962.

The title problem is solved using an integral method and ignoring viscous dissipation. A partial differential equation is derived which yields as special cases Lighthill's non-uniform heat-transfer formula and the nonsteady heat conduction in a slab. The differential equation is then specialized to the unsteady but uniform heat transfer on a flat plate. Comparisons with other solutions are made when available, and it is shown that the integral method produces accuracy of a few % in these limited cases. (Contractor's abstract)

50

American Inst. for Research, San Mateo, Calif.

SOME EFFECTS OF GRADUATED PARTIAL CUEING ON THE LEARNING OF PAIRED ASSOCIATES, by P. M. Guthrie and A. A. Lumsdaine. Sept. 1961, 34p. incl. diagrs. tables, refs. (Research rept. no. AIR-C14-9/61-SR3) (AFOSR-1341) (AF 49(638)681) AD 275851 Unclassified

The effects of several cueing methods on paired-associates learning were investigated. A total of 48 subjects learned the items in lists of city-names paired with corresponding airport-city codes, using special cueing procedures or standard anticipation procedures. Response terms, presented under lowered conditions of visibility, were the cues. Visibility, and hence cue strength, was varied tachistoscopically or gradually by adjusting illumination of the cue. Under conditions in which subjects had increasing amounts of time to anticipate the response terms, tachistoscopic cueing produced better learning than a comparable anticipation condition. However, the positive effects produced were small. Furthermore, this form of partial prompting was not superior to an immediate full prompt. These results are discussed in relation to needs for further study of graduated cueing techniques in the learning of paired-associate and continuous-discourse materials. (Contractor's abstract)

51

American Inst. for Research, San Mateo, Calif.

A STUDY OF SUBJECT-CONTROLLED PARTIAL CUEING IN PAIRED-ASSOCIATE LEARNING, by D. Angell and A. A. Lumsdaine. Sept. 1961, 13p. incl. tables. (Research rept. no. AIR-C14-9/61-SR4) (AFOSR-1342) (AF 49(638)681) AD 265070 Unclassified

A study was performed to determine what effect, if any, a training procedure which utilized partial cueing at the option of the learner would have upon the learning of paired-associate materials. The technique was a simple one which provided partial cueing by successive revelation, upon student demand, of the letters of the 3-letter response term in an S-R pair. No instrumentation was employed; E served as the device by which response components were revealed (aurally) to the student. The data showed little difference in over-all effectiveness between the partial-cueing technique and a standard anticipation procedure for learning paired associates. When the effectiveness of the 2 training procedures was examined with respect to "task difficulty" —items having been dichotomized into difficult and easy, and S_s having been dichotomized into slow learners and fast learners—the partial-cueing procedure was found to be somewhat more effective for slow learners with hard items, and slightly less effective for fast learners with easy items. This interaction was marginally significant ($P < .10$). The findings are discussed in relation to other studies of partial cueing in paired-associate learning.

52

American Inst. for Research, San Mateo, Calif.

THE EFFECTS OF PROMPTING TRIALS AND PARTIAL-CORRECTION PROCEDURES ON LEARNING BY ANTICIPATION, by D. Angell and A. A. Lumsdaine. Sept. 1961, 47p. incl. diagrs. tables, refs. (Research rept. no. AIR-C14-9/61-SR5) (AFOSR-1343) (AF 49(638)681) AD 264969 Unclassified

Two experiments are reported which were designed to provide data on several issues relevant to [illegible]-instructional techniques. The first of these issues is the question of the relative effectiveness of prompting trials and anticipation (confirmation) trials. The second issue is the question of the effectiveness of partial-cueing techniques. The 2 experiments used different paired-associate materials and somewhat different experimental procedures and designs. Results of Experiment I showed a highly significant effect due to prompting trials, a significant effect due to correction treatment in the case where no prompting trials had been given, and a

significant interaction which reflects 2 clear experimental facts: (1) a prompting trial was more effective than an anticipation trial when partial correction was employed but not when full correction was used, and (2) full correction is superior to partial correction when there had been no initial prompting trials but not when there had been 2 or more prompting trials. In Experiment II, the advantage of prompting trials over anticipation trials (found in Experiment I) did not materialize, and there was in fact some indication of a trend in the opposite direction. The differing results of the 2 experiments is interpreted as being dependent on the nature of the correction treatment: in Experiment I, subjects did not respond overtly following partial correction; in Experiment II, they continued to choose from among the partial correction alternatives until they made a correct response.

53

American Inst. of Physics, New York.

PHYSICS OF FLUIDS, ed. by F. N. Frenkiel. 1961-1962. (AF 49(638)275) Unclassified

This contract is to assist the American Inst. of Phys. in collecting, collating, interpreting and editing original research papers for publication in this monthly journal. Topics include kinetic theory, statistical mechanics, structure and general physics of gases, liquids and other fluids, as well as certain basic aspects of physics of fluids bordering geophysics, astrophysics, biophysics, and other fields of science.

54

American Mathematical Soc., Providence, R. I.

PARTIAL DIFFERENTIAL EQUATIONS; PROCEEDINGS OF SYMPOSIA IN PURE MATHEMATICS, VOLUME IV, California U., Berkeley, Apr. 21-22, 1960, ed. by C. B. Morrey, Jr. Providence, Amer. Math. Soc., 1961, 169p. incl. refs. (AF 49(638)746) Unclassified

Sixteen papers presented at the seventh Symposium in Pure Mathematics are published. The research is concerned with the application of partial differential equations in Dirichlet's principle, Lebesque spaces, Hilbert spaces, Cauchy's problem, Boundary problems, steady state problems and other areas.

55

American Mathematical Soc., Providence, R. I.

CONVEXITY; PROCEEDINGS OF SYMPOSIA IN PURE MATHEMATICS, VOLUME VII, Washington U., Seattle, June 13-15, 1961, ed. by V. L. Klee. Providence, Amer. Math. Soc., 1963, 516p. incl. diagrs. tables, refs. (AF 49(638)964) Unclassified

Thirty-two papers of which seventeen were presented at the Symposium on Convexity make up this volume. The symposium was intended to emphasize the more qualitative aspects of the theory. Particularly the following 5 aspects are represented in this volume: the combinatorial geometry associated with intersection and covering properties, the refinement and application (especially in functional analysis and game theory) of such notions as extremal structure and separation properties, the study of convexity in infinite-dimensional spaces, increasing use of convexity as a descriptive tool, and the evolution of various analogues and generalizations of convexity. In addition to the wide range of topics treated, there is much variety of approach. Some of the shorter papers treat a single problem in full detail, while at the other extreme are several long papers which include very few proofs but survey broad areas in the field of convexity.

55A

American Soc. of Mechanical Engineers, New York.

APPLIED MECHANICS REVIEWS, ed. by M. Goland and S. Juhasz. 1960-1962. (MIPR-60-17 and AFOSR-62-368) Unclassified

This project is for the production of the above technical journal, which provides critical reviews of over 900 periodicals, domestic and foreign, as well as summary and feature articles in the overall field of applied mechanics, specifically including the mechanics of solids and fluids, and heat.

56

Antioch Coll. [Behavior Research Lab.] Yellow Springs, Ohio.

QUANTITATIVE ANALYSIS OF EVOLUTION OF THE BRAIN IN MAMMALS, by H. J. Jerison. [1960] [3]p. incl. diagr. refs. (AFOSR-208) [AF 49(638)536] AD 611607 Unclassified

Also published in Science, v. 133: 1012-1014, Mar. 1961.

Empirical equations derived from brain size (E) and body size (P) of archaic-Eocene, Oligocene, and Recent mammals were all of the form $E = kP^{2/3}$, k = 0.03 for the Eocene, 0.06 for the Oligocene, and 0.12 for the Recent mammals. It is suggested that k, which has been used as an index of cephalization in contemporary mammals, may be an approximate measure of brain evolution in the mammals as a class. (Contractor's abstract)

57

Arizona U. Dept. of Physics, Tucson.

EFFECT OF HYDROSTATIC PRESSURE UP TO 8000 ATM ON THE SELF-DIFFUSION RATE IN SILVER

SINGLE CRYSTALS, by C. T. Tomizuka. [1960] [5]p. incl. diagr. (AFOSR-262) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)-790 and Office of Naval Research under N6ori-02020) Unclassified

Also published in Progress in Very High Pressure Research: Proc. Internat'l. Conf., Bolton Landing, Lake George, N. Y. (June 13-14, 1960), New York, Wiley and Sons, 1961, p. 266-270.

Investigations on the pressure effect on the self-diffusion rate in noble metals are presented. It is generally accepted that the activation volume for self-diffusion is closely related to the actual volume of a mole of moving vacancies. The experimentally determined activated volume ΔV is considered to be a measure of the volume relaxation around a vacancy. Experiments of this type on lead, sodium, and white phosphor indicate that there is approximately 50% volume relaxation around a moving vacancy. A similar amount of relaxation is not, however, expected in the close packed structure of noble metals. It is shown that the atomic relaxation around the vacancy is 10% in volume.

58

Arizona U. Dept. of Physics, Tucson.

DIFFUSION IN Ag-Zn SYSTEM, by C. T. Tomizuka and R. A. Roberts. [1961] [6]p. incl. diagr. table. (AFOSR-2808) (AF 49(638)790) AD 281233 Unclassified

The present work is an attempt to enhance the current understanding of measuring diffusion by radioactive tracer methods and anelastic techniques. There is 1 school of thought that says the 2 methods are the same. If that be the case, then the activation energies found by the 2 methods should be identical. The activation energy obtained by Zn tracer diffusion in Ag-Zn at 15% Zn is practically identical to that of anelastic relaxation in the same alloy. Three possible explanations are offered: (1) It could be that the discrepancy between the 2 activation energies is approximately proportional to the Zn concentration and the expected 2 kcal/mol difference is difficult to establish by the present experimental techniques. (2) It could be that an appreciable amount of zinc was lost from the surface of those specimens with a high Zn concentration (30%) and the observed discrepancies at 30% Zn were brought about by not comparing the activation energies at the same Zn concentration. (3) It is probable that the anelastic relaxation is controlled by the faster moving component of an alloy, even though the actual model by which such a relaxation takes place is difficult to conceive.

59

Arkansas U. Dept. of Physics, Fayetteville.

SOME ISOTOPE SHIFTS IN THE SPARK SPECTRUM OF Te, by R. H. Hughes, W. A. Hilton, and F. A. Sharpton. [1961] [1]p. incl. table. (AFOSR-3551) [AF 49(638)547] Unclassified

Also published in Jour. Opt. Soc. Amer., v. 51: 696, June 1961.

The 2 previous investigations of the isotope shifts in tellurium have produced widely differing results (Bull. Amer. Phys. Soc., v. 3: 414, 1958 and Phys. Rev., v. 85: 559, 1952). It therefore seemed reasonable to check the isotope shifts in the region of the largest discrepancy to ascertain the nature of the discrepancy. The hollow-cathode spectra from enriched samples of Te-124, Te-126, and Te-128 were studied. The discharge tubes were liquid-air cooled. The isotopic abundance of the principal isotope in the 124, 126, and 128 samples was 83.9%, 95.4%, and 96.5%, respectively. The 126-124 shift was corrected for the presence of 4.5% of Te-126 in the 124 sample. The present measurements correspond closely with those of Kuhn and Turner.

60

Arkansas U. Dept. of Physics, Fayetteville.

STUDIES OF OPTICAL POLARIZATION BY ELECTRON IMPACT, by R. H. Hughes and O. H. Zinke. Final rept. Dec. 1961 [54]p. incl. diagrs. refs. (AFOSR-2259) (AF 49(638)559) AD 273339 Unclassified

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. An expression is derived which enables the measurement of gas-kinetic collision cross sections involving atoms in excited states by observing the depolarization as the gas pressure increases. The feasibility of the detection of the Lyman alpha radiation from positronium formed through the charge-changing collisions between positrons and gas atoms, was investigated. Excitation of nitrogen and rare-gas atoms by beta emission from W^{185} has been observed.

61

Arkansas U. [Dept. of Physics] Fayetteville.

POLARIZATION OF SPECTRAL EMISSION INDUCED BY ELECTRON IMPACT ON HELIUM (Abstract), by R. H. Hughes, R. B. Kay, and L. D. Weaver. [1961] [1]p. [AF 49(638)559] Unclassified

Presented at meeting of the Amer. Phys. Soc., Schenectady, N. Y., Oct. 11-13, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 130, Feb. 23, 1962.

The polarization of several lines induced by electron impact on helium is being studied as a function of electron energy and pressure. Data have been obtained on the lines λ 3889A ($3^3P - 2^3S$), λ 4922A ($4^1D - 2^1P$), and λ 4471A ($4^3D - 2^3P$). The λ 3889 polarization data at low energy confirm the minimum in the polarization found by Lamb and Maiman. A minimum polarization at ≈ 25.5 v with rising polarization of about 24 v, the lowest energy used, was obtained. λ 4922 shows a peak polarization of slightly over 50% (at ≈ 31 v and < 1 μ pressure). Both λ 4922 and λ 4471 exhibit a monotonic decrease in polarization with decreasing energy past the peak. In the "high"-energy region, the point at which the polarization changes sign is pressure dependent for all 3 lines. This "crossover" point occurs at higher energies as the pressure is decreased. The polarization is sensitive to secondary excitation processes, such as cascade and collisions of the second kind.

62

Arkansas U. Dept. of Physics, Fayetteville.

A POSSIBLE METHOD FOR THE STUDY OF GAS-KINETIC COLLISIONS INVOLVING ATOMS IN EXCITED STATES, by R. H. Hughes. [1961] 6p. (AF 49(638)559) Unclassified

It appears possible to study gas-kinetic collisions between ground state atoms and excited atoms by observing the pressure dependence of the polarization of optical radiation induced by the passage of an electron beam through a gas or by the absorption of polarized resonance radiation. It is well known that a well-collimated mono-energetic beam of electrons, particularly low energy electrons somewhat near excitation threshold, can simultaneously excite and orient the atom with respect to beam direction, thus producing polarization of the optical radiation emitted when the atom de-excites. As the gas pressure increases, the probability of disorienting collisions before de-excitation is also increased and subsequently should produce depolarization of the emitted radiation. This depolarization depends on the following parameters: the lifetime of the excited state, the gas density, the thermal velocity, and the collision cross section. An expression involving the depolarization and these parameters is derived.

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

63

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

INVESTIGATION OF HEAT VIBRATIONS IN SOLIDS BY USING X-RAYS, by J. Boscovits, M. Rollos and others. Aug. 1961 [18]p. incl. diagrs. tables, refs. (AFOSR-2090) (AF 61(514)1248) AD 272414 Unclassified

Measurements were reported of x-ray integrated intensities at low and high temperature, carried out on several diffraction lines of Ag, Au, Pt and Pb powders in vacuum, to determine the temperature dependence of characteristic temperature. For Au and Pt a decrease of characteristic temperature with temperature, resulting from volume expansion, was found. In the case of Ag, the decrease of characteristic temperature with temperature exceeds that due to volume expansion. For Pb, the disagreement in characteristic temperature values obtained from the various diffraction lines did not allow any conclusion. (Contractor's abstract)

64

Atlantic Research Corp., Alexandria, Va.

A STUDY OF THE TRAPPING OF FREE ALKYL RADICALS, by J. B. Levy. Final rept. Sept. 1958-Dec. 1961. Dec. 22, 1961, 13p. (AFOSR-2037) (AF 49-(638)483) AD 601705 Unclassified

The kinetics of the decomposition of 2,2'-azoisobutane, the compound chosen as the source of the free radicals, were studied. In the next phase of the work studies of the pyrolysis of 2,2'-azoisobutane in a fast flow system were performed. The suitability of this compound as a source of t-butyl radicals was demonstrated by mirror removal studies and many experiments performed under a variety of conditions in which it was attempted to demonstrate the presence of trapped t-butyl radicals. The last portion of this program was devoted to a study of the colored deposits obtained in the pyrolysis of dibenzyl ketone. (Contractor's abstract)

65

Atlantic Research Corp., Alexandria, Va.

CESIUM SOLID PROPELLANT AS PLASMA SOURCE (Abstract), by R. Friedman and L. [W.] Fagg. [1960] [1]p. incl. table. (AF 49(638)651) Unclassified

Presented at Third AFOSR Contractors' meeting on Ion and Plasma Propulsion, Republic Aviation Corp., Farmingdale, N. Y., Mar. 22-24, 1960. (AFOSR-TN-60-405; AD 235949; PB 146900)

Experimental and theoretical studies have been made of the combustion characteristics and the ion density produced in the burning of compressed strands of $CsClO_4$:Al and $CsNO_3$:Al. The purpose of this research has been to develop and characterize a convenient technique for producing a concentrated plasma. Computer calculations have been made which predict the adiabatic flame temperature and equilibrium percentages of the various expected atomic, molecular and ionic species. Small particle size (< 37 microns), lower ambient pressure, and lower compressing pressure generally favor slower, more uniform burning. It has been found that $CsClO_4$:Al inhibited strands compressed at from 3000 to 20,000 psi will burn at atmospheric pressure with an average rate of about 0.15 in/sec. At these compressing pressures, the strand is at 75% of theoretical density. This porosity made it necessary to use only nonpenetrating surface-inhibiting materials. Measurements have been made of ion densities by means of spectroscopic methods. Other measuring methods are also being attempted.

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Atlantic Research Corp., Alexandria, Va.

HIGH PRESSURE PLASMA PRODUCTION TECHNIQUES (Abstract), by L. W. Fagg and R. Friedman. [1961] [1]p. (Bound with AFOSR-582; AD 257892) (AF 49(638)651) Unclassified

Presented at Fourth annual AFOSR Contractors' meeting on Ion and Plasma Acceleration, Beverly Hills, Calif., Apr. 20-21, 1961.

Mixtures of $CsClO_4$:Al and $CsNO_3$:Al are being investigated in terms of a study of their burning characteristics and measurements of the electron density produced. It has been found that more complete, but considerably faster, burning takes place when fine grain sizes are used in both mixtures and when percentages of aluminum somewhat higher than stoichiometric are used. These techniques have made it possible to burn the $CsNO_3$:Al mixture in strand form at atmospheric pressure. Work has also been done on both mixtures with various percentages of polyvinyl chloride added. Although the burning temperature and consequently the ion density are lower, the addition of this material has served to make the burning of both mixtures slower and more uniform, and also makes strand burning possible without inhibition. Tentative measurements of the electron densities of the plasmas created in the burning of both the $CsNO_3$:Al and $CsClO_4$:Al mixtures were made by a method due to Petschek et al involving the measurement of the line shift occurring as a result of the second-order Stark effect. In the light of more recent theoretical work, the theory upon which the method is based is now no longer considered adequate, and in its present form is only reliable to within perhaps a factor of five. Nevertheless, the method was used to give tentative results averaging to 1.3×10^{16} electrons/cc for $CsClO_4$:Al and 4.8×10^{16} for $CsNO_3$:Al at one atmosphere. These values agree fairly well with thermodynamic equilibrium computations of electron density. Infrared absorption studies are now in progress at both atmospheric and high pressure, which may yield an additional value of the electron density for each of the mixtures.

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Atlantic Research Corp., Alexandria, Va.

THE THERMAL DECOMPOSITION OF PERCHLORIC ACID VAPOR, by J. B. Levy. Oct. 4, 1961 [32]p. incl. diagrs. tables, refs. (AFOSR-1555) (AF 49(638)813) AD 265051 Unclassified

Presented in part at 140th Nat'l. meeting of the Amer. Chem. Soc., Chicago, Ill.

Also published in Jour. Phys. Chem., v. 66: 1092-1097, June 1962.

The thermal decomposition of perchloric acid vapor has been studied from 200° to 439°C. The reaction products over this temperature range have been found to be chlorine, water and oxygen. From 200° to 350°C the kinetics of the decomposition reaction have been studied by determining the rate of chlorine formation colorimetrically; from 350° to 439°C the kinetics were determined by a flow system technique. The results of the kinetic measurements are interpreted in terms of a heterogeneous reaction at the lower temperatures and a homogeneous 1 at the higher temperatures. A mechanism for the homogeneous reaction is proposed. (Contractor's abstract)

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Atlantic Research Corp., Alexandria, Va.

RESEARCH ON SOLID-PROPELLANT COMBUSTION. Final technical rept. Dec. 31, 1961 [35]p. incl. diagrs. tables, refs. (AFOSR-2005) (AF 49(638)813) AD 270929 Unclassified

The experimental work already carried out and reported in this program includes measurements of burning rate and lower pressure limit of flammability of dead-pressed ammonium perchlorate as a function of ambient pressure, initial temperature, incident radiant flux, and catalyst content. Temperature measurements have been made with fine thermocouples and by photopyrometry. Detailed chemical analysis of combustion products has been carried out for a variety of combustion conditions. Kinetics of the gaseous decomposition of perchloric acid vapor has been studied. In very recent and incomplete work, experiments dealing with kinetics of the perchloric acid vapor-ammonia reaction are presented. A variety of experiments dealing with pure ammonium perchlorate

deflagration and interactions of deflagrating ammonium perchlorate with gaseous and solid fuels in controlled geometrices are described. In addition to this body of experimental work, much thought has been given to the coupling of the various rate processes and to possible kinetic schemes relevant to the governing chemical reactions. Simplified mathematical models have been developed, and the more accurate model developed by Nachbar, which however, requires extensive computation to obtain numerical solutions, has been carefully considered. Attention has been given to experimental results arising out of other programs. A review is presented of the current understanding of the combustion mechanism of ammonium perchlorate-based solid propellants as viewed by the Atlantic Research Corp.

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

SHOCK WAVES IN COLLISION-FREE PLASMAS, by M. Camac, A. R. Kantrowitz and others. Aug. 1961, 67p. incl. diagrs. refs. (Research rept. no. 107) (AFOSR-1173) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)61 and Office of Naval Research under Nonr-252400) AD 265454 Unclassified

Presented at Internat'l. Atomic Energy meeting, Salzburg (Austria), Sept. 4-8, 1961.

Investigation of the structure of a shock wave provides an excellent opportunity for studying the dissipation processes in collision-free plasmas. The thickness of collision-free shock waves was previously obtained from measurements of the light emitted by the plasma in a magnetic annular shock tube. The magnitude of the shock thickness, and its Mach number and density dependence were in agreement with a theoretical estimate based on the concept that the required dissipation in the shock is produced by non-linear interactions between magnetohydrodynamic waves. Further confirmation of these results has been obtained. Measurements of the magnetic field have shown that the magnitude of the field change across the shock agrees with that expected from the conservation equations. Also the distance over which the field changes agrees with the previous shock thickness measurements. The electron temperature was estimated to be above 10 ev based on the ultraviolet radiation intensity and the ratio of bound-bound and free-free radiation. Measurements of the heat transfer from the plasma to the shock tube wall indicates that less than 1/10 of the gas energy is dissipated to the walls, thus, there is good containment of the shock heated plasma for a time large (50 times) compared to the shock rise transit time. The theory of the wave dissipation mechanism has been reformulated so that the distribution of wave action in wave-vector space is described by a Boltzmann equation similar to that for the distribution of phonons in solids. Estimates of relaxation times for the non-linear wave interactions agree with previous predictions. Preliminary results for the shock structure suggest that in the shock front the wave distribution is somewhat concentrated in regions of wave-vector space away from the origin. There are indications that the wave frequency band should be narrow at the shock front and increase going towards the back of the shock. Waves of about ion cyclotron frequency may persist behind the shock while other waves spread to high frequencies by wave-wave collisions and are damped. (Contractor's abstract)

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

BASIC STUDIES IN MAGNETOHYDRODYNAMICS, by R. M. Patrick. Final rept. May 1, 1957-Oct. 31, 1961, 28p. incl. illus. diagrs. refs. (AFOSR-1782) (AF 49(638)61) AD 269797 Unclassified

Research was directed toward obtaining a basic understanding of magnetohydrodynamics. The initial studies led to 3 possible applications for magnetohydrodynamics which in turn led to 3 categories of research. The first application appeared in connection with the problem of high-altitude, very high velocity flight which we call flight magnetohydrodynamics. The second application was plasma propulsion. The third category was the production of a very high temperature collision-free plasma. (Contractor's abstract)

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

EXPERIMENTAL INVESTIGATION OF COLLISION-FREE SHOCKS AND PLASMAS, by R. M. Patrick and M. Camac. Sept. 1961, 38p. incl. illus. diagrs. refs. (Research rept. no. 122) (AFOSR-2266) (AF 49(638)61) AD 274218 Unclassified

Investigation of the structure of a shock wave provides an excellent opportunity for studying the dissipation processes in collision-free plasmas. Measurements of the magnetic field have shown that the magnitude of the field change across the shock agrees with that expected from the conservation equations. The electron temperature was estimated to be above 10 ev based on the ultraviolet radiation intensity and the ratio of bound-bound and free-free radiation. Measurements of the heat transfer from the plasma to the shock tube wall indicates that less than 1/10 of the gas energy is dissipated to the walls; thus, there is good containment of the shock heated plasma for a time large (50 times) compared to the shock rise transit time. The results of these experiments show that the collision-free thickness is inversely proportional to the Alfvén Mach number of the shock. The radiation emitted by the shock heated plasma has been measured over a large range in plasma density; these results, together with those for the magnetic field jump across the shock, show that the performance of the MAST can be predicted by a theory which assumes infinite plasma conductivity.

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

BASIC STUDIES IN MAGNETOHYDRODYNAMICS (Abstract), by R. M. Patrick. [1961] [1]p. (Bound with AFOSR-582; AD 257892) (AF 49(638)61) Unclassified

Presented at Fourth annual AFOSR Contractors' meeting on Ion and Plasma Acceleration, Beverly Hills, Calif., Apr. 20-21, 1961.

An experimental investigation of the structure of shock waves produced in a magnetic annular shock tube (MAST) has been reported. Recently, the change in the magnetic field across these shock waves has been measured. These measurements give a collision-free shock thickness which agrees with previous results. The change in the field agrees with the value predicted using the Rankine-Hugoniot equations in conjunction with the measured shock speeds and plasma density behind the shock. Additional measurements of the dependence of the collision free shock thickness on the Alfvén Mach number have been obtained. The range of plasma densities has been extended to 10^{17} part/cm^3. The overall shock thickness (the order of 1 mm) obtained at high densities by monitoring the radiation across the annulus indicates that the angle between the plane of the shock and the normal to the wall is equal to or less than 2°. Experimental measurements of the heat transfer rates on the side wall of the magnetic annular shock tube have been initiated with the use of a new type of heat-transfer gage that works in the presence of strong electric and magnetic fields. A portion of the stainless steel shock tube wall is replaced with a thin sapphire window coated with a 1000 A carbon layer. The shock heated plasma comes in contact with the carbon. Infrared radiation from the back surface of the carbon is sensed with a fast 0.1 μsec rise time IR detector.

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

EXPERIMENTAL INVESTIGATION OF THE STRUCTURE OF SHOCK WAVES PRODUCED IN A MAST (Abstract), by R. M. Patrick. [1961] [1]p. [AF 49(638)-61] Unclassified

Presented at meeting of the Amer. Phys. Soc., Mexico City (Mexico), June 22-24, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 380, June 22, 1961.

An experimental investigation of the structure of shock waves produced in a magnetic annular shock tube (MAST) has been reported. Recently, the change in the magnetic field across these shock waves has been measured. The measured change in the field agrees with the value predicted using the Rankine-Hugoniot equations in conjunction with the measured shock speeds and plasma density behind the shock. Additional measurements of the dependence of the thickness of collision free shocks on the Alfvén Mach number have been obtained and are presented. Also, the range of plasma densities has been extended (up to 10^{17} part/cm^3) and the visible radiation emitted by the shock heated plasma along with the shock thickness has been measured. The overall shock thickness (the order of 1 mm) obtained at high densities by monitoring the radiation across the annulus indicates that the angle between the plane of the shock and the normal to the wall is equal to or less than 2°.

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

HEAT TRANSPORT FROM A HOT PLASMA (Abstract), by M. Camac and R. Feinberg. [1961] [1]p. [AF 49(638)-61] Unclassified

Presented at meeting of the Amer. Phys. Soc., Mexico City (Mexico), June 22-24, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 380, June 22, 1961.

Experimental measurements of the heat transfer rates on the side wall of the magnetic annular shock tube (MAST) have been initiated with the use of a new type of heat transfer gage that works in the presence of strong electric and magnetic fields. A portion of the stainless steel shock tube wall is replaced with a thin sapphire window coated with a 1000A carbon layer. The shock heated plasma comes in contact with the carbon. Infrared radiation from the back surface of the carbon is sensed with a fast 0.1 microsec rise time IR detector. With this rise time the system can determine temperature changes of a few degrees of objects at room temperature. The system was calibrated by measuring the heat transfer from air in the reflected shock region in a chemically driven shock tube.

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

THE REACTION OF GLASSES, PYROLYTIC GRAPHITE AND SELECTED REFRACTORIES WITH SODIUM VAPOR AT ELEVATED TEMPERATURES, by M. E. Unat. Apr. 1960, 30p. incl. illus. diagrs. tables. (Technical memorandum no. RAD-TM-60-41) (AFOSR-TN-60-871) (AF 49(638/659) AD 278425 Unclassified

The materials Vycor, Pyrex, boron nitride, aluminum oxide (Morganite), beryllium oxide, magnesium oxide (99% dense), aluminum oxide (fully dense) and pyrolytic graphite were exposed to sodium vapor at a measured temperature of 940°C for a period of 15 min. The complete loss of the Vycor sample, structural disintegration of pyrolytic graphite, reaction of Pyrex, and diffusion of

sodium into the less dense ceramics was observed. A corrosive reaction of type 304 stainless was observed where it was in contact with the Vycor sample. The test shows the need for dense ceramics where sodium vapors are to be in contact with alkali metal propulsion system components.

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

REALIZATION OF MAGNETOHYDRODYNAMIC PROPULSION (Abstract), by G. S. Janes. [1960] [1]p. (AF 49(638)659) Unclassified

Presented at Third AFOSR Contractors' meeting on Ion and Plasma Propulsion, Republic Aviation Corp., Farmingdale, N. Y., Mar. 22-24, 1960. (AFOSR-TN-60-405; AD 235949; PB 146900)

An analysis has been made of a low temperature magnetic plasma accelerator which consists of a rectangular duct in which the magnetic field and the electric current are perpendicular to each other and to the direction of the flow. An analysis has been made of the eddy current losses associated with removal of the conducting plasma from the magnetic field. These losses take the form of joule heating of the plasma (rather than push) and will be excessive unless the plasma is removed from the magnetic field slowly over a long distance. A precise evaluation of the effects of this requirement which appears to be in conflict with the requirements for minimum wall losses will require a more detailed understanding of the boundary layer wall losses, although it is now apparent that this device is closer to an arc jet with some magnetic push rather than to a magnetic accelerator with some incidental joule heating. The use of a magnetic annular shock tube as a pulsed plasma propulsion engine is being investigated. The ultimate objective is to develop an efficient propulsion device which will operate at specific impulses of up to 5000 sec at an average power level of 50 kw. The aim of this program is to measure and to minimize the various losses in the device as well as to establish design criteria for such a propulsion system. In order to establish these design criteria, various features of the magnetic annular shock (such as magnetohydrodynamic containment, electrode arc voltage drops, etc.) are being investigated. Despite conceptual simplicity, plasma accelerators employing electrodes have limitations which are associated with the necessity for contact between the electrode materials and the hot plasma. In accelerators employing electrodes, a limitation is imposed by the requirements for minimizing energy losses which occur in the arc voltage drop. In order to avoid this power limitation and permit steady state operation, an electrodeless traveling wave machine is being built in which the acceleration is accomplished by a multiple moving mirror magnetic field configuration. The initial plans call for operation with sodium vapor at a specific impulse of 3000 sec.

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

A MAGNETIC ANGULAR ARC, by W. E. Powers and R. M. Patrick. Mar. 1961, 15p. incl. illus. diagrs. (AFOSR-300) (AF 49(638)659) AD 275739 Unclassified

Presented at Second Symposium on Engineering Aspects of Magnetohydrodynamics, Pennsylvania U., Philadelphia, Mar. 9-10, 1961, p. 5-18.

Experiments have been carried out in a geometry where an arc was formed by a radial current in the annulus between 2 coaxial electrodes. The arc was used to heat a cold gas which was flowing in the axial direction in the annulus. There was an axial magnetic field throughout the flow region. The operation characteristics of this annular arc have been calculated. The variation of the electrical impedance of the arc with power level, particle density and magnetic field strength has been measured and compared to the calculated values and indicate that the arc impedance is linearly dependent upon $\omega_e \tau_e$ where ω_e is the gyro frequency and τ_e is the average time between collisions. The heat flux to the walls of the arc chamber has been measured and compared to the theoretical value. The static and total pressure of the arc heated plasma have been measured and the results have been used to establish the plasma conditions, which are necessary to obtain a preliminary comparison of the experimental results with theoretical predictions. (Contractor's abstract, modified)

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

PLASMA BOUNDARY LAYERS, by J. A. Fay. Dec. 1961, 29p. incl. refs. (Rept. no. AMP-83; rept. no. NP-12150) (AFOSR-3902) (AF 49(638)659) AD 294152 Unclassified

A review is given of recent work on boundary layers in electrically-conducting fluids. This includes a discussion of the differences between ordinary boundary layers and plasma boundary layers with special reference to the new dimensionless parameters for the magnetic case, including those which arise from the microscopic structure of the fluid. The convection of current and vorticity along magnetic field lines by the Alfvén wave mechanism is shown to be the principal new propagation mechanism in magneto-hydrodynamic boundary layers. Recent work in inertial boundary layers, channel flows, wakes, and electrode boundary layers is summarized. (Contractor's abstract)

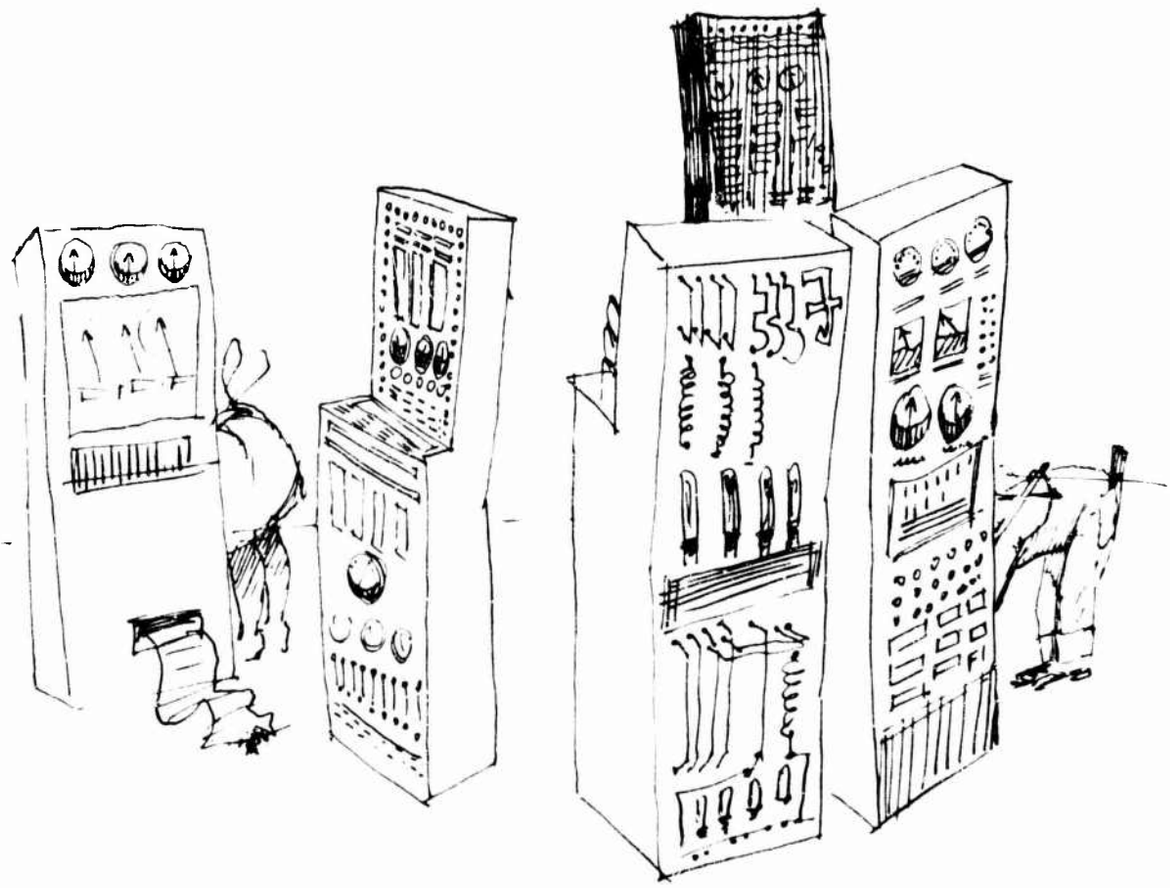
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Avco Corp. Avco-Everett Researc Lab., Everett, Mass.

RESEARCH ON PLASMA PROPULSION (Abstract), by G. S. Janes. [1961] [1]p. (Bound with AFOSR-582; AD 257892) (AF 49(638)659) Unclassified

Presented at Fourth annual AFOSR Contractors' meeting on Ion and Plasma Acceleration, Beverly Hills, Calif., Apr. 20-21, 1961.

Low Temperature Accelerator Experiments: A plasma acceleration device consisting of an annular dc arc configuration with an axial magnetic field has been under study. Experiments have shown that the arc impedance can be increased and the energy transfer thereby improved through the application of a magnetic field. This result is an agreement with a 1-dimensional theory relating arc impedance to $\omega_e \tau_e$. Pulsed Accelerator Experiments: The flow field in a magnetic annular shock tube of radius 3:1 is being studied using optical, electrostatic, and magnetic probes. It has been found that when the center electrode is positive the current interface is not plane but assumes the shape of a blunt body for which Newtonian pressure distributions match the magnetic pressure. It has been further determined that the gas does not accumulate ahead of the current interface but flows around the "body" to the outside wall where it "leaks by" the current interface and accumulates in a bubble behind it. Electrodeless Traveling Wave Accelerator Experiments: Steady-state electrodeless plasma acceleration experiments have been performed utilizing the moving magnetic cusp configuration. In initial experiments, the mean final plasma velocity (2500 sec) corresponds to about 2/3 of the final phase velocity. The experimental evidence includes thrust, heat transfer, and Langmuir probe measurements, as well as mass flow rate and energy balance considerations.



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

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Battelle Memorial Inst., Columbus, Ohio.

GALVANOMAGNETIC EFFECTS IN III-V COMPOUND SEMICONDUCTORS, by A. C. Beer. [1961] [6]p. incl. diagrs. refs. (AFOSR-955) [AF 49(638)959]
AD 451556 Unclassified

Also published in Jour. Appl. Phys. Suppl., v. 32: 2107-2112, Oct. 1961.

Also published in Semiconducting Compounds; Proc. of the Conf., Schenectady, N. Y. (June 14-16, 1961), New York, W. A. Benjamin, Inc., 1961, p. 2107-2112. (AFOSR-2010)

The influence of various structural characteristics in the III-IV compounds on galvanomagnetic properties is discussed. Evidence for the scattering of charge carriers by polar optical modes is reviewed, and the behavior of Hall and magnetoresistance coefficients is examined in regard to the conduction band structure. Unique characteristics, imparted by light masses in certain bands, include high mobilities and large magneto-effects associated either with transport in the band or with ionization energies of the impurity centers. The importance of avoiding inhomogeneities, either in specimen or in magnetic field, when measuring Hall coefficient or magnetoresistance in high-mobility materials is emphasized. Illustrations are given of the effects of nonuniformities in carrier concentration or in applied magnetic field on various galvanomagnetic phenomena. (Contractor's abstract)

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Battelle Memorial Inst., Columbus, Ohio.

EVIDENCE FOR A SELENIUM DONOR LEVEL ABOVE THE PRINCIPAL CONDUCTION BAND EDGE IN GaSb, by R. T. Bate. [1961] [3]p. incl. diagrs. refs. (AFOSR-956) (AF 49(638)959) Unclassified

Also published in Jour. Appl. Phys., v. 33: 26-28, Jan. 1962.

Low-temperature Hall coefficient and resistivity data on selenium-doped GaSb are interpreted under the assumption that selenium introduces a donor level above the principal [000] conduction band minimum. The postulated level is associated with electrons in [111] valleys localized in hydrogen-like orbits around selenium atoms. The results at 77°K are consistent with the assumption that impurity scattering is dominant and that a selenium donor level is located about 0.07 ev above the principal conduction band edge at 77°K. The low-temperature data on tellurium-doped samples are also discussed. (Contractor's abstract)

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

INTERSENSORY COMPARISONS OF TEMPORAL JUDGMENTS, by S. Goldstone, W. K. Boardman, and W. T. Lhamon. [1958] [6]p. incl. diagr. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)79 and Public Health Service) Unclassified

Published in Jour. Exper. Psychol., v. 57: 243-248, Apr. 1959.

Audio-visual comparisons were made of absolute judgements of a standard unit of time, 1 sec. The Ss judged the duration of sounds and lights as more or less than their concept of 1 clock sec. Four hundred and three Ss were divided into 12 groups. The following results are discussed: (1) The visual "second" was consistently longer than the auditory "second". (2) Long and short anchor stimuli pulled the transition zone of the Ss' subjective "second" in the direction of the anchor magnitude for both modes. Visual judgments were more affected by the anchors. (3) Past experience with long and short anchors influence contemporary temporal judgments, with the residual effect of a past anchor being more potent for the visual mode. (4) Stimulus effectiveness and sensory dominance appeared to be a function of stimulus intensity. Under conditions of simultaneous audio-visual stimulation, the judgments approximated auditory alone when auditory was more intense; when visual was more intense the judgments approximated visual alone. (5) Stimulus intensity was the differentiating factor even when attention was varied through instructions to focus on either the light or the sound.

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

HEAD-BODY DIFFERENTIATIONS IN BODY IMAGE AND SKIN RESISTANCE LEVEL, by S. Fisher. [1958] [3]p. (Sponsored jointly by [Air Force Office of Scientific Research under AF 18(603)79] and Public Health Service) Unclassified

Published in Jour. Abnorm. and Social Psychol., v. 60: 283-285, Mar. 1960.

The data support the hypothesis that different levels of reactivity in given body sectors are linked with corresponding differences in body image attitudes toward such sectors. Thus, when the head area was perceived as having large magnitude with reference to the body, it was characterized by relatively lower skin resistance (indicating greater reactivity) than that of the non-head area. These findings are congruent with previously reported correlations between body image boundary definiteness and body interior vs body exterior reactivity... body image attitudes towards a given body sector may play a causative role in the level of reactivity of that sector.

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

THE EFFECTS OF ANCHORS ON APPARENT LENGTH, by W. K. Boardman, R. C. Aldrich and others. [1958] [5]p. incl. tables. (Sponsored jointly by Air Force Office of Scientific Research under AF 18-(603)79 and National Institute of Mental Health) Unclassified

Published in Jour. Gen. Psychol., v. 61: 45-49, July 1959.

Anchor effects on judgments of a standard physical unit, 1 in., were studied in 61 normal Ss, divided into 3 groups: neutral anchor (1.0 in.), long anchor (2.0 in.), and short anchor (0.1 in.). Anchor refers here to the initial stimulus of a series. S's estimate of an in. and his variability of judgment were derived and these measures compared for the 3 groups. Judgments showed no significant anchor effect and approximated the 1.0 in. objective standard. An anchor-reversed condition produced a significant change in judgments of the 0.1 in. initial anchor group but not in those of the 2.0 in. initial anchor group. The findings are discussed in comparison to analogous temporal judgments. (Contractor's abstract)

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

A RAPIDLY CONVERGENT ORTHOGONAL REPRESENTATION FOR EEG TIME SERIES AND RELATED METHODS OF AUTOMATIC ANALYSIS, by B. Saltzberg and N. R. Burch. [1959] [9]p. incl. diagrs. [AF 18-(603)79] Unclassified

Presented at Western Electronic Show and Convention, San Francisco, Calif., Aug. 18-21, 1959.

Published in I.R.E. Wescon Convention Record, Pt. 8: 35-43, 1959.

A mathematical model for characterizing electroencephalograph waveforms and a simple method of data analysis based on this model are described. A Gram-Charlier series representation arises as a consequence of the model used and the parameters which characterize this series are evaluated by measuring and processing zero crossing of the waveform and its derivatives. The model considers each time interval bounded by a pair of zeros of the EEG record as representing a probability distribution over this interval. The EEG is then characterized by parameters which relate to the shape of the distribution and which can be derived from derivative zero crossings within the interval. This technique has been applied with encouraging results to EEG studies of hypoxia and the effects of drugs administered to simulate human stress and fatigue. (Contractor's abstract)

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

A FURTHER NOTE ON INTERSENSORY DIFFERENCES IN TEMPORAL JUDGMENT, by S. Goldstone, C. Jernigan and others. [1959] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)79 and Public Health Service) Unclassified

Published in Perceptual and Motor Skills, v. 9: 252, Sept. 1959.

A previous study (see item no. 82, Vol. V) showed that a longer visual than auditory duration is likely to be judged by Ss' as 1 clock sec and compared binaural judgments of a pure tone with binocular judgments of a 1° circular target. This study was to determine whether this intersensory difference was a function of the dissimilar pattern of stimulation directed to the 2 modes since only part of the visual field was stimulated and greater visual attention presumably was required. Test results verify the previously reported intersensory difference in temporal judgment.

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

A BIOPHYSICAL BASIS FOR EXPRESSING THE GSR AS A CHANGE IN CONDUCTANCE: PRELIMINARY NOTE, by R. Edelberg. [1959] [5]p. incl. diagr. [AF 18(603)79] Unclassified

Published in Psychophysiol. Newsltrs., v. 6: 9-13, Aug. 1960.

The following expression, which has the advantage of a theoretical basis and experimental validation as well as pointing the way toward the recording circuit most logically used in measuring the exosomatic GSR, is given: $E = I.t/F^2(u_o r_o c_o + \frac{v_i c_i}{r_i})$, where E is the voltage across membrane; t the membrane thickness; F the Faraday constant; u_o the mobility of the external cation; c_o the concentration of the external cation; r_o the Donnan ratio for the external boundary (actually a function of fixed charge concentration on the membrane); v_i the mobility of the internal anion; c_i the concentration of the internal anion; and r_i the Donnan ratio for the internal boundary. The equation is further discussed with respect to the resting voltage (dE) in case of a small change in ionic mobility. It is concluded that a system is developed which will give a writeout in which changes in skin resistance are automatically converted to conductance units and most important, in which changes in basal resistance are automatically taken into account.

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

THE INTERRELATIONSHIP BETWEEN THE GALVANIC SKIN RESPONSE, BASAL, RESISTANCE, AND TEMPERATURE, by R. L. Maulsby and R. Edelberg. [1959] [5]p. incl. diagrs. refs. (Sponsored jointly by [Air Force Office of Scientific Research under AF 18-(603)79], National Institute of Mental Health, and Wright Air Development Center) Unclassified

Published in Jour. Compar. and Physiol. Psychol., v. 53: 475-479, Oct. 1960.

A comparison of 2 simultaneously recorded skin sites shows that basal resistance varies inversely with skin surface temperature by 3%/°C. Cooling of the site initially increases the GSR by about 5%/°C, and warming similarly reduces the GSR; but after 2-8 min there is a reversal of the effect. These changes are interpreted in terms of the membrane concept of the GSR effector. A peripheral interrelationship between GSR and basal resistance is indicated. (Contractor's abstract)

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

FRONT-BACK DIFFERENTIATIONS IN BODY IMAGE AND BODY REACTIVITY, by S. Fisher. [1959] [7]p. incl. table. (Sponsored jointly by [Air Force Office of Scientific Research under AF 18(603)79] and Public Health Service) Unclassified

Published in Jour. Gen. Psychol., v. 64: 373-379, Apr. 1961.

Ss' estimates of the relative sizes of front vs back areas of their bodies were obtained. Measures of front vs back reactivity were secured by means of skin resistance recordings. As hypothesized, it was found that the ratio of front skin resistance to back skin resistance was significantly related to the body image valuations applied to these areas. It was predicted that the greater the body image prominence and also physiological reactivity of the back vs the front, the greater the imaginative spontaneity in interpreting stimuli. Data from the Rorschach and Thurstone Interest Schedule were partially supportive of this view.

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

THE USE OF SOCIOLOGICAL AND SOCIAL-PSYCHOLOGICAL CONCEPTS IN PHYSIOLOGICAL RESEARCH: A REVIEW OF SELECTED EXPERIMENTAL STUDIES, by H. B. Kaplan and S. W. Bloom. [1960] [7]p. incl. refs. [AF 18(603)79] Unclassified

Published in Jour. Nervous and Mental Disease, v. 131: 128-134, July 1960.

A number of experimental studies are reviewed in the formulation of which social and social-psychological concepts were intentionally used as distinct from the accidental use of such concepts in many interdisciplinary studies. The 4 variables utilized in the studies reviewed are: social status, social sanction, definition of the situation, and empathy.

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

THE RELATIONSHIP BETWEEN THE GALVANIC SKIN RESPONSE, VASOCONSTRICTION, AND TACTILE SENSITIVITY, by R. Edelberg. [1960] [9]p. incl. diagrs. table, refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)79 and National Institute of Mental Health) Unclassified

Published in Jour. Exper. Psychol., v. 62: 187-195, Aug. 1961.

The relationship over short periods of time between cutaneous tactile threshold and autonomic activity, as reflected in galvanic skin response (GSR) or in degree of vasoconstriction, was determined by a method allowing continuous monitoring of S's threshold to 250 cps vibration. Increased autonomic activity occurring either spontaneously or as a result of external stimulation is generally accompanied by a fall in tactile threshold, the highest correlation occurring when finger pulse volume is used as the autonomic measure. Experiments to determine whether the correlation with vascular activity is due to the mechanical effect of the stretching or relaxing of the skin on tactile threshold showed that this is a possible explanation but cannot account for all of the results. A survey of the palmar surface of the hand showed a relationship between the relative magnitude of the GSR from a given site and its tactile sensitivity, and further, that the sites comprise separate populations, each associated with a different cutaneous nerve. It is postulated that the GSR may in part be a by-product of the arrival of sympathetic impulses whose function is to sensitize tactile receptors. The influence of general arousal and of focus of attention on the tactile-autonomic relationship has tentatively been assigned a dominant position. (Contractor's abstract)

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

MICROELECTRODE STUDY OF THE GALVANIC SKIN RESPONSE (Abstract), by R. Edelberg. [1961] [1]p. (Sponsored jointly by [Air Force Office of Scientific Research under AF 18(603)79] and Public Health Service) Unclassified

Presented at Forty-fifth annual meeting of the Fed. Amer. Soc. for Exper. Biol., Atlantic City, N. J., Apr. 14, 1961.

Published in Fed. Proc., v. 20 (Pt. 1): 326, Mar. 1961.

Several lines of indirect evidence have indicated that epidermal cells as well as sweat glands may participate in the electrical resistance changes occurring during the GSR. This hypothesis has been tested directly on 30 humans by exploration of the palmar skin surface with reversible microelectrodes. Because shunting of current by the corneum renders interpretation uncertain, a micro-surgical technique has been utilized to isolate physically and electrically a slab of epidermis from the surrounding sweat ducts. Even with this precaution, local humidity changes incidental to sweating have been shown to alter epidermal hydration and thereby introduce an uncertainty in determining the origin of the large resistance changes observed on these slabs. Demonstration of selective inactivation of these epidermal slabs and observation of the phase and amplitude relations of the resistance changes with those of nearby sweat glands and gross sites under various degrees of local humidity lead to the conclusion that the living layer of the epidermis contributes significantly to the resistance changes of the GSR.

93

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

NEW MICROWAVE STRUCTURAL MEASUREMENTS OF LINEAR MOLECULES (Abstract), by J. K. Tyler and J. Sheridan. Feb. 1961 [1]p. (Technical note no. 1) (AFOSR-802) (AF 61(052)241) Unclassified

Structures have been determined for fluorine cyanide, FCN (3 isotopic forms), and fluoroacetylene, FCCH (6 isotopic forms). Spectra have also been measured for the following molecules for use with earlier data in computing structures: $Cl^{35}CN^{15}$, $Cl^{37}CN^{15}$, ICN^{15}, $Cl^{35}C^{13}CH$, and $Cl^{35}CC^{13}H$. Dipole moments have been determined from stark effects for FCN and FCCH, and l-type doublet spectra have been measured for excited states of both these molecules and for cyanoacetylene, HCCCN. The CN substitution distances are 1.159A in all the halogen cyanides. The quadrupole coupling constant for N^{14} in these falls along the series to a value of -2.67 mc/sec in FCN, and bears no simple relation to the CN length. The CF distances in FCN and FCCH are the shortest ever found for this linkage. The CC distance in FCCH is probably slightly shorter than the 1.204A found in ClCCH and acetylene itself. Iodoacetylene, ICCH and ICCD, have been prepared and characterized for the first time by means of mass- and infrared-spectra. Failure to date to detect a microwave spectrum of this substance indicates that it has a very small dipole moment.

94

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

THE EFFECTS OF CHLORPROMAZINE, THIOPENTONE AMPHETAMINE AND D-LYSERGIC ACID DIETHYLAMIDE ON CONDUCTION WITHIN AN EXTRALEMNISCAL SYSTEM IN THE BRAIN STEM OF THE CAT, by A. J. Hance. [1958] [2]p. [AF 61(514)1184] Unclassified

Presented at meeting of the Physiol. Soc., London (Gt. Brit.), Dec. 5-6, 1958.

Published in Jour. Physiol. (London), v. 145. 41P-42P, Mar. 1959.

The experiments were carried out on cat preparations of the encéphale isolé type in which the spinal cord was transected at the C 1 level while the animal was under ether anesthesia. Single 1 msec rectangular pulses, 4-10 v in amplitude, were applied once/2 sec to the region of the nucleus recticularis slightly lateral and dorsal to the inferior olive by means of a concentric bipolar electrode. Potentials were recorded from the nucleous commissurae posterioris or occasionally from the central grey matter at the level of the superior colliculus and displayed on a cathode-ray oscilloscope. Measurements were made of the initial latency, peak latency and amplitude of the evoked response during 1 or more control periods and again after the administration of drugs. Latency measurements show that the fastest components of the recorded wave had a conduction velocity of 1.0-3.0 m/sec while the peak of the wave was propagated at 0.5-0.95 m/sec. Both thiopentone sodium and r-amphetamine sulphate caused reduction in amplitude of the evoked potential. The results support earlier findings that there is a difference in the sites of action of amphetamine and LSD-25.

95

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

A COMPARATIVE STUDY OF THE EFFECTS OF DRUGS ON THE AROUSAL SYSTEM OF THE BRAIN, by P. B. Bradley and B. J. Key. [1959] [10]p. (AF 61-(514)1184) Unclassified

Published in Brit. Jour. Pharmacol. and Chemotherapy, v. 14: 340-349, 1959.

A concentric bipolar stimulating electrode was oriented in the brain stem reticular formation in the encéphale isolé of the cat; the electrocorticogram was recorded from 12-16 cortical electrodes and the behavioral arousal response (opening of the eyes and contraction of the nictitating membrane) to electrical stimulation was observed. The response to auditory stimulation was also examined. Thresholds for arousal response

were determined and the effects of the following drugs were examined: chlorpromazine, promazine, acepromazine, hydroxyzine, benactyzine, imipramine, hyoscine, reserpine, rescinnamine, deserpidine, meprobamate, and azacyclonal. The drugs could be classified into 4 groups: (1) drugs producing slight depression of the direct and afferent nerve stimulation, arousal with similar effects on the electrocorticogram and arousal (chlorpromazine, promazine, acepromazine and hydroxyzine), (2) drugs increasing arousal thresholds but dissociating behavior and electrical activity (benactyzine and imipramine), (3) drugs having no effect on arousal but in high doses producing changes in the electrocorticogram towards activation pattern (reserpine add related compounds, and (4) with no detectable effects (meprobamate and azacyclonal).

96

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

ELECTROPHYSIOLOGICAL INVESTIGATION INTO THE ACTION OF CENTRAL STIMULANT AND TRANQUILLISING DRUGS, by P. B. Bradley. Final technical rept. May 31, 1961, 49p. incl. diagrs. table, refs. (AFOSR-1034) (AF 61(514)1184) AD 262162
Unclassified

Three main types of investigation have been carried out: (1) Studies of the effects of drugs on conduction within the brain stem. Of the drugs studied, only 2, thiopentone sodium and amphetamine had any significant effects. (2) Studies of the effects of central stimulant and tranquilizing drugs on arousal responses. Three central excitant drugs, Preludin, Ritalin and Meratran were found to have similar effects to those of amphetamine and it is suggested that they have the same site of action. Of the tranquilizers studied, promazine, acepromazine and hydroxyzine were found to have similar effects on arousal thresholds to those of chlorpromazine and probably act in the same way. (3) Studies of the effects of drugs on conditioning and habituation to arousal stimuli in animals. In this investigation chlorpromazine was found to elevate thresholds for both unconditioned and conditioned afferent stimuli in producing arousal and eventually blocked these responses. Reserpine caused only a slight rise in threshold for the conditioned response but blocked the unconditioned response although this latter effect may have been partly due to habituation. (Contractor's abstract)

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Boston U. Dept. of Chemistry, Mass.

REACTIONS OF ACTIVE NITROGEN WITH ORGANIC SUBSTRATES. I. THE MONOMERIC PRODUCTS OF THE REACTION WITH 1,3-BUTADIENE, by A. Tsukamoto and N. N. Lichtin. [1961] [5]p. incl. diagrs. tables, refs. (AFOSR-3752) (AF 49(638)2)
Unclassified

Also published in Jour. Amer. Chem. Soc., v. 84: 1601-1605, May 5, 1962.

The reaction of active nitrogen with 1,3-butadiene yields important amounts of pyrrole and cis- and trans-crotononitriles which can be rationalized as resulting from addition of a nitrogen atom and loss of a hydrogen atom. Other products arise from degradative processes and include cis- and trans-1-cyano-1,3-butadiene, 3-cyano-1-butene, 2 nitriles tentatively identified as cis- and trans-1-cyanopentene-3, ethylene, acetylene, propylene and hydrogen cyanide, the most abundant product. A substantial quantity of polymeric material of composition approximating $(C_4H_6N)_x$ is also formed. The small dependence of the relative yields of monomeric (i.e., C_4N, C_5N and C_6N) products on partial pressures of reactants suggests that they are all formed via the same nitrogenous intermediate. Mechanistic speculations consistent with the data are offered. (Contractor's abstract)

98

Boston U. [Dept. of Physics] Mass.

EXPANSION OF THE LINEAR BOLTZMANN OPERATOR, by A. Siegel. [1961] 6p. (AFOSR-1114) (AF 49-(638)675)
Unclassified

Also published in Prog. Theoret. Phys. (Japan), v. 25: 1049-1051, June 1961.

The Kramer expansion is rearranged to form the "CD expansion", which operates on a transformed distribution function $P(y,t)\exp(y^2/4)$, P being the usual distribution function for thermal fluctuations of the variable y. C and D are creation and destruction operators for Hermite functions of y. Successive terms of the expansion can be interpreted directly as successive kinetic-theory connectors. The relation of the new expansion to the topics is discussed in AFOSR-TN-60-905 (see item no. 136, Vol. IV).

99

Boston U. Dept. of Physics, Mass.

[STATISTICAL QUANTUM MECHANICS], by A. Siegel. Interim final rept. Dec. 1961, 3p (AFOSR-1981) (AF 49(638)675)
Unclassified

This contract ran from Aug. 1, 1959 to Nov. 1, 1961 and is continued by AF AFOSR-62-177 for the following two years. A summary of results obtained in each of the following three fields is given: (1) Turbulence theory; (2) kinetic theory (see item nos. 134-136, Vol. IV; also item no. 98, Vol. V); and (3) fundamentals of quantum mechanics.

100

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

STRUCTURE OF A QUANTIZED VORTEX IN BOSON SYSTEM, by E. P. Gross. [1961] [23]p. incl. refs. (AFOSR-J520) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)27] and National Science Foundation) AD 414439 Unclassified

Also published in Nuovo Cimento, Series X, v. 20: 454-477, May 1, 1961.

For a system of weakly repelling bosons, a theory of the elementary line vortex excitations is developed. The vortex state is characterized by the presence of a finite fraction of the particles in a single particle state of integer angular momentum. The radial dependence of the highly occupied state follows from a self-consistent field equation. The radial function and the associated particle density are essentially constant everywhere except inside a core, where they drop to zero. The core size is the de Broglie wavelength associated with the mean interaction energy/particle. The expectation value of the velocity has the radial dependence of a classical vortex. In this Hartree approximation the vorticity is zero everywhere except on the vortex line. When the description of the state is refined to include the zero point oscillations of the phonon field, the vorticity is spread out over the core. These results confirm in all essentials the intuitive arguments of ONSAGER and FEYNMAN. The phonons moving perpendicular to the vortex line are coherent excitations of equal and opposite angular momentum relative to the subetratum of moving particles that constitute the vortex. The vortex motion resolves the degeneracy of the Bogolyubov phonons with respect to the azimuthal quantum number. (Contractor's abstract)

101

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

STRUCTURE OF THE VERTEX FUNCTION, by S. Deser, W. Gilbert, and E. C. G. Sudarshan. [1958] [5]p. incl. diagrs. [AF 49(638)636] Unclassified

Published in Phys. Rev., v. 115: 731-735, Aug. 1, 1959.

An integral representation as a function of invariants is found for the Fourier transform of the matrix element between the vacuum and a 1-particle state of the retarded commutator of 2 currents. A special case is a spectral representation for the vertex as a function of momentum transfer. The threshold in this representation is lower than that found in the usual perturbation theory. (Contractor's abstract)

102

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

DYNAMICAL STRUCTURE AND DEFINITION ON ENERGY IN GENERAL RELATIVITY, by S. Deser. [1959] [13]p. incl. refs. (AFOSR-3960) (Sponsored jointly by [Air Force Office of Scientific Research under AF 49(638)636] and National Science Foundation) Unclassified

Also published in Les Théories Relativistes de la Gravitation; Colloq. Internationaux du Centre Nat'l. de la Recherche Scientifique, Royaumont (France). (June 21-26, 1959), Paris, Centre Nat'l. de la Scientifique, 1962, p. 395-407.

Also published in Phys. Rev., v. 116: 1322-1330, Dec. 1, 1959.

The dynamical structure and definition of energy for the classical general theory of relativity is considered on a formal level. The Schwinger action principle is used. Starting with the full Einstein Lagrangian in 1st order Palatini form, an action integral is derived in which the algebraic constraint variables have been eliminated. This action possesses a "Hamiltonian" density which vanishes due to the differential constraints. An analysis of the equations of motion and the constraint equations shows that the 2 pairs of dynamical variables representing the 2 independent degree of freedom of the gravitational field are explicitly exhibited. It is suggested that the theory is to be restated in terms of variables that possess the geometrical properties of decomposing the 4 dimensional characterizations of the space into 3 + 1 dimensional aspects.

103

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

CANONICAL VARIABLES, EXPRESSION FOR ENERGY, AND THE CRITERIA FOR RADIATION IN GENERAL RELATIVITY, by R. Arnowitt, S. Deser, and C. W. Misner. [1959] [9]p. (Sponsored jointly by [Air Force Office of Scientific Research under AF 49(638)636] and National Science Foundation) Unclassified

Published in Nuovo Cimento, Series X, v. 15: 487-491, Feb. 1, 1960.

A canonical form for general relativity involving only 2 pairs of unconstrained conjugate variables is obtained by an orthogonal decomposition of the space part of the metric and the conjugate momentum variables, of the form $f_{ij} = f_{ij}^{TT} + \frac{1}{2}[f^{T}\delta_{ij} - (1/\Delta^2)f^{T}{}_{,ij}] + f_{i,j} + f_{j,i}$, ($1/\Delta^2$ the inverse of the flat space Laplacian operator with appropriate boundary conditions). The coordinate conditions (without which the decomposition is

meaningless) are $g_{ij,j} = 0$, $\pi^{ii}{}_{,jj} - \pi^{ij}{}_{,ij} = 0$. The criterion for the existence of radiation at a point is then a non zero TT part of the metric (of conjugate variable).

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

CANONICAL VARIABLES FOR GENERAL RELATIVITY, by R. Arnowitt, S. Deser, and C. W. Misner. [1959] [8]p. (Sponsored jointly by [Air Force Office of Scientific Research under AF 49(638)636] and National Science Foundation) Unclassified

Published in Phys. Rev., v. 117: 1595-1602, Mar. 15, 1960.

The general theory of relativity is cast into normal Hamiltonian form in terms of 2 pairs of independent conjugate field variables. These variables are explicitly exhibited and obey ordinary Poisson bracket relations. This form is reached by imposing a simple set of coordinate conditions. It is shown that these functionals of the metric used as invariant coordinates do not appear explicitly in the Hamiltonian and momentum densities, so that the standard differential conservations laws hold. The bearing of these results on the quantization problem is discussed. (Contractor's abstract)

105

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

ENERGY AND THE CRITERIA FOR RADIATION IN GENERAL RELATIVITY, by R. Arnowitt, S. Deser, and C. W. Misner. [1959] [4]p. incl. refs. (Sponsored jointly by Aeronautical Research Lab., [Air Force Office of Scientific Research under AF 49(638)636], and National Science Foundation) Unclassified

Published in Phys. Rev., v. 118: 1100-1104, May 15, 1960.

The Hamiltonian for general relativity obtained in a previous paper (Phys. Rev., v. 113: 745-750, Jan. 15, 1959) furnishes a definition of energy whose physical interpretation is direct, and which fulfills the conditions required of the energy in other physical systems. The energy can be expressed as a surface integral at spacial infinity in terms of the spacial components of the covariant metric tensor at any given time. Thus, the energy depends only on the minimal initial Cauchy data and may be evaluated in any coordinate system, provided this system can be made asymptotically rectangular. These statements remain valid when particles are coupled to the gravitational field. The criteria for existence of gravitational radiation are formulated in terms of the canonical variables and the stress-tensor. These criteria are identical to those used in electromagnetic theory. Some applications are discussed. (Contractor's abstract)

106

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

HEISENBERG REPRESENTATION IN CLASSICAL GENERAL RELATIVITY, by A. Arnowitt, S. Deser, and C. W. Misner. [1960] [14]p. incl. refs. (AFOSR-J1433) (Sponsored jointly by Aeronautical Research Laboratory, Air Force Office of Scientific Research under AF 49-(638)636, and National Science Foundation) AD 427646 Unclassified

Also published in Nuovo Cimento, Series X, v. 19: 668-681, Feb. 16, 1961.

The energy of the gravitational field (as of any other system) is not always the numerical value of the Hamiltonian (for example, not in a Hamilton-Jacobi formulation). A classical "Heisenberg representation" is here defined that excludes Hamilton-Jacobi-like canonical transformations. Ordinarily, within the Heisenberg representation, there remains only the possibility of time-independent canonical transformation among the dynamical variables. However, the freedom of co-ordinate transformations in general relativity allows many extra "canonical" transformations not found in conventional Lorentz covariant theory. This wider class of canonical formalisms possess all the properties usually associated with the Heisenberg picture in that in each formalism the measurable quantities, $g_{\mu\nu}(t)$, are obtained from knowledge of the canonical variables at the same time without any explicit co-ordinate dependence. Further, the Hamiltonian is a constant of motion. Only in Heisenberg frames is the Hamiltonian to be associated with the energy of the system. In spite of the additional freedom of canonical transformations (due to the freedom of co-ordinate change mentioned above), it is shown that the Hamiltonian is numerically the same for a fixed state of the gravitational field in any Heisenberg representation. The energy is then a uniquely definable quantity in the theory. In the process, it is established that 2 Heisenberg frames can differ by coordinates. These transformations must also preserve the property that depend only on the canonical variables and not explicitly on the coordinates. These transformations must also preserve the property that at spatial infinity the metric become Lorentz so that the physical boundary conditions are unaltered. (Contractor's abstract)

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

WAVE ZONE IN GENERAL RELATIVITY, by R. Arnowitt, S. Deser, and C. W. Misner. [1960] [11]p. incl. refs. (AFOSR-J1452) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)-636], National Science Foundation, and Wright Air Development Division) AD 427582 Unclassified

Also published in Phys. Rev., v. 121: 1556-1566, Mar. 1, 1961.

In general relativity a "wave zone" may be defined for systems which are asymptotically flat. In this region, gravitational radiation propagates freely, independent of its interior sources, and obeys the superposition principle. The independent dynamical variables of the full theory which describe the radiation are shown to be coordinate invariant in the wave zone and to satisfy the linearized theory's equations there. Thus, the basic properties of free waves in linear field theories (e.g., electrodynamics) are reproduced for the gravitational case. True waves are also clearly distinguished from so-called "coordinate waves". Reduction to asymptotic form (taking leading powers of 1/r), is not identical to linearization, since, for example, the Newtonian-like 1/r part of the metric begins quadratically in the linear theory's variables. The Poynting vector of the full theory, which measures energy flux in the wave zone, is correspondingly shown to be given by the linearized theory's formula. (Contractor's abstract)

108

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

FINITE SELF-ENERGY OF CLASSICAL POINT PARTICLES, by R. Arnowitt, S. Deser, and C. W. Misner. [1960] [3]p. (Sponsored jointly by [Air Force Office of Scientific Research under AF 49(638)636] and National Science Foundation) Unclassified

Published in Phys. Rev. Ltrs., v. 4: 375-377, Apr. 1, 1960.

The self-energy of a point particle in classical general relativity theory is considered. It is shown that the gravitational self-mass of a neutral particle cancels the bare mass, giving total mass zero. A finite result is obtained for the coulomb self-energy of a charged particle.

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

SPIN-STATISTICS THEOREM (Abstract), by R. Arnowitt and S. Deser. [1961] [2]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)636] and National Science Foundation) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 305-306, Apr. 24, 1961.

A derivation of the connection between spin and statistics is obtained on the basis of the specific set of postulates of the Schwinger action principle. These included that (1) the Hilbert space metric is positive-definite, (2) local commutativity, (3) proper Lorentz invariance hold, (4) the fields have local interactions, and (5) variations of field amplitudes either commute or anticommute with the fields themselves. Neither positive-definiteness of the Hamiltonian nor TCP invariance need then be involved to obtain the connection for charged and neutral spin 0 to 1 and for neutral spin 1/2. Either of the last named assumptions may be used to guarantee the proper connection for the charged spin 1/2 field, where the purely algebraic consistency proof used in the other cases is not sufficient.

110

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

FURTHER CONSIDERATIONS ON ELECTROMAGNETIC POTENTIALS IN THE QUANTUM THEORY, by Y. Aharonov and D. Bohm. [1961] [14]p. incl. refs. [AF 49-(638)636] Unclassified

Published in Phys. Rev., v. 123: 1511-1524, Aug. 15, 1961.

The significance of potentials in the quantum theory is discussed in order to answer a number of arguments that were raised against the conclusions of a previous paper (Phys. Rev., v. 115: 485, 1959) on the same subject. It is then proceeded to extend the treatment to include the sources of potentials quantum-mechanically, and it is shown that when this is done, the same results are obtained as those of the previous paper, in which the potential was taken to be a specified function of space and time. In this way it not only answers certain additional criticisms that have been made of the original treatment, but also brings out more clearly the importance of the potential in the expression of the local character of the interaction of charged particles and the electromagnetic field. (Contractor's abstract)

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

THE SPIN-STATISTICS THEOREM, by R. Arnowitt and S. Deser. [1961] 38p. incl. refs. (AFOSR-J1449) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-22 and National Science Foundation) AD 427648 Unclassified

Also published in Jour. Math. Phys., v. 3: 637-649, July-Aug. 1962.

A derivation of the connection between spin and statistics is obtained for spin 0, 1/2 and 1 fields with arbitrary local interactions. The basis used is the Schwinger action principle, whose assumptions are specified; they include neither positive energy spectrum nor TCP invariance. The connection can be obtained without either of these 2 extra requirements in most cases. The remaining cases are characterized by non-TCP invariant free Lagrangians and non-positive definite free-particle

energies. Commutation relations among different fields are also briefly discussed by means of the action principle. (Contractor's abstract)

112

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

INTERFERENCE EFFECTS IN THE DECAY OF NEUTRAL K MESONS: $K^0 \to \pi + \pi + \gamma$, by S. Barshay and C. Iso. [1961] [4]p. incl. diagr. refs. (AFOSR-64-0876) (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-61-22] and National Science Foundation) AD 438669 Unclassified

Also published in Phys. Rev., v. 125: 2168-2171, Mar. 15, 1962.

An analysis is made of interference effects between the K_1^0 and K_2^0 components of a neutral K beam undergoing the $\pi^+ + \pi^- + \gamma$ decay mode. It is shown that a time dependence of the angle between the photon polarization and the normal to the decay plane in the rest system of the K particle results from the interference between the K_1^0 and K_2^0 channels. If we can assume that for π-π scattering at the energies relevant here only I = 0, D wave and I = 1, P-wave elastic phase shifts may be large, then these interference terms can be uniquely written in terms of the π-π phase shifts and Δm, the $K_1^0 - K_2^0$ mass difference. This effect may serve as a good method to determine the sign, as well as the magnitude, of the $K_1^0 - K_2^0$ mass difference. It may also be useful to determine the π-π scattering phase shifts. (Contractor's abstract)

113

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

SYMMETRIC MEANS AND MATRIX INEQUALITIES, by P. Bullen and M. Marcus. [1960] [8]p. (AF 49-(638)776) Unclassified

Published in Proc. Amer. Math. Soc., v. 12: 285-290, Apr. 1961.

Several inequalities for elementary symmetric functions are studied. Let (a) denote the n-type of positive numbers $(a_1, \ldots, a_n)$, $(\bar{a})$ the $(n+1)$-tuple of positive numbers $(a_1, \ldots, a_n, a_{n+1})$, $E_r(a)$ the rth elementary symmetric function of the (a), $p_r(a) = \binom{n}{r}^{-1} E_r(a)$, $F_{r,p} = (E_r/E_{r-p})^{1/p}$; (a) is proportional to (b) if there exists λ such that $a_i = \lambda b_i$, i = 1, 2, ..., n. The following are proved: (1) If $1 \le r \le k \le n$, then $p_r^k(a)/p k^r(a) = p_r^{k+1}(\bar{a})/p_{k+1}^r(\bar{a})$, with equality only if $a_1 = \ldots = a_{n+1}$. (2) If $\mu_1 \ge \ldots \ge \mu_{n+1} > 0$ are eigenvalues of a positive definite Hermitian matrix H and $\lambda_1 = \ldots = \lambda_n > 0$ the eigenvalues of a principal submatrix of H, then $p_1^k(\lambda)/p_k(\lambda) \ge p_1^{k+1}(\bar{\mu})/p_{k+1}(\bar{\mu})$. (3) If $1 \le p \le r \le n$, the $F_{r,p}(a+b) \ge F_{r,p}(a) + F_{r,p}(b)$, with equality only if r = 1, p = 1 or (a) is proportional to (b). (4) If A and B are positive definite Hermitian matrices with eigenvalues $0 < \alpha_1 \le \ldots \le \alpha_n$, $0 < \beta_1 \le \ldots \le \beta_n$, respectively, and C = A + B has eigenvalues $0 < \delta_1 \le \ldots \le \delta_n$, then $1 \le p \le r \le k \le n$ $F_{r,p}(\delta_1, \ldots, \delta_k) \ge F_{r,p}(\alpha_1, \ldots, \alpha_k) + F_{r,p}(\beta_1, \ldots, \beta_k)$.

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

SOME RESULTS ON NON-NEGATIVE MATRICES, by M. Marcus, H. Minc, and B. N. Moyls. Apr. 1961, 16p. (AFOSR-599) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)776 and Office of Naval Research) AD 258985 Unclassified

Also published in Jour. Research Nat'l. Bur. Stand., v. 65B: 205-209, Sept. 1961.

In 1946 Birkhoff proved that any doubly stochastic (d.s.) matrix with non-negative entries is a convex combination of permutation matrices and that a matrix is d.s. if every row and column sum is 1. Let Ω_n denote the polyhedron of non-negative d.s. matrices. As noted in a previous paper (see item no. BCU.03:002, Vol. II) that dim $\Omega_n = (n-1)^2$, and hence any $A \in \Omega_n$ can be written as a convex combination of at most $(n-1)^2 + 1$ permutation matrices. Mirsky and Farahat have suggested (Proc. Camb. Phil. Soc., v. 56: 322-328, 1960) that an investigation of the minimum no $\beta(A)$ of permutation matrices is necessary to represent $A \in \Omega_n$ as a convex combination. The study is carried out as follows: (1) An inequality relating $\beta(A)$ to h(A) is obtained, the no of characteristic roots of A of absolute value 1. A problem of the similarity of 2 matrices in Ω_n is studied. (2) Conditions on $A \ge 0$ that are implied by the equality $\det(I-A) = \prod_{i=1}^{n} (1 - a_{ii})$ are studied. (3) An inequality is obtained for the difference between the max characteristic roots of 2 matrices A and B satisfying $B \ge A \ge 0$, where $B \ge A$ means $b_{ij} = a_{ij}$ for all i, j. (4) The question is discussed of transitivity of sets of functions on the set of integers $(1, \ldots, n)$ into itself by matrix methods.

115

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

A NORM INEQUALITY FOR LINEAR TRANSFORMATIONS, by B. N. Moyls and N. A. Khan. [1961] [5]p. [AF 49(638)776] Unclassified

Published in Canad. Math. Bull., v. 4: 239-242, Sept. 1961.

Let A be a normal matrix of order n with eigenvalues $\alpha_j = \lambda_j + i\mu_j$, so arranged that $\lambda_1 \leq \ldots \leq \lambda_n$. Let $\nu_1 \leq \ldots \leq \nu_n$ be the rearrangement of the μ_j's in non-decreasing order. For an arbitrary complex matrix B of order n, if $\beta_1 \leq \ldots \leq \beta_n$ and $\gamma_1 \geq \ldots \geq \gamma_n$ are the eigenvalues of B + B* and i(B - B*), respectively, then $\sum_{j=1}^{n} (\lambda_j\beta_{n-j+1} - \nu_j\gamma_j) \leq \|A + B\|^2 - \|A\|^2 - \|B\|^2 \leq \sum_{j=1}^{n} (\lambda_j\beta_j - \gamma_j\gamma_{n-j+1})$, where $\|A\|^2 = \mathrm{tr}A^*A$.

116

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

ASYMPTOTIC ESTIMATES FOR LIMIT POINT PROBLEMS, by C. A. Swanson. [1961] [12]p. (AFOSR-J1019) (AF AFOSR-61-89) AD 418299 Unclassified

Also published in Pacific Jour. Math., v. 13: 305-316, Spring 1963.

The variation of characteristic values and functions of the differential operator L defined by $Lx = \frac{1}{k(s)}\left\{-\frac{d}{ds}\left[p(s)\frac{dx}{ds}\right] + q(s)x\right\}$ is studied when the domain of L varies because of a change of boundary conditions. The basic interval is an open interval $\omega_- < s < \omega_+$ on which k is positive and piecewise continuous, p is positive and differentiable, and q is real-valued and piecewise continuous. For a closed subinterval [a,b] of the basic interval the main purpose is to obtain estimates for the characteristic values μ_{ab} and characteristic functions y_{ab} of regular Sturm-Liouville problems on [a,b] when a,b are near ω_-, ω_+. Such results have been obtained previously (Pacific Jour. Math., v. 11: 1549-1559, 1961) in the case that both ω_- and ω_+ are limit circle singularities in H. Weyl's classification. Here the analogous results are derived in the limit point case and the mixed case (one singularity of each type).

117

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

SOME TOPICS IN THE FLUCTUATIONS OF PHOTOPROCESS IN SOLIDS, by R. E. Burgess. [1961] [7]p. [AF AFOSR-61-91] Unclassified

Presented at the 1961 Internat'l. Conf. on Photoconductivity, Cornell U., Ithaca, N. Y., Aug. 21-24.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 484, Nov. 24, 1961.

Published in Jour. Phys. and Chem. Solids, v. 22: 371-377, Dec. 1961.

Photons and electrons in solids can undergo the stochastic processes of generation, absorption and multiplication. A general analysis of the steady-state mean value and variance due to these processes is applied to consideration of imperfect photon absorbers, and of photon and electron multipliers. The fluctuations of photon flux interacting with perturbed populations in a pair of electron levels are shown to be consistent with boson statistics at an effective temperature determined by the temperature of the input photons and the temperature of the level populations; the results are valid even if the latter temperature is negative and thus apply to amplifying as well as to attenuating systems. Fluctuations of carrier numbers in a nonstationary system are considered and the difficulties of formulating their spectral distribution are indicated. Carriers in a photoconductor produced by energetic photons have excess energy which is rapidly lost by photon scattering or by further ionization and these hot carriers therefore introduce additional noise components. (Contractor's abstract)

118

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

FURTHER STUDIES OF THE INFLUENCE OF ACOUSTIC MICROSTREAMING ON THE PHOTOGRAPHIC DEVELOPMENT PROCESS, by F. J. Jackson. [1961] [2]p. incl. illus. diagrs. (AFOSR-2124) (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(603)54], National Institutes of Health, and Office of Naval Research) Unclassified

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

Also published in Jour. Acoustic Soc. Amer., v. 33: 1144-1145, Aug. 1961.

A major obstacle in attempting quantitative investigations of the influence of microstreaming on solid-liquid interface reactions has been the inability to prevent gaseous cavitation (which destroys the orderly streaming action) from occurring in the liquid medium when the latter is subjected to a high-amplitude sound field. A description

is given of a modification of an earlier experimental arrangement, used to study microstreaming effects on a specific interphase chemical reaction (i.e., development of a photographic emulsion), which incorporates a means for suppressing undesired cavitation. Preliminary results obtained using this apparatus are presented. These results permit a more precise correlation between observed effects and properties of the streaming field than has hitherto been possible. Preliminary data indicating the extent to which microstreaming affects the local development rate are also presented. (Contractor's abstract)

119

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

ON THE ROLE OF MICROBUBBLES IN THE NONLINEAR TRANSMISSION OF SOUND IN LIQUIDS, by C. E. Adams and F. J. Jackson. [1961] [2]p. incl. illus. diagr. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(603)54] and National Institutes of Health) Unclassified

Published in Jour. Acoust. Soc. Amer., v. 33: 1145-1146, Aug. 1961.

The harmonic content of 25-kc sound transmitted through water was measured as a function of ambient pressure (0-12 atm) and an inverse relationship was found to hold; the nonlinearity disappeared completely at the higher pressures. It is suggested that gaseous cavitation, a pressure-dependent phenomenon, may be involved as a mechanism in the sound transmission. (Contractor's abstract)

120

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

ON THE FERMI SURFACE SHAPES OF THE NOBLE METALS BY ULTRASONICS, by R. W. Morse, A. Myers, and C. T. Walker. [1961] [2]p. incl. diagrs. [AF 49(638)6] Unclassified

Published in Jour. Acoust. Soc. Amer., v. 33: 699-700, May 1961.

Some revised conclusions are given concerning the Fermi surface shapes of the noble metals as determined ultrasonically. The main new conclusions are: (a) The relative amount of zone boundary touching in copper and gold is nearly the same. (b) There is evidence that the main bodies of the surfaces are considerably more distorted than previously believed, being bulged outward along [100] and possibly being concave in the [110] direction. (Contractor's abstract)

121

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

ULTRASONIC ATTENUATION IN SUPERCONDUCTORS, by R. W. Morse. [1961] [5]p. incl. diagrs. [AF 49(638)-6] Unclassified

Presented at IBM Conf. on Fundamental Research in Superconductivity, Yorktown Heights, N. Y., June 1961.

Published in IBM Jour. Research and Develop., v. 6: 58-62, Jan. 1962.

A brief review is given of the ultrasonic attenuation in metals arising from direct interaction of the elastic waves and conduction electrons, and the physical variables on which it depends. The drop in attenuation of longitudinal waves on entering the superconducting state is in good agreement with BCS theory, the various factors combining to make the relative attenuation, α_s/α_n, depend only on the energy gap; the measurements give evidence, however, for gap anisotropy or the presence of more than 1 gap. Recent measurements at Brown by Claiborne of shear wave attenuation in single-crystal Al, are in good agreement with a theory based on the Boltzmann and London equations. The steep drop at T_c is produced by shorting out of electromagnetic waves by supercurrents; the residual attenuation results from the effects of collision drag. (Contractor's abstract)

122

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

DIRECT CALCULATION OF PRESSURE DISTRIBUTION ON BLUNT HYPERSONIC NOSE SHAPES WITH SHARP CORNERS, by M. Holt. [1960] [5]p. incl. diagrs. refs. (AF 49(638)232) Unclassified

Published in Jour. Aerospace Sci., v. 28: 872-878, Nov. 1961.

The method of Belotserkovskii for calculating hypersonic flow fields past a circular cylinder is extended to deal with axially symmetric flow past sharp-cornered nose shapes, in particular, spherical segments and flat-headed cylinders. Results on spheres are also included In the present paper Belotserkovskii's first approximation is considered, and comparison of calculated pressure distribution and shock shape with experimental results shows very good agreement. (Contractor's abstract)

123

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

THE VISCOSITY OF STEAM AND WATER AT MODERATE PRESSURES AND TEMPERATURES, by J. R. Moszynski. [1961] [14]p. incl. diagrs. tables, refs. (In cooperation with Case Inst. of Tech., Cleveland, Ohio) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)891 and Steam Research Committee of American Society of Mechanical Engineers) Unclassified

Presented at ASME-AIChE Heat Transfer Conf., Buffalo, N. Y., Aug. 15-17, 1960.

Published in Jour. Heat Transfer, v. 83: 111-124, May 1961.

The paper reports the results of an investigation of the viscosity of steam and compressed water. The measurements were carried out by means of an oscillating-body-type viscometer in order to develop an alternative method of measurement to the usually employed capillary viscometer, and also to provide an independent check on published data. The results for compressed water, obtained with the aid of an oscillating sphere, represent absolute measurements, and cover a range from 3 to 340 atm and from 20° to 186°C. The viscosity of water is shown to have a negative pressure coefficient below 35°C and a positive coefficient above that temperature. The maximum change in viscosity at any given temperature over the pressure range covered is 5%. The results show good agreement with previously published data and the deviations of experimental points from smoothed curves do not exceed 0.05%. Although the present instrument is severely limited in range, the feasibility of measurements at elevated temperatures and pressures by means of the oscillation-type viscometer is clearly demonstrated. Particularly striking is the reproducibility and self-consistency of the results obtained. (Contractor's abstract)

124

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

THERMALLY DRIVEN NONLINEAR OSCILLATION IN A PIPE WITH TRAVELLING SHOCK WAVES, by B.-T. Chu and S. J. Ying. Apr. 1961, 32p. incl. diagrs. (Rept. no. AF 646/1) (AFOSR-686) (AF 49(638)646) AD 267069 Unclassified

Also published in Phys. Fluids, v. 6: 1625-1637, Nov. 1963.

Lin's method of characteristics perturbation was successfully applied to the calculation of a case of periodic nonlinear vibration of a column of gas in a pipe. The system consists of a heater located at the mid-section of a pipe closed at both ends. When the frequency of change in the heat-release rate is nearly equal to the natural frequency of the column of gas to 1 side of the heater, the fluctuation in pressure at the heater becomes almost in phase with the fluctuating change in heat-release rate. As a result, the amplitude of fluctuation in the pipe increases linearly with time until shock waves are formed in the system. Ultimately the level of fluctuation in the pipe attains a limiting value and the changes in the pipe become periodic. The results of this calculation of periodic nonlinear vibration agree with those of Betchov (Phys. Fluids, v. 1: 205-212, 1958). The method used here opens the way toward solving many similar problems of nonlinear vibration by a straight-forward and systematic procedure. (Contractor's abstract)

125

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

ON THE STABILITY OF LAMINAR FLAME, by B.-T. Chu and J. Y. Parlange. Sept. 1961, 30p. incl. diagrs. (Rept. no. AF 646/2) (AFOSR-1593) (AF 49(638)646) AD 267070 Unclassified

The stability of a laminar flame subjected to a small perturbation is examined. A practical case is considered in which the amplitude of the disturbance, as measured by the flame displacement, is small in comparison with the wave length of the disturbance, but not necessarily small in comparison with the flame thickness. From the basic equations governing a reactive mixture and making use of an expansion procedure in the parameter 1, defined as the ratio of the wave length to the flame thickness, the following results are obtained (1) For $1 \gg 1$, the phenomenological theory of Landau is justified. Accordingly, Landau's conclusion that a flame is unstable to small disturbances is strictly valid for disturbances of sufficiently long wave length. (2) The second term in the expansion in $1/1$ yields a correction to Landau's theory. Both the coefficient of thermal conduction and viscosity enter into the correction. The stabilizing influence of these additional terms is indicated. (Contractor's abstract)

126

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

EFFECTS OF CONDUCTION AND VISCOSITY ON THE STABILITY OF LAMINAR FLAME, by J. Y. Parlange and B.-T. Chu. Sept. 1961, 19p. incl. diagr. (Rept. no. 646/3) (AFOSR-1594) (AF 49(638)646) AD 269350 Unclassified

The effects of conduction and viscosity on the stability of laminar flame are examined. If 1 denotes the ratio of the wave length of a disturbance to the flame width and α is the ratio of the ultimate temperature of the burned gas to the initial temperature of the fresh mixture, the flame is found to be stable if $1 < \left(\frac{2\alpha}{\alpha-1}\right)\left(\frac{1}{RePr}\right)$, where Re is the Reynolds number of

the flame based on the flame width and Pr denotes the Prandtl number of the mixture. It is further shown that the stabilization is achieved primarily through the effect of heat conduction on the flame speed rather than the influence of viscosity. (Contractor's abstract)

127

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

ANALYSIS OF A SELF-SUSTAINED NONLINEAR VIBRATION IN A PIPE CONTAINING A HEATER, by B.-T. Chu. Sept. 1961, 18p. incl. diagrs. (Rept. no. AF 646/4) (AFOSR-1755) (AF 49(638)646)
AD 269351 Unclassified

Also published in Phys. Fluids, v. 6: 1638-1644, Nov. 1963. (Title varies)

A pipe of length 2L closed at both ends contains a pressure-sensitive plane heater at its midsection. The rate of heat release per unit area of the heater is assumed to vary with the pressure fluctuation. Such a system is unstable to small disturbances and a self-excited oscillation grows exponentially in time until nonlinear effects set in and shock waves are formed in the system. Ultimately a self-sustained nonlinear periodic vibration takes place in the pipe. When the feedback coefficient is small in comparison with unity, the nonlinear vibration can be calculated by a perturbation technique. (Contractor's abstract)

128

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

EFFECTS OF A MAGNETIC FIELD ON THE STABILITY OF A LAMINAR FLAME, by J. Y. Parlange and B.-T. Chu. Sept. 1961, 33p. incl. diagrs. (Rept. no. 646/5) (AFOSR-1756) (AF 49(638)646)
AD 269352 Unclassified

The stability of a laminar flame in the presence of a magnetic field is examined. Two important cases are considered: In the first case, the imposed magnetic field is assumed to be parallel to the flame; in the second, it is assumed to be normal to the flame. It is shown that a flame cannot be stabilized by the imposition of such magnetic fields and that the parallel magnetic field of sufficient strength can have a stabilizing effect on some harmonic components only.

129

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

THEORETICAL RESEARCH IN COMBUSTION AERODYNAMICS, by B.-T. Chu. Final rept. Oct. 1961 [5]p. (Rept. no. AF 646/6) (AFOSR-1800) (AF 49(638)646)
AD 269353 Unclassified

The work completed from Oct. 1, 1959 to Sept. 30, 1961 is summarized: (1) Nonlinear oscillations in a thermal system (see item nos. 124 and 127, Vol. V). (2) Stability of laminar flame (see item nos. 125, 126 and 128, Vol. V).

130

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

SOME TOPICS IN QUANTUM STATISTICS. THE WIGNER FUNCTION AND TRANSPORT THEORY, by H. Mori, I. Oppenheim, and J. Ross. [1959] [86]p. incl. refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(603)87] and Atomic Energy Commission)
Unclassified

Published in Studies in Statistical Mech., v. 1: 217-298, 1962.

A discussion is given of the foundations of quantum statistical mechanics. The tools used for this discussion are the density matrix and the phase-space distribution function due to Wigner. The general properties of these 2 concepts are reviewed in detail in Chapter 1. Chapter 2 is devoted to a discussion of equilibrium systems: subjects such as time average, phase averages and ergodic theory are reviewed; but the main part of the paper deals with non-equilibrium theory. The problems are stated and discussed qualitatively in Chapter 4. In a general system one is faced with the study of 2 types of evolution: a relatively rapid relaxation in momentum space and a much slower hydrodynamical evolution, the 2 processes being intimately coupled. The 2 following chapters illustrate the 2 existing approaches towards the solution of these problems; one based on the direct study of reduced distribution functions and kinetic equation (Boltzmann-like theories) and the 2nd based on the direct study of the time evolution of the macroscopic quantities, expressed in terms of certain correlation functions(Kubo-like theories). In both cases the authors present their own formulation of the theory. In the 1st case it is based on an extension of Kirkwood's original theory, employing time-smoother distribution functions. In the 2nd approach the authors start from the local equilibrium distribution and express the flows in terms of the derivation of the real distribution and express the flows in terms of deviation of the real distribution from the local equilibrium.

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

CONTINUUM RADIATION FROM IONIZED RARE GASES IN REFLECTED SHOCK WAVES, by F. W. Mies and E. F. Greene. [1961] [40]p. incl. diagrs. table, refs. (AFOSR-1303) [AF 49(638)167] AD 263792
Unclassified

Presented at meeting of the Amer. Phys. Soc., Chicago, Ill., Nov. 24-25, 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 423, Nov. 24, 1961.

Also published in Jour. Chem. Phys., v. 37: 1101-1111, Sept. 1, 1962.

A study was made of the radiation emitted by the ionized rare gases Ar, Kr, and Xe. These gases were formed in reflected shock waves in which the equilibrium temperatures ranged from 7,500-12,000°K and the electron densities from 10^{15}-10^{18} cm^{-3}. The intensity of the continuum radiation which is emitted throughout the visible and ultraviolet regions reached a steady state value some distance behind the reflected shock wave which corresponds to the equilibrium region predicted for the shock wave. (Contractor's abstract)

132

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

KINETIC STUDY OF THE FORMATION AND REACTION OF CN MOLECULES IN SHOCK WAVES, by W. L. Patterson, Jr. and E. F. Greene. [1961] [21]p. incl. illus. diagrs. refs. (AFOSR-1304) [AF 49(638)167] AD 263793 Unclassified

Also published in Jour. Chem. Phys., v. 36: 1146-1151, Mar. 1962.

The decomposition of gaseous BrCN in shock waves was measured over the temperature range 2500-7000°K by following the light emitted by CN and C_2. The rate of the reaction in 1 and 5% mixtures with Ar is $-d[BrCN]/dt = 2.0 \times 10^{12} T^{\frac{1}{2}} \exp(-90.5 \text{ kcal mol}^{-1}/RT)[Ar][BrCN]$ mol cc^{-1} sec^{-1}. The subsequent disappearance of CN as determined by both the loss of CN and the formation of C_2 is consistent with the reaction $2CN \rightarrow C_2 + N_2$ for which the bimolecular rate constant is $1.6 \times 10^{15} \exp(-43 \text{ kcal mol}^{-1}/RT)$ cc mol^{-1} sec^{-1}. (Contractor's abstract)

133

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

CHEMICAL REACTIONS IN SHOCK WAVES, by E. F. Greene. Final rept. Jan. 1, 1957-June 30, 1961. Aug. 1961 [7]p. incl. diagrs. (AFOSR-1305) (AF 49-(638)167) AD 263794 Unclassified

A list of technical reports published under the contract is given. It is then followed by summaries of work under progress: (1) The reactions of HBr at high temperatures under R. Araujo; (2) the rate of excitation of the separate vibrational levels of HI under C. C. Chow; and (3) examination of the reliability of the use of reflected shock wave velocities as a method of measuring the thermodynamic properties of hot gases. The dissociation energy of S_2 under T. P. Williams.

Brussels U. (Belgium). see Free U. of Brussels (Belgium).

134

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

SUBMICROSCOPIC CHANGES IN VISUAL CELLS OF THE RABBIT INDUCED BY IODOACETATE, by A. Lasansky and E. DeRobertis. [1958] [5]p. incl. refs. (Sponsored jointly by [Air Force Office of Scientific Research under AF AFOSR-60-5] and National Institutes of Health) Unclassified

Presented at Seventy-first annual meeting of the Amer. Assoc. of Anatomists, Buffalo U., Buffalo, N. Y., Apr. 2-4, 1958.

Abstract published in Anat. Rec., v. 130: 423-424, Feb. 1958. (Title varies)

Also published in Jour. Biophys. and Biochem. Cytol., v. 5: 245-249, Mar. 25, 1959.

Alterations produced by iodoacetate in visual cells were studied under the electron microscope. Lesions of the outer segments of the rods are visible as early as 3 hr after a single injection of 20 mg iodoacetate/kg body-wt. After 6 hr the changes are more marked and consist then of disorganization, vesiculation, and lysis of the rod sacs. The inner segments of most rod cells show swelling and vacuolization of the matrix, the endoplasmic reticulum, and the Golgi complex. The mitochondria of the ellipsoid show a tendency to disintegrate. In some inner segments the changes consist primarily in an increase in density of the matrix and deposition of a granular material. The rod synapses are also affected, showing lysis of the synaptic vesicles and alterations of the synaptic membrane. All these changes become more marked and lead to complete destruction of the rod cells when a 2nd injection of 20 mg iodoacetate/kg body-wt was given. The cones seem more resistant than the rods. A single injection produces no visible changes in the outer or inner segments of the cones. These observations are discussed in relation to various hypotheses put forward to explain the mode of action of iodoacetate on visual cells. The pronounced alterations of submicroscopic intracellular membranes suggest that the locus of action of iodoacetate may be a component widely dispersed throughout the visual cells and related somewhat to the maintenance of these lipo-protein structures. (Contractor's abstract, modified)

135

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

MORPHOLOGICAL BASES FOR A NURSING ROLE OF GLIA IN THE TOAD RETINA. ELECTRON MICROSCOPE OBSERVATIONS, by A. Lasansky. [1961] [7]p. incl. illus. refs. (AFOSR-2420) (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. Biophys. and Biochem. Cytol., v. 11: 237-243, Oct. 1961.

Müller cells embedding retinal neurons were suspected of not merely bedding retinal neurons but of providing a passage for metabolites. Evidence is presented suggesting a functional relationship between Müller and photoreceptor cells.

136

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

THE ACTION OF GLUTAMATE AND THE PROBLEM OF THE "EXTRACELLULAR SPACE" IN THE RETINA. AN ELECTRON MICROSCOPE STUDY, by F. Wald and E. De Robertis. [1961] [13]p. incl. illus. diagr. refs. (AFOSR-2421) (AF AFOSR-60-5) Unclassified

Also published in Zeitschr. Zellforsch. und Mikroskop. Anat., v. 55: 649-661, 1961.

Turtle's retinae were incubated in isotonic Ringer and then studied. Like the normal ones, no extracellular space was observed. However, no increase of intracellular volume was observed. The addition of glutamate to the incubation medium caused cellular swelling localized in the inner synaptic layer and gangiion cells. This selective action is discussed with relation to the biochemistry and physiology of synapses in these 2 strata.

137

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

SUBMICROSCOPIC MORPHOLOGY OF THE INRAFRED RECEPTOR OF PIT VIPERS, by H. Bleichmar and E. De Robertis. [1961] [14]p. (AFOSR-J1174) (AF AFOSR-61-40) AD 424258 Unclassified

Also published in Zeitschr. Zellforsch. und Mikroskop. Anat., v. 56: 748-761, 1962.

Electron microscope studies of the sensory membrane in crotalid snakes showed a complex structure of 7 layers, agreeing with previous light microscope observations suggesting its thermoreceptor function. The dense layer of nerve endings with compact masses of mitrochondria was the most prominent component, and may be involved in transferring temperature changes into nerve impulse.

138

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

A NEW AVERAGING TECHNIQUE FOR IMPROVING THE SIGNAL-TO-NOISE RATIO OF EVOKED POTENTIALS, by A. J. Buller and P. R. Styles. [1959] [1]p. [AF 61(514)1178] Unclassified

Presented at meeting of the Physiol. Soc., Mill Hill [London] (Gt. Brit.), Nov. 6-7, 1959.

Published in Jour. Physiol. (London), v. 149: 65P, Dec. 1959.

The use of the E.M.I. Barrier grid storage tube in a purely electronic system functioning on similar principles to those suggested by Dawson (Jour. Physiol., v. 115: 2, 1951) increases the flexibility of the method. The scanning beam passes through the barrier grid and deposits charge on the storage surface of the dielectric sheet. The charge deposited at any point depends on the time integral of the scanning beam current, up to an equilibrium charge determined by the potential difference between the barrier grid and the backing plate. The signal is read off by scanning the storage surface with a high beam current, and measuring the current flowing into the backing plate; this operation also erases the store. The resolution of the tube is approx 150 elements and the max storage time approx 60 min. Deflection and focus of the scanning beam are electrostatic. This device improves the time discrimination greatly.

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

THE RELATION BETWEEN NEUROPHYSIOLOGICAL AND PSYCHOSOCIAL ASPECTS OF HUMAN MENTALITY AND BEHAVIOR, by W. G. Walter. Final technical rept. [Jan. 1957-Oct. 1960] Mar. 1, 1961, 1v. incl. illus. diagrs. tables, refs. (AFOSR-716) (AF 61(514)1178) AD 262029 Unclassified

A total of 326 experiments have been performed on 200 human subjects, including 71 complete Defensive-avoidance conditioning procedures with 58 subjects. During conditioning records were obtained of: temperamental disposition, operant performance, EEG activity analyzed in 22 channels, somatic and autonomic responses indicated by EMG, EKG, BP, GSR and Respiration, together with introspective reports. The results

show wide variations in all factors, and in their interrelations, between individuals. The most significant variations are in the time-relations of intrinsic brain rhythms and in the latencies of both cerebral and autonomic responses. Individual patterns of intrinsic rhythms and responses are significantly related to characters of conditional adaptation to the experimental situation. Acute or chronic perturbations of the response time-relations are associated with irregular or totally incompetent conditional adaptation. Against the theoretical background of this research these results suggest that (a) the intrinsic adaptive capacity of a human brain depends on its accurate computation of contingent association; (b) the manner in which the cerebral computation is performed varies considerably in different brains, particularly in the extent to which information from different external and internal sources is combined and correlated; (c) the interaction between neo-cortical and paleo-cortical systems (including autonomic functions) is essential for the initiation of the computation but may impede its completion; and (d) the distribution of the variables determining the above may be such as to justify a pragmatic operational typology of human behavior patterns. (Contractor's abstract)

140

Bureau of Mines, Bartlesville, Okla.

THE HEAT OF FORMATION OF SILICA, by W. D. Good. [1961] [4]p. (Contribution no. 112) (AFOSR-1701) [CSO-680-59-9] AD 268046 Unclassified

Presented at Internat'l. Calorimetry Conf., Ottawa, Ontario (Canada), Aug. 14-18, 1961.

Also published in Jour. Phys. Chem., v. 66: 380-381, Feb. 1962.

From the heat of formation of H_2SiF_6, and the heat of SiO_2 in aqueous HF, the value $\Delta H = 217.5 \pm 0.5$ kcal/mol at 25°C was derived for the equation $Si(c) + O_2(g) = SiO_2(c, quartz)$.

141

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

SOCIAL-PSYCHOLOGICAL NEEDS AND "INVOLUNTARY" BEHAVIOR AS ILLUSTRATED BY COMPLIANCE IN INTERROGATION, by A. D. Biderman. [1958] [28]p. incl. refs. [AF 49(638)727] Unclassified

Published in Sociometry, v. 23: 120-147, Mar. 1960.

Some social-psychological aspects of the situation of a prisoner confronting enemy interrogration are interpreted as accounting in part for the observation in recent wars that almost all prisoners converse with interrogators, despite rigid orders to the contrary. The interpretations are based primarily on an analysis of the interrogation experience of 235 Air Force personnel returned from captivity in China and North Korea, with special reliance on a content analysis of 203 interviews with cases repatriated at the close of the Korean War. The discussed aspects of interrogation are not distinctive to experiences of the Korean War prisoners. The study confirmed the conclusion that a prisoner is unable to maintain silence in the face of intensive interrogation.

142

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

INTRODUCTION—MANIPULATIONS OF HUMAN BEHAVIOR, by A. D. Biderman and H. Zimmer. [1960] [18]p. incl. refs. [AF 49(638)727] Unclassified

Published in The Manipulation of Human Behavior, ed. by A. D. Biderman and H. Zimmer, New York, John Wiley and Sons, Inc., 1961, p. 1-18.

Both scholarly and popular literature have written about the dangers of scientific developments that could be used to control and manipulate human behavior. The aim of this book is to give a critical examination of some of the conjectures about the application of scientific knowledge to manipulate human behavior with particular reference to the interrogation of an unwilling subject. Specific references are given with regard to the background, origin of nonrational concern, myth and reality, focus on objective behavior, scientific purpose, sources, and scope.

143

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

A SELECTED BIBLIOGRAPHY ON CAPTIVITY BEHAVIOR, by A. D. Biderman, B. S. Heller, and P. Epstein. Feb. 1961 [45]p. incl. refs. (BSSR Research rept. no. 339-1) (AFOSR-295) (AF 49(638)727) AD 253964; PB 155316 Unclassified

The bibliography lists titles reviewed during a study of the implications for the social sciences of knowledge developed in studies of prisoners of war, political prisoners, concentration camp prisoners, and civilian internees. The study focuses on material concerning American prisoners during the Korean War, but literature on earlier and subsequent events is also reviewed. (Contractor's abstract, modified)

144

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

CULTURAL MODELS OF CAPTIVITY RELATIONSHIPS, by A. D. Biderman. Feb. 1961 [56]p. incl. refs. (BSSR Research rept. no. 339-4) (AFOSR-452) (AF 49(638)-727) AD 257325 Unclassified

The behavior of captives is in large measure dependent upon their conceptions of what social roles are appropriate to the unfamiliar situations they encounter. These situations are also shaped in important ways by cultural conceptions of the captor regarding the status of his captives. The present report reviews some of the historical and traditional elements of the cultures of captor and captives that have important direct effects on these role conceptions. Some possible implications of the discussion for the training of armed forces personnel for the event of capture are indicated. The report was prepared as part of a critical review of studies of prisoners of war, concentration camp prisoners, and political prisoners. The study examined the relevance of this literature for the social sciences. The emphasis in the present report, as in the larger study, was on works dealing with the Korean war. (Contractor's abstract)

145

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

DEATH AS A CRITERION IN THE STUDY OF EXTREME CAPTIVITY SITUATIONS, by A. D. Biderman. Feb. 1961 [55]p. (BSSR Research rept. no. 339-3) (AFOSR-453) (AF 49(638)727) AD 254487
Unclassified

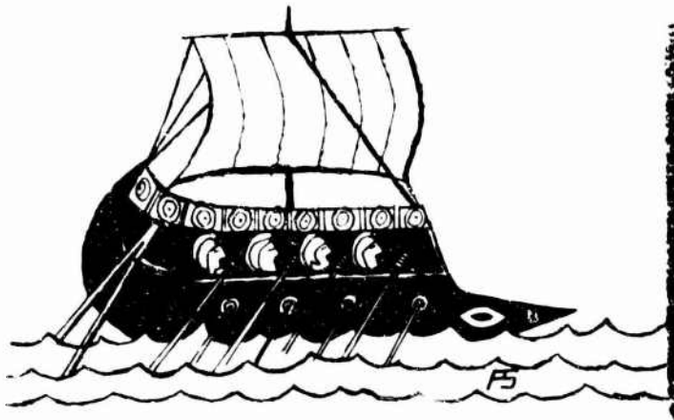
Some questions raised in previous evaluations and interpretations of fatalities among American prisoners of war in Korea are examined by reference to studies of other historical cases of stressful captivity and by some reanalysis of Korean War data. The paper considers effects on survival of the following: individual and cultural concepts of survival requirements, modes of adaptation to privation, social background characteristics, and forms of prisoner organization. The adequacy of data and frequently employed theoretical formulations in which death is the criterion are also considered in relation to generalizations regarding these relationships. The paper is a preliminary effort in a larger study considering the relevance for the social sciences of knowledge developed by studies of extreme captivity situations. (Contractor's abstract)

146

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

THE RELEVANCE FOR THE SOCIAL SCIENCES OF KNOWLEDGE DERIVED FROM STUDIES OF STRESSFUL CAPTIVITY, by A. D. Biderman and E. H. Schein. Mar. 1961 [26]p. (BSSR Research rept. no. 339-2) (AFOSR-454) (AF 49(638)727) AD 253365; PB 155460
Unclassified

An outline is given of major topics treated in accounts and studies of conditions of stressful captivity that are relevant to the social sciences. It is focused on studies of Americans who were prisoners during the Korean War, however, it also considered in the context of the broad literature that exists on prisoners of war, concentration camp prisoners, and political prisoners. The topics are: (1) Cultural models of captivity relationships; (2) physical privation in captivity; (3) captivity as an incomplete social situation; (4) captor-captive relationships; (5) prisoner societies; (6) psychological self-maintenance and change; and (7) post-captivity problems. Numerous references (see item no 143, Vol. V) are given under each discussion. The present study will be employed in a larger work which attempts to analyze and integrate the present and potential contributions of studies of stressful captivity situations to social science knowledge.





147

California Inst. of Tech., Pasadena.

NUMERICAL EVALUATION OF X-RAY ABSORPTION FACTORS FOR CYLINDRICAL SAMPLES AND ANNULAR SAMPLE CELLS, by H. H. Paalman and C. J. Pings. [1961] [5]p. incl. diagrs. table. (AFOSR-3793) (Bound with its AFOSR-2428, as Appendix B) (In cooperation with Stanford U., Calif.) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)800], National Science Foundation, and Office of Naval Research) AD 400068 Unclassified

Also published in Jour. Appl. Phys., v. 33: 2635-2639, Aug. 1962.

An analysis is presented for the absorption corrections necessary for the x-ray analysis of diffraction data from a liquid sample confined within a cylindrical sample cell. The evaluation of necessary absorption integrals has been formulated in a numerical calculus procedure appropriate for a digital computer. The procedure has been verified against previous graphical computations. (Contractor's abstract)

148

California Inst. of Tech., Pasadena.

BERYLLIUM SAMPLE CELL FOR X-RAY DIFFRACTION STUDY OF LIQUIDS, by H. H. Paalman and C. J. Pings. [1961] 4p. (Bound with its AFOSR-2428, as Appendix A) (AFOSR-J5) (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 400075 Unclassified

Also published in Rev. Scient. Instr., v. 33: 496-497, Apr. 1962.

A description is presented of a cylindrical beryllium sample cell which has been used successfully for an extensive set of x-ray diffraction measurements on a sample of liquid nitrogen confined at 100 psi and -193°. The central portion of the cell is the active sample area which is irradiated during the experiments. To the right and left are somewhat larger cylindrical sections which fit snugly into a cell holder. These latter areas affect thermal communication between the sample and a liquid nitrogen heat sink. The left section serves as a thermocouple well which permits positioning a thermocouple within 0.04 in. of the sample cavity. At the extreme right end of the assembly is a collar which is required for a pressure seal. An estimate of the x-ray absorption within the cell is obtained by considering a beam scattered from the axis of the cylindrical sample. For this case the x-ray attenuation was calculated to be 20%, using a mass absorption coefficient of 1.35.

149

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

RADIATION FROM AN ELECTRIC DIPOLE IN AN ANISOTROPIC COLD PLASMA, by H. H. Kuehl. Oct. 1960, 54p. incl. illus. (Technical rept. no. 24) (AFOSR-TN-60-1169) (AF 18(600)1113) AD 246496 Unclassified

The general expression for the far-zone dyadic Green's function in an anisotropic medium is presented. The radiation of an electric dipole in a cold plasma is considered. Expressions for the far-zone radiation from a dipole for the case of weak magnetic field and low plasma density are derived. Expressions are also obtained for the case of an infinite magnetic field. (Contractor's abstract)

150

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

MEASUREMENTS ON THE ASYMMETRICALLY-EXCITED PROLATE SPHEROIDAL ANTENNA, by H. H. Kuehl. [1960] [3]p. incl. illus. diagrs. (AF 18-(600)1113) Unclassified

Published in I.R.E. Trans. on Antennas and Propagation, v. AP-9: 105-107, Jan. 1961.

An experimental study is reported on the asymmetrically-fed prolate spheroidal antenna. The measurements presented were made on a spheroidal antenna operated in the receiving state and the detecting equipment was contained within the antenna so that the usual rf transmission line was not necessary to carry the signal from the antenna. The "gap" is a polystyrene ring through which the impinging radiation travels. Two circular metal plates on either side of the "gap" form a radial transmission line which guides the received energy to the detector within the antenna. Experimental and theoretical patterns of the far zone electric field are shown for the 3 positions of the gap. It is estimated that the experimental error in the measurements is less than 2%.

151

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

THE INCOHERENT SCATTERING OF ELECTROMAGNETIC WAVES BY FREE ELECTRONS, by C. H. Papas and K. S. H. Lee. Aug. 1961, 14p. incl. diagrs. (Technical rept. no. 26) (AFOSR-1330) (AF 18(600)1113) AD 266260 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: 1204-1215, 1962.

The incoherent scattering of an electromagnetic wave by free electrons is examined theoretically. Under the assumption that the electrons have a Maxwellian

velocity distribution, the scattered power and its frequency spectrum are calculated. The applicability of these results of ionospheric and laboratory plasmas is discussed. (Contractor's abstract)

152

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

COMPARATIVE EXPERIMENTAL AND THEORETICAL STUDIES OF THE FLUTTER OF FLAT PANELS IN A LOW SUPERSONIC FLOW, by M. H. Lock and Y. C. Fung. Final rept. [May 1961] 80p. incl. illus. diagrs. tables, refs. (AFOSR-670) (AF 49(638)220) Unclassified

A series of panel flutter experiments were performed in the GALCIT transonic wind tunnel. The preflutter panel motion and the motion during flutter were studied in detail. Flutter boundaries were obtained between Mach numbers 1.15 and 1.5. Three analytical studies of the flutter phenomenon, based upon conventional assumptions, are presented which facilitate comparison between theory and experiment. A detailed comparison between the theoretical and experimental results reveals considerable disagreement in the flutter boundaries at supersonic Mach numbers less than 1.4. The agreement between theory and experiment improves at the higher Mach numbers. The theory appears inadequate for the prediction of flutter boundaries at the lower supersonic Mach numbers. A possible cause of this inadequacy of the theory is discussed. (Contractor's abstract)

153

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

SUPERSONIC FLUTTER OF A CYLINDRICAL SHELL OF FINITE LENGTH IN AN AXISYMMETRICAL MODE, by H. Krumhaar. Oct. 1961, 78p. incl diagrs. refs. (GALCIT rept. no. 95) (AFOSR-1574) (AF 49(638)220) AD 268497 Unclassified

Also published in Internat'l. Jour. Solids and Structures, v. 1: 23-57, 1965.

The flutter in an axisymmetrical mode of a simply supported cylindrical shell is studied. The linearized Timoshenko shell equations and linear piston theory lead to a non-self-adjoint eigenvalue problem, which has been solved without further approximations. Using these exact solutions two checks can be made. A comparison of the exact result with those obtained by Galerkin's method proves whether or not this method is reliable if applied to the present eigenvalue problem. On the other hand, a comparison of the exact results with experimental data will prove whether or not the basic physical assumptions are satisfactory. (Contractor's abstract)

154

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

BLUNT BODY THEORY FOR HYPERSONIC FLOW, by K. Hida. Jan. 1961 [27]p. incl. diagrs. table. (AFOSR-204) (AF 49(638)476) AD 262022 Unclassified

A systematic analysis of Newtonian flow past an axisymmetrical blunt body is developed by expanding various physical quantities in power series of $\lambda = (\gamma-1)/(\gamma+1)$, where γ stands for the ratio of specific heats of a gas. Some general results such as stand-off distance, pressure distribution along the axis of symmetry are given, provided that the shock is detached and has finite curvature at its nose. More extensive calculations are made for the flow past a flat-faced disc and power-law bodies. (Contractor's abstract)

154A

California Inst. of Tech. [Guggenheim Aeronautical Lab.] Pasadena.

ON A DIVERGENT INTEGRAL IN MAGNETOHYDRODYNAMICS, by D. MacGillivray. [1961] [8]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)476 and National Aeronautics and Space Administration) Unclassified

Published in Arch. Rational Mech. and Anal., v. 9: 145-152, 1962.

An asymptotic expansion is sought for a 2-dimensional steady flow of an incompressible viscous fluid possessing finite electrical conductivity. Navier-Stokes equations are assumed to describe the physical problem and a reasonable asymptotic expansion constructed.

155

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. (AF 49(638)476) Unclassified

Presented at ARS Internat'l. Hypersonics Conf., Cambridge, Mass., Aug. 16-18, 1961.

Also published in Prog. in Astronaut. and Rocketry, v. 7: 321-343, 1962.

Newtonian theory is worked out for a flat plate normal to a hypersonic stream. For a slender flat wing the results are applied in spanwise strips and heat transfer is calculated on the basis of boundary layer theory. Fair agreement with experiments on delta wings at angle of attack near 90° is found. (Contractor's abstract)

156

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

STOKES FLOW PAST AN AXIALLY SYMMETRIC BODY IN A CYLINDRICAL TUBE IN THE PRESENCE OF A MAGNETIC FIELD, by I.-D. Chang. [1961] [15]p. incl. diagr. table. (Publ. no. 512) (AFOSR-4215) (AF 49(638)521) Unclassified

Also published in Jour. Math. and Phys., v. 40: 205-219, Oct. 1961.

Consideration is given the motion within a fluid-filled tube of an axially symmetric body. The fluid is incompressible, viscous and electrically conducting; the magnetic field is along the axis of the tube and both the Reynolds number and magnetic Reynolds number are assumed to be small. The author's purpose is to derive a drag formula which accounts for the effect of the wall. The resultant formula is $D = D_0(1 + \frac{D_0 M}{16\pi\rho\nu a U} + \frac{\varkappa D_0}{2\pi\rho\nu UR} + \cdots$, where M is the Hartman number, R is the tube radius and $\varkappa$ is a known function of MR. (Math. Rev. abstract)

157

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

NAVIER-STOKES SOLUTIONS AT LARGE DISTANCES FROM A FINITE BODY, by I.-D. Chang. [1961] [66]p. incl. diagr. refs. (Publ. no. 508) (AFOSR-4216) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)521 and Office of Naval Research under Nonr-22029) Unclassified

Also published in Jour. Math. and Mech., v. 10: 811-876, Nov. 1961.

A theoretical investigation is made of the flow field at large distances from an object moving through a viscous fluid. The discussion is restricted to the case of 2-dimensional stationary incompressible flow. The object will be assumed to be of finite size. The domain of the fluid is infinite and it is assumed that there are no other boundaries for the fluid except that of the given object.

158

California Inst. of Tech. [Guggenheim Aeronautical Lab.] Pasadena.

UNIFORMLY VALID ASYMPTOTIC APPROXIMATIONS FOR CERTAIN NON-LINEAR DIFFERENTIAL EQUATIONS, by J. D. Cole and J. Kevorkian. [1961] [8]p. (AF 49(638)521) Unclassified

Published in Proc. Internat'l. Symposium on Nonlinear Differential Equations and Nonlinear Mechanics, Air Force Academy, Colorado Springs, Colo. (July 31-Aug. 4, 1961), New York, Academic Press, 1963, p. 113-120.

Various physical problems lead to differential equations characterized by the presence of a small force active for a long time. It is often useful to be able to construct an approximation which is a good representation of the solution for the complete time interval $0 < t < \infty$. In this note a new method is presented which utilizes an expansion in terms of 2 or more time scales. This method is applicable when the overall behavior of the solution is sufficiently well known. The various time scales have significance also for nonlinear systems since they are formed of combinations of the physical constants (with dimensions) which enter the description of the phenomena. The small parameter, ϵ, of the problem can be expressed as a ratio of 2 significant time scales. The explicit introduction of several time scales changes the original ordinary differential equation into what is formally a partial differential equation, which can be exploited in several ways. The solution to this equation is expanded in a suitable series, each term of which satisfies an ordinary differential equation. In this note the method is applied to several simple examples. The advantage of the present method is its simplicity especially for computing higher approximations and its applicability to a large class of problems for which the motion is bounded for large times.

159

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

SOME REMARKS ON INTEGRAL MOMENT METHODS FOR LAMINAR BOUNDARY LAYERS WITH APPLICATION TO SEPARATION AND REATTACHMENT, by L. Lees and B. L. Reeves. Dec. 31, 1961, 10p. incl. diagrs. table. (AFOSR-1920) (AF 49(638)916) AD 275557 Unclassified

It is pointed out that the Kármán-Pohlhausen integral method may be completely inadequate for the analysis of laminar boundary layers in regions of adverse pressure gradient, particularly downstream of separation, between the separation and reattachment points. It is suggested that an integral method is needed which exhibits velocity profiles containing reverse-flow for vanishingly small adverse pressure gradients analogous to the "lower branch" solutions of the Falkner-Skan equation, which were found by Stewartson. The present report demonstrates that the method first proposed by Walz and modified by Tani produces velocity profiles with reverse flow, even in the limit of constant pressure, and appears to be a promising method for predicting the behavior of separated flows.

160

California Inst. of Tech. [Guggenheim Aeronautical Lab.] Pasadena.

SIMILAR SOLUTIONS OF THE FREE CONVECTION

BOUNDARY LAYER EQUATIONS FOR AN ELECTRICALLY CONDUCTING FLUID, by B. L. Reeves. [1961] [2]p. (AFOSR-3397) (AF 49(638)916) Unclassified

Also published in ARS Jour., v. 31: 557-558, Apr. 1961.

An analysis is presented of the free convection boundary layer adjacent to a vertical plate with uniform surface temperature, where the surrounding medium is an electrically conducting fluid. It is shown that, as in the case of a nonconducting fluid, an entire class of similar solutions exists also for a conducting fluid.

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

EXPERIMENTS ON CARBON FORMATION FROM HYDROCARBONS BEHIND INCIDENT AND REFLECTED SHOCK FRONTS, by S. S. Penner, E. N. Bennett and others. [1961] [38]p. incl. illus. diagrs. refs. (AF 18(603)2) Unclassified

Published in Fundamental Data Obtained from Shock-Tube Experiments, ed. by A. Ferri. London, Pergamon Press, 1961, p. 183-220. (NATO AGARDograph no. 41)

One of the theories of carbon formation from hydrocarbons involves the assumption that carbon formation is preceded by the production of acetylene as an intermediate step. Slow pyrolysis (i. e. heating of acetylene with maintenance of chemical equilibrium to decomposition temperatures) often involves heterogeneous processes and usually leads to a variety of polymerization reactions. The shock tube provides a unique tool for preparing hydrocarbons, under uniform conditions, at elevated temperatures where the decompositions and/or polymerization rates may be studied conveniently. The following experimental studies on carbon formation are reported: (1) thermodynamic calculations on carbon formation from acetylene; (2) estimates for the temperature rise associated with the decomposition of acetylene; (3) thermodynamic calculations on carbon formation from methane, n-heptane, and benzene using equilibrium values of γ; (4) calculation of the minimum time at temperature T_5 behind a reflected shock wave; (5) description of apparatus and procedure for the study of acetylene decomposition; and (6) experimental results of the studies.

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

CONSTANT-TEMPERATURE MAGNETO-GASDYNAMIC CHANNEL FLOW, by J. L. Kerrebrock and F. E. Marble. [1959] [1]p. [AF 49(638)758] Unclassified

Published in Jour. Aero Space Sci., v. 27: 78, Jan. 1960.

Some simple algebraic solutions of magneto-gasdynamic channel flow are developed for the case of a constant temperature plasma. The solutions serve as free stream boundary conditions for investigations of the boundary layer in a plasma accelerator.

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

SIMILAR SOLUTIONS FOR BOUNDARY LAYERS IN CONSTANT-TEMPERATURE MAGNETO-GASDYNAMIC CHANNEL FLOW, by J. L. Kerrebrock. [1959] [2]p. [AF 49(638)758] Unclassified

Published in Jour. Aero/Space Sci., v. 27: 156-157, Feb. 1960.

The boundary layer equations are considered for a viscous, compressible heat conducting, electrically conducting gas moving near a wall in the presence of a magnetic field whose direction is perpendicular to that of the stream. Among others it is assumed that the magnetic Reynolds number is low enough for the induction to be prescribed, that the wall temperature is constant, and that the Mach number is small. It is shown that similar solutions exist for both the thermal and velocity boundary layers. A brief discussion on the relevance of this work to boundary layer growth on the walls of plasma accelerators is given. (Math. Rev. abstract)

164

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

CONDUCTION IN GASES WITH ELEVATED ELECTRON TEMPERATURE, by J. L. Kerrebrock. [1961] [20]p. incl. illus. diagrs. tables. (AF 49-(638)758) Unclassified

Published in Engineering Aspects of Magnetohydrodynamics; Proc. Second Symposium, Philadelphia, Pa. (Mar. 9-10, 1961) New York, Columbia U. Press, 1962, p. 327-346.

A simple theory of nonequilibrium conduction in ionized gases has been developed which accounts for the elevation of the electron temperature by energy gain in the electric field. It is assumed that the ionization is in equilibrium at the electron temperature. The theory yields a modified Ohm's law such that the current density varies as a power of the electric field. The power is unity for gases at high temperatures, but can be very large at low gas temperatures. Measurements carried out with hot tantalum electrodes in an argon-potassium plasma at temperatures between 1500° and 2500°K, at atmospheric pressure, agree with the predicted variations of the

conductivity with both current density and gas temperature. This is regarded as a verification of the assumption of ionization equilibrium at the electron temperature. (Contractor's abstract)

165

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

IONIZATION RATES IN SHOCK HEATED ARGON—EFFECT OF IMPURITIES (Abstract), by R. G. Jahn. [1961] [1]p. (Bound with its AFOSR-582; AD 257892) (AF 49(638)758) Unclassified

Presented at Fourth annual AFOSR Contractors' meeting on Ion and Plasma Acceleration, Beverly Hills, Calif., Apr. 20-21, 1961.

Argon initially at room temperatures and 5mm pressure is heated suddenly to atomic temperatures between 5500 and 9000°K by the passage of shock waves of Mach number 7.5 to 9.2. The subsequent relaxation to ionization equilibrium is observed by a transverse probing 24.0 kmc microwave beam which interacts with the free electron components in the ionized gas. The reflection and transmission amplitude of the beam as a function of time after passage of the shock are recorded on a dual-beam oscilloscope. From this data the electron density and collision frequency and the rate of ionization can be evaluated. Small amounts of air from a few parts per million to 3/10 of 1% have been added as a controlled impurity and are found to increase the ionization rate substantially.

166

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

CONSIDERATION OF SOME ELECTRONIC COMPONENTS IN SHOCK TUBE INSTRUMENTATION, by T. A. Jacobs. Feb. 1961, 16p. incl. illus. (Technical rept. no. 2) (AFOSR-285) (AF 49(638)984) AD 253461; PB 155485 Unclassified

Descriptions are presented of certain electronic components employed during the course of shock tube radiation measurements. Radiation detectors, including infrared, visual and ultraviolet, are discussed. Shock velocity measurements are presented. (Contractor's abstract)

167

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

SPECTROSCOPIC METHODS OF TEMPERATURE MEASUREMENTS, by S. S. Penner. Mar. 1961, 39p. incl. diagrs. refs. (Technical rept. no. 1) (AFOSR-286) (AF 49(638)984) AD 253371; PB 155441 Unclassified

Also published in Temperature, Its Measurement and Control in Science and Industry, a Symposium, Columbus, Ohio (Mar. 27-31, 1961), New York, Reinhold, v. 3 (Pt. 1):561-574, 1962.

Spectroscopic methods for temperature measurements are described with special reference to techniques that can be used if observation times are of the order of a msec or less. Recently developed procedures for reconstructing temperature profiles in systems with axial symmetry are also described. (Contractor's abstract)

168

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

FURTHER SHOCK-TUBE STUDIES OF THE HOMOGENEOUS DECOMPOSITION OF NH_3, by T. A. Jacobs. Oct. 1961 [13]p. incl. diagrs. (Technical rept. no. 3) (AFOSR-1471) (AF 49(638)984) AD 266412 Unclassified

The rate of decomposition of NH_3 in Ar was measured between 2000 to 3000°K by following the rate of decrease of NH_3 emission intensity in the 2.7 to 3.2 micron wavelength region. Data indicated that the thermal decomposition of NH_3 follows a kinetic law given by $d(NH_3)/dt = k\,(NH_3)^{3/2}\,(Ar)^{1/2}$ where $k = (2.5 \times 10^{13})\, e^{-77,700/RT}$ liters/mole-sec.

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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. Patch, W. [L.] Shackleford, and S. S. Penner. Nov. 1961, 17p. incl. diagrs. (Technical rept. no. 4) (AFOSR-1624) (AF 49(638)984) AD 266740 Unclassified

Also published in Jour. Quant. Spectros. and Radiative Transfer, v. 2: 263-271, July/Sept. 1962.

The spectral absorption coefficients in electronic band systems of diatomic emitters were computed in the past by models that may be described as the just overlapping line model and a model utilizing a smeared out rotational structure. Although basic relations are obtained by utilizing somewhat different physical arguments, the resulting equations are, in fact, identical. Spectral absorption coefficients were calculated for the NO γ-bands at 2000°K by using the approximate theoretical relations. The calculated results are in good agreement with estimates derived by numerical calculations in which, however, the absorption coefficient data were averaged over intervals of 1/2000 cm. (Contractor's abstract)

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

PRELIMINARY STUDIES ON THE SPECTRUM OF Ti I EMITTED BEHIND REFLECTED SHOCK WAVES IN $TiCl_4$-Ar MIXTURES, PART A. APPROXIMATE CONTINUOUS OPACITY CALCULATIONS FOR IONIZED TITANIUM AND CHROMIUM, PART B, by W. L. Shackleford. Dec. 1961, 1v. incl. illus. tables, refs. (Technical rept. no. 5) (AFOSR-1738) (AF 49(638)984) AD 269010 Unclassified

Part B also published in Jour. Quant. Spectros. and Radiative Transfer, v. 2: 93-98, Jan./Mar. 1962.

Part A: Time integrated emission spectra from a shock tube containing $TiCl_4$-Ar mixtures were photographed and several Ti I lines were identified. Self absorption could not be sufficiently reduced to permit temperature measurements from relative line intensities. Investigations of shock-heated $Cr(CO)_6$-Ar mixtures are in progress. PART B: The technique of Raizer, as modified by Pappert and Penner, was applied to the approximate calculation of the Rosseland and Planck mean free paths for titanium and chromium continuum radiation. The method involves use of unscreened hydrogenic transition probabilities and replacement of the summation over discrete levels by an integration. (Contractor's abstract)

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

A PRELIMINARY STUDY OF NEUTRAL TITANIUM EMISSION BEHIND REFLECTED SHOCK WAVES IN $TiCl_4$-Ar MIXTURES, by W. L. Shackleford. [1961] [2]p. (AFOSR-J98) (AF 49(638)984) AD 400062 Unclassified

Also published in Jour. Quant. Spectros. and Radiative Transfer, v. 2: 245-246, Apr./June 1962.

Mixtures of $TiCl_4$ and argon were subjected to incident and reflected shock waves and the time integrated spectra of the visible radiation emitted axially through the end of the tube were photographed. The more dilute mixtures yielded spectra showing several multiplets of neutral titanium at the highest Mach numbers used. Under these conditions, the gas behind the reflected shock was completely dissociated and partially ionized at a temperature of about 8000°K. Weaker shocks and shocks in mixtures containing higher $TiCl_4$ concentrations produced only background and impurity radiation (because of the lower shock temperatures). Relative line intensity measurements showed that the observed spectral lines were heavily self-absorbed, and therefore, were not suitable for color temperature of f-number measurements.

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[California Inst. of Tech.] Palomar Observatory, Pasadena.

THE ORIGIN OF THE SOLAR SYSTEM, by A. G. W. Cameron. [1960] 6p. (In cooperation with Mount Wilson Observatory, Pasadena, Calif.) (AF 49(638)-21) Unclassified

Published in Problems Related to Interplanetary Matter; Proc. Informal Conf., Highland Park, Ill. (June 20-22, 1960), Washington, National Academy of Sciences—National Research Council, 1961, p. 1-6. (AFOSR-721)

The solar system could have been formed from neutron sources of moderate power in a variety of ways. It is suggested that the N^{22} (α, n) Mg^{25} reaction is the principal source of neutrons for the building of heavy elements. With this assumption, together with others regarding a time scale such as the age of the galaxy, a process by which the sun and planets could have been formed is outlined.

173

California Inst. of Tech. Palomar Observatory, Pasadena.

THE ATMOSPHERES OF TWO B-TYPE STARS IN THE GALACTIC HALO, by G. Traving. [1961] [20]p. incl. diagrs. tables, refs. (AFOSR-50) (In cooperation with Mount Wilson Observatory, Pasadena, Calif.) (AF 49(638)21) AD 612344 Unclassified

Also published in Astrophys. Jour., v. 135: 439-458, 1962.

Spectra of 2 B-type stars (+33°2642, which is at a galactic latitude of 49°, and Barnard 29, a member of the globular cluster M13) have been analyzed by using the method of coarse analysis. In +33°2642 the relative abundance of He is approximately the same as in the main-sequence star τ Sco, whereas the heavier elements C, N, O, Mg, and Si are less abundant by a factor of 5-10. In Barnard 29, for which only lower-dispersion spectra were available, only the He/H ratio could be determined. Compared with τ Sco, it is smaller by a factor of 2. The colors of both stars are the same and correspond to spectral type B2. The procedure followed in this rough analysis is based on a generalization of the methods of Unsöld. In addition, the theory of line broadening is discussed, for H and He I. The ionization temperature, derived from the measured strength of the Si III lines combined with the absence of the strongest lines of Si II and Si IV, was found to be $0.265 < \theta_i < 0.295$. The electron densities from the broadening of H and He I lines, are log N = 13.32 (BD + 33°2642) and log N = 13.60 (Barnard 29). The surface gravities are smaller than for main-sequence B stars, log g = 2.34 and log g = 2.66. Using the known distance modulus of Barnard 29, we obtain its mass, $0.2\ \mu\odot \leq \mu B_{29} \leq \mu\odot$, which is extremely low. The uncertainty arises mainly from insufficient knowledge of turbulent velocities in the atmosphere. (Contractor's abstract)

174

California Inst. of Tech. Palomar Observatory, Pasadena.

THE CIRCUMSTELLAR ENVELOPE OF RHO CASSIOPEIAE. by W. L. W. Sargent. July 1961 [20]p. incl. diagrs. tables, refs. (AFOSR-126) (In cooperation with Mount Wilson Observatory, Pasadena, Calif.) (AF 49(638)21) AD 261992 Unclassified

Also published in Astrophys. Jour., v. 134: 142-160, July 1961.

It has been found that ρ Cas is surrounded by a shell which is expanding at ~40 km/sec relative to the photosphere. Absorption lines of Fe I, Ni I, and Ca I are formed in the shell. Variations in the strengths of these lines are attributed to variations in the mass of the shell. From galactic rotation, we find $M_{bol} = -5.5$. The radius is about 700 $R_\odot$ and the mass about 25 $M_\odot$. The emission and absorption lines of Ca I indicate a small geometrical dilution (0.1 - 0.01) in the shell. A curve-of-growth analysis shows it to be composed of neutral hydrogen having a density of $\sim 10^{10}$ H atoms/cm^3. The excitation temperature in the shell is ~3500°; the ionization temperature is ~4000°. The turbulent velocities in the shell and in the photosphere are estimated both from the curves of growth and from the line profiles. In the shell both methods lead to a microturbulent velocity of 7 km/sec. In the reversing layer the macroturbulent velocity is 20 km/sec for ionized and 14 km/sec for neutral atoms. The microturbulent velocity is 10 km/sec for zero volt neutral lines and decreases to 6 km/sec with increasing excitation. A pronounced weakness in the Balmer absorption lines is attributed to their being filled in by emission arising in a chromosphere which lies between the reversing layer and the cool shell. There is insufficient Lyman continuum radiation from ρ Cas to heat the chromosphere, which must therefore be heated by the dissipation of mechanical energy. The flux of turbulent energy is probably sufficient. It is found that ρ Cas is losing mass at a rate of 10^{-6} stellar masses per year. The ejection is sporadic, although the rate quoted may be comparable with the mean rate.

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California Inst. of Tech. Palomar Observatory, Pasadena.

THE EXISTENCE OF He^3 IN 3 CENTAURI A, by W. L. W. Sargent and J. Jugaku. [1961] [6]p. incl. diagr. tables, refs. (AFOSR-502) (In cooperation with Mount Wilson Observatory, Pasadena) (AF 49-(638)21) AD 612333 Unclassified

Also published in Astrophys. Jour., v. 134: 777-782, Nov. 1961.

The positions of 10 He I lines have been measured on 5 high-dispersion plates of 3 Centauri A (B4p) Some of the lines are displaced longward of their normal wavelengths by up to 0.39 A. There is a good correlation between the observed shifts and the isotope shifts for He^3. On comparing the displacements in 3 Centauri with those measured in other B stars, it is concluded that the Stark effect cannot produce shifts of the magnitude observed in 3 Centauri. Using the simple approximation that the observed displacements are proportional to the ratio $He^3/He^3 + He^4$, it is found that this ratio in 3 Centauri is 0.84 ± 0.10. From a study of the profile of $H\gamma$ measured on 3 plates, it is found that the ratio deuterium: hydrogen is less than about 0.01. Some possible ways in which He^3 could be produced in large quantities in the atmosphere of 3 Centauri are considered. (Contractor's abstract)

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California Inst. of Tech. Palomar Observatory, Pasadena.

THE SPECTRUM OF α SCULPTORIS, by J. Jugaku and W. L. W. Sargent. [1961] [7]p. incl. tables, refs. (AFOSR-586) (In cooperation with Mount Wilson Observatory, Pasadena, Calif.) (AF 49(638)21) AD 612334 Unclassified

Also published in Publ. Astronom. Soc. Pacific, v. 73: 249-255, Aug. 1961.

Studies of the spectrum of α Sculptoris resulted in the following conclusions: (1) α Sculptoris is a star of spectral type about B4 V; (2) it may be a spectrum variable; (3) oxygen and helium are underabundant by a factor of about five; and (4) chromium, titanium, and strontium are overabundant by an undetermined factor. The stars α Sculptoris and 3 Centauri appear to be the hottest objects whose spectra contain anomalous line intensities similar to those in the peculiar A stars. However, the peculiarities in the two stars are remarkably different. Thus, 3 Centauri has strong N II lines and normal C II lines, whereas the reverse is the case in α Sculptoris. In 3 Centauri phosphorus is overabundant by a factor of about 100 whereas in α Sculptoris phosphorus lines are not observed at all. In α Sculptoris some of the iron peak elements are enhanced; in 3 Centauri lines of Ti II and Cr II are not observed. Weak lines of S II are observed in α Sculptoris but not in 3 Centauri. The two stars resemble each other in two respects—they both have He I and O I lines that are far too weak.

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California Inst. of Tech. Palomar Observatory, Pasadena.

THE FORMATION OF THE SUN AND PLANETS, by A. G. W. Cameron. Feb. 1961, 106p. incl. tables, refs. (AFOSR-726) (In cooperation with Mount Wilson Observatory, Pasadena, Calif.) (AF 49(638)21) AD 289469 Unclassified

Also published in Icarus, v. 1: 13-69, 1962.

The evidence concerning the presence of the products of extinct radioactivities in meteorites and in the atmosphere is reviewed and analyzed. The radioactive

content of the interstellar medium depends on the history of galactic nucleosynthesis. Some mechanisms of nucleosynthesis are reviewed, and it is shown that the elements can be divided into products of primary and secondary processes. A model of the stellar activity throughout galactic history is devised, and its parameters are determined by the abundances of the uranium and thorium isotopes. In this model stellar activity decreases exponentially with time, but there is a localized increase immediately prior to formation of the solar system. A chronology is then deduced for events associated with the early history of the solar system, based on the assumption that Al^{26} may have been required to melt iron in the meteorite parent bodies. Some physical processes probably associated with the formation of the solar system are discussed. It appears that an interstellar cloud must be fairly dense and massive before it can undergo gravitational collapse. It also appears likely that it will attain instability through the action of an unusually large external pressure. The collapse and fragmentation of the cloud requires of the order of 10^6 yr, after which the subsequent evolution of the protostars becomes very rapid.

178

California Inst. of Tech. Palomar Observatory, Pasadena.

AN ABUNDANCE ANALYSIS OF 3 CENTAURI, by J. Jugaku, W. L. W. Sargent, and J. L. Greenstein. [1961] [14]p. incl. diagrs. tables, refs. (AFOSR-871) (In cooperation with Mount Wilson Observatory, Pasadena, Calif.) (AF 49(638)21) AD 611515 Unclassified

Also published in Astrophys. Jour., v. 134: 783-796, Nov. 1961.

Abundances in 3 Centauri A (B4 IV or Vp) are derived, using γ Pegasi (B2 IV) as a standard comparison star and the approximation of a single-layer atmosphere. The abundances of certain elements (P, Ca, Ga, and Kr) not observed or observed only weakly in γ Pegasi are derived relative to Si in 3 Centauri A. It is found that C, Ne, Si, A, and Ca have normal abundances. He and O are underabundant by a factor of 6 in 3 Centauri A; N is overabundant by a factor of 5; P by a factor of 100; Fe by a factor of 4; and Kr by a factor of about 1300. An identification of Ga II which is not yet certain leads to an overabundance of about 8000 for Ga. Upper limits are derived for the abundances of Al, S, Cl, Zn, Ge, As, Se, Br, Rb, and Sr. Of these, S is deficient by a factor of more than about 10. It is likely that Ga and Kr are local abundance peaks but that other elements in the same region of the periodic table could be almost as overabundant without being detected spectroscopically. It is conjectured that these abundance anomalies, together with the large concentration of He^3 reported previously, have been produced by the acceleration of particles on the surface of 3 Cen A. H. W. Babcock has not detected a regular magnetic field in the star, although it is probably related to the "manganese" stars which have magnetic fields. (Contractor's abstract)

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[California Inst. of Tech. Palomar Observatory, Pasadena]

NUCLEOSYNTHESIS DURING THE EARLY HISTORY OF THE SOLAR SYSTEM, by W. A. Fowler, J. L. Greenstein and F. Hoyle. [1961] [73]p. incl. tables, refs. (AFOSR-988) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)21], Atomic Energy Commission, and Office of Naval Research) AD 613242 Unclassified

Also published in Geophys. Jour., v. 6: 148-220, 1962.

Abundances in terrestrial and meteoritic matter indicate that the synthesis of D^2, Li^6, Li^7, Be^9, B^{10} B^{11} and possibly C^{13} and N^{15} occurred during an intermediate stage in the early history of the solar system. In this intermediate stage, the planetary material had become largely separated, but not completely, from the hydrogen which was the main constituent of primitive solar material. Appropriate physical conditions were satisfied by solid planetesimals of dimensions from 1 to 50 m consisting of silicates and oxides of the metals embedded in an icy matrix. The synthesis occurred through spallation and neutron reactions simultaneously induced in the outer layers of the planetesimals by the bombardment of high energy charged particles, mostly protons accelerated in magnetic flares at the surface of the condensing sun. The total particle energy was approximately 10^{45} ergs while the average energy was close to 500 mev per nucleon. Recent studies of the abundance of lithium in young T Tauri stars serve as the primary astronomical evidence for this point of view. The observed abundances of lithium and beryilium in the surface of the sun are discussed in terms of the astronomical and nuclear considerations brought forward.

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California Inst. of Tech. Palomar Observatory, Pasadena.

A COMPARISON OF PHOTOELECTRIC AND PHOTOGRAPHIC SPECTROPHOTOMETRY, by G. Cayrel de Strobel. Sept. 20, 1961, 7p. incl. diagrs. tables, refs. (AFOSR-1145) (In cooperation with Mount Wilson Observatory, Pasadena, Calif.) (AF 49(638)-21) AD 456571 Unclassified

Also published in Ann. Astrophys., v. 24: 509-515, Nov.-Dec. 1961.

The absolute gradients, the relative gradients, in respect with α Lyr and the Balmer discontinuities of stars measured with a photoelectric spectrum scanner by Code, Whitford, Oke and Melbourne have been compared with spectrophotographic gradients and discontinuities obtained by Chalonge and collaborators. The relative gradients in the blue region determined in these two independent ways agree, with only small errors, but disagree concerning the structure of the continuum near $H\beta$. The difference in

the zero point of the absolute scale of gradients and therefore of color temperatures, is significant. (Contractor's abstract)

181

California Inst. of Tech. [Palomar Observatory] Pasadena.

DEUTERONOMY. SYNTHESIS OF DEUTERONS AND THE LIGHT NUCLEI DURING THE EARLY HISTORY OF THE SOLAR SYSTEM, by W. A. Fowler, J. L. Greenstein, and F. Hoyle. [1961] [11p. incl. table, refs. (AFOSR-1351) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)21], Atomic Energy Commission, and Office of Naval Research) Unclassified

Presented at joint ceremonial session of the Amer. Assoc. Phys. Teachers and Amer. Phys. Soc., New York, Feb. 2, 1961.

Presented at meeting of the Astronom. Soc. Pacific, Los Angeles, Calif., June 12-14, 1961.

Also published in Amer. Jour. Phys., v. 29: 393-403, July 1961.

Abstract published in Publ. Astronom. Soc. Pacific, v. 73: 326-327, Oct. 1961. (Title varies)

Abundances in terrestrial and meteoritic matter indicate that the synthesis of deuterons and of the isotopes of lithium, beryllium, and boron occurred during an intermediate stage in the early history of the solar system. In this intermediate stage, the planetary material had become largely separated, but not completely, from the hydrogen which was the main constituent of primitive solar material. Appropriate physical conditions were satisfied by solid planetesimals with dimensions of the order of 10 m and consisting of silicates and oxides of the metals embedded in an icy matrix. The synthesis occurred through spallation and neutron reactions induced in the outer layers of the planetesimals by the bombardment of high-energy charged particles accelerated in magnetic flares at the surface of the condensing sun. The importance of the (n, α) reactions on Li^6 and B^{10} is indicated by the relatively low abundances of these two nuclei. Anomalous abundances of Xe^{129} and Ag^{107} observed in meteorites can be attributed to the decay of radioactive I^{129} and Pd^{107} produced in the planetesimals. The interval between the irradiation of the small planetesimals and the formation of large bodies in the solar system could not have exceeded 10^7 to 10^8 yr.

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California Inst. of Tech. Palomar Observatory, Pasadena.

EFFECTIVE TEMPERATURES OF F-TYPE STARS USING Hγ LINE PROFILES, by L. Searle and J. B. Oke. [1961] [12]p. incl. diagrs. tables, refs. (AFOSR-1740) (In cooperation with Mount Wilson Observatory, Pasadena, Calif.) (AF 49(638)21) AD 611516 Unclassified

Also published in Astrophys. Jour., v. 135: 790-801, May 1962.

Line profiles for the hydrogen line Hγ have been computed for a range of effective temperatures and gravities corresponding to those of F-type stars of different luminosity classes. These have been compared with observed profiles for (a) the cluster-type variables RR Lyrae and SU Draconis, (b) 2 F-type subdwarfs, and (c) the F-type stars with metal lines of normal strength-ν Herculis, η-Aquilae, and δ-Cephei. For the first 2 groups of stars, the metal lines are weak, and the continuum can be drawn unambiguously. The observed and computed profiles are in excellent agreement, and the line profiles can be used as reddening-independent temperature indicators. A comparison of these Hγ temperatures with those determined by fitting observed absolute energy distributions to fluxes computed from model atmospheres shows satisfactory agreement, provided that 1 allows for interstellar reddening. For the third group of stars, which have strong metallic lines, the evidence is strong that no true continuum is observed. The depression of the continuum is small enough in ν-Herculis (F2 II) that an estimate of the effective temperature can still be made by fitting the observed Hγ profile to those computed. At spectral types F5 or later, the continuum is depressed to such an extent that a temperature determination by Hγ fitting is not possible. (Contractor's abstract)

183

California Inst. of Tech. [Palomar Observatory] Pasadena.

HEATING OF STELLAR CHROMOSPHERES BY SHOCK WAVES, by R. Weymann. [1960] [9]p. incl. diagr. (AFOSR-J139) (AF 49(638)21) AD 400450 Unclassified

Also published in Astrophys. Jour., v. 132: 452-460, Sept. 1960.

On the basis of a very simple model for the dissipation of energy by shock waves, the structure of the chromospheres of stars with very different values of the surface gravity is discussed. Sharp jumps in the temperature at certain critical points would be expected. Reasonable chromospheric structures follow from this model for dwarfs, but not for stars of very low surface gravity unless very long-period shock waves are considered. The question of the thermal stability of the solutions is discussed. (Contractor's abstract)

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[California Inst. of Tech. Palomar Observatory, Pasadena]

ANOMALOUS ABUNDANCES OF ATMOSPHERIC

XENON RELATIVE TO METEORITIC XENON ISOTOPES (Abstract), by A. G. W. Cameron. [1961] [1]p. [AF 49(638)21] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 51, Feb. 1, 1961.

It has been found that the isotopic composition of cosmogenic xenon extracted from stone meteorites is the same except for variations in Xe^{129} (attributed to the decay of I^{129}). However, the relative isotopic composition of atmospheric xenon differs from that of meteoritic xenon in all isotopes. The largest difference is the excess of unshielded xenon isotopes in the atmosphere, attributed by Kuroda to spontaneous fission of Pu^{244} in the primitive earth. The differences in abundances of the shielded isotopes appear to require the subjection of part of the atmospheric xenon to a large moderated neutron flux. The order of magnitude of the anomalies can be accounted for if it is assumed that about 10% of atmospheric xenon has come from the sun where it has been subjected to the neutron flux associated with deuterium thermonuclear reactions. The ordinary constituents of the solar wind should be deflected away by the earth's magnetic field, but the large mass-to-charge ratio of the xenon ions may allow them to be captured into the atmosphere.

185

California Inst. of Tech. Palomar Observatory, Pasadena.

AN ANALYSIS OF THE ABSOLUTE ENERGY DISTRIBUTION IN THE SPECTRUM OF δ CEPHEI, by J. B. Oke. [1961] [8]p. incl. diagrs. tables, refs. (In cooperation with Mount Wilson Observatory, Pasadena, Calif. and Toronto U. (Canada)) [AF 49(638)21] Unclassified

Published in Astrophys. Jour., v. 134: 214-221, July 1961.

Photoelectric spectrum scans and high-dispersion spectra have been analyzed to obtain the absolute energy distributions in the spectrum of δ Cephei at various phases. Assuming an interstellar reddening of 0.11 in B - V, comparisons of these energy distributions with model atmospheres yield effective temperatures. Using fluxes from the model atmospheres, the observed absolute energy distributions, and the radial-velocity data, a mean radius of $40.3 \pm 0.8\ R_\odot$ is obtained. The radius and temperature give a mean absolute visual magnitude of -3.3. A comparison of these data with those obtained previously for η Aquilae indicates that the temperature-color relations agree if the reddening of η Aquilae is increased from 0.14 to 0.20. This increases the mean absolute visual magnitude found previously from -4.05 to -4.25. Consideration of some recently computed model atmospheres suggests the possibility that the temperatures obtained are a little too high; if this is the case, the absolute magnitudes of δ Cephei and η Aquilae should be changed to -3.2 and -4.1, respectively. A suggested relation between intrinsic color, $(B - V)_0$, and θ_e is given by equation (3); a slight modification of this equation is suggested. (Contractor's abstract)

186

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

RADIATION OF SEISMIC SURFACE-WAVES FROM FINITE MOVING SOURCES, by A. Ben-Menahem. [1960] [35]p. incl. diagrs. refs. (AF 49(638)910) Unclassified

Published in Bull. Seismol. Soc. Amer., v. 51: 401-435, July 1961.

A theory is proposed for the propagation of seismic surface-waves from finite moving sources. The method consists of obtaining, in the first place, basic solutions for surface displacements from directional sources. These solutions are integrated to obtain the effect of a moving fault with arbitrary dip angle. Displacements are evaluated for Rayleigh and Love waves at long ranges. It is shown that the dimensions of the source and the speed of rupture play an important role in the wave-pattern and cannot be ignored whenever the dimensions of the source are of the order of the radiation's dominant wavelength. It is demonstrated how this theory may lead to a derivation of the velocity of rupture and the length of faulting from seismic records of a single station. (Contractor's abstract)

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

A FAST, CONVENIENT PROGRAM FOR COMPUTATION OF SURFACE-WAVE DISPERSION CURVES IN MULTILAYERED MEDIA, by F. Press, D. G. Harkrider, and C. A. Seafeldt. [1961] [8]p. incl. diagr. tables. (AFOSR-576) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)910 and National Aeronautics and Space Administration under NAS w-6 and NAS w-81) Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 51: 495-502, Oct. 1961.

Surface wave analysis has become an important tool for exploration of crustal and mantle structure. The need exists for fast, convenient digital computer programs for computing theoretical dispersion curves and displacements for Rayleigh waves and Love waves. One such program for an IBM 7090 computer is described and made available to the scientific community. Among the conveniences are mail-order service, high speed, and choice of many options. (Contractor's abstract)

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

ELASTIC WAVE PROPAGATION IN LAYERED

ANISOTROPIC MEDIA, by D. L. Anderson. [Aug. 17, 1961] 36p. incl. diagrs. table, refs. (AFOSR-1116) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)910 and Army Research Office under DA-04-495-ORD-1808) AD 454671 Unclassified

Also published in Jour. Geophys Research, v. 66: 2953-2963, Sept. 1961.

This is an analysis of the dispersive properties of transversely isotropic media. Such anisotropy is exhibited by hexagonal crystals, sediments, planar igneous bodies, ice sheets and rolled metal sheets where the unique axis is perpendicular to the direction of surface wave propagation and the other axes are distributed randomly in the plane of the layers. Period equations are derived for Rayleigh, Stoneley and Love type waves and comparisons are made, in certain cases, with ray theoretical and plane stress solutions. Anisotropy can have quite a pronounced effect on both the range of existence and the shape of the dispersion curves and can lead to an apparent discrepancy between Love and Rayleigh wave data. Attention is focused in this initial paper on a single solid layer in vacuo (i. e., a free plate) and a solid layer in contact with a fluid halfspace. The single layer solutions can be generalized to n-layer media by the use of Haskell matrices. (Contractor's abstract)

189

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

EXPERIMENTAL DETERMINATION OF EARTHQUAKE FAULT LENGTH AND RUPTURE VELOCITY, by F. Press, A. Ben-Menahem, and M. N. Toksöz. [Aug. 17, 1961] 1v. incl. diagrs. refs. (AFOSR-1117) (AF 49(638)910) AD 454672 Unclassified

Also published in Jour. Geophys. Research, v. 66: 3471-3485, Oct. 1961.

Three methods for determining the fault parameters of length and rupture velocity are examined with ultrasonic models. The theory behind the methods is shown to have a valid though approximate basis. Oversimplified assumptions and imperfect experimental data restrict initial results to only rough indications of fault parameters. When applied to the great Chilean earthquake of May 1960, a fault length of the order of 1000 km and a rupture velocity near the speed of shear waves in crustal is found. (Contractor's abstract)

190

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

RADIATION OF SEISMIC BODY WAVES FROM A FINITE MOVING SOURCE IN THE EARTH, by A. Ben-Menahem. [1961] [6]p. incl. diagrs. refs. (AFOSR-1527) (AF 49(638)910) Unclassified

Also published in Jour. Geophys. Research, v. 67: 345-350, Jan. 1962.

Body waves from a finite moving source are investigated. Ray theory is used to obtain a long-range approximation for the surface displacements from a buried horizontal force. A weak velocity gradient in the medium is assumed, and the curvature of the earth is replaced by an equivalent additional velocity gradient. The displacements are then integrated over a finite line to simulate a disturbance moving with constant speed. Results indicate that the finiteness of the source is manifested in a factor of the form $e^{-iX}\sin X/X$ and that the derivation of the fault length and the velocity of rupture of earthquakes from the spectra of body waves is possible. The results are similar to those obtained earlier for seismic surface waves, except that for body waves X depends on both polar coordinates of the station with respect to the source. The method can be extended to other types of common faulting. (Contractor's abstract)

191

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

RELEASE OF TECTONIC STRAIN BY UNDERGROUND NUCLEAR EXPLOSIONS, by F. Press and C. Archambeau. [1961] [23]p. incl. diagrs. table, refs. (AFOSR-1538) (AF 49(638)910) Unclassified

Also published in Jour. Geophys. Research, v. 67: 337-343, Jan. 1962.

The strong excitation of horizontally polarized shear (SH) waves and other phenomena associated with underground nuclear explosions suggest the hypothesis that pre-existing tectonic strain was released by the explosion. The pertinent evidence from the Rainier explosion is reviewed. A calculation of tectonic energy release is made for a simple model in which a spherical cavity is inserted in a prestrained medium. It is tentatively concluded that, although tectonic release does occur, its magnitude is probably too small to affect the character of seismograms. Experiments are suggested which could provide the basis for a better evaluation of the hypothesis. (Contractor's abstract)

192

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

COMPUTATION OF SURFACE WAVE DISPERSION FOR MULTILAYERED ANISOTROPIC MEDIA, by D. G. Harkrider and D. L. Anderson. [1961] [12]p. incl. diagr. tables. (AFOSR-1597) (AF 49(638)910) Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 52: 321-332, Apr. 1962.

A program is described which now makes it possible to compute surface wave dispersion in a solid heterogeneous halfspace containing up to 200 anisotropic layers. Certain discrepancies in surface wave observations, such as disagreement between Love and Rayleigh wave data and other independent evidence,

suggest that anisotropy may be important in some seismological problems. In order to study the effect of anisotropy on surface wave dispersion a program was written for an IBM 7090 computer which will compute dispersion curves and displacements for Rayleigh waves in a layered halfspace in which each layer is transversely isotropic. A simple redefinition of parameters makes it possible to use existing programs to compute Love wave dispersion.

193

California Inst. of Tech. [Seismological Lab.] Pasadena.

A SPECIAL PURPOSE PROGRAM FOR EARTHQUAKE LOCATION WITH AN ELECTRONIC COMPUTER, by J. M. Nordquist. [1961] [7]p. incl. tables. (AFOSR-1598) (AF 49(638)910) Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 52: 431-437, Apr. 1962.

An electronic digital computer program has been developed for determining the source and origin time of a local earthquake by the method of least squares using the times of arrival of direct and refracted P waves at stations in the Pasadena network. Output includes the geographic coordinates and depth of the source, the origin time, direct distances from the source to each station, and the difference between observed and computed arrival time of P at each station. Limitations to the applicability of the program are discussed. (Contractor's abstract)

194

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

SOURCE-MECHANISM FROM SPECTRA OF LONG-PERIOD SEISMIC SURFACE WAVES. I. THE MONGOLIAN EARTHQUAKE OF DECEMBER 4, 1957, by A. Ben-Menahem and M. N. Toksöz. [1961] 41p. incl. diagrs. tables, refs. (AFOSR-1931) (AF 49-(638)910) AD 454673 Unclassified

Also published in Jour. Geophys. Research, v. 67: 1943-1955, May 1962.

The Pasadena seismograms of the Mongolian earthquake of Dec. 4, 1957 were studied: Mantle Rayleigh waves R_3, R_4, R_5, and R_6 were separated, digitized, filtered and Fourier-analyzed. After the evaluation of the phase-velocities and the absorption coefficients from R_3/R_5 and R_4/R_6 the directivity was computed from the amplitude ratio of R_3/R_4. A fault of 560 km, striking S 80° E, and a rupture velocity of 3.5 km/sec gave the best fit to the observed directivity. Auxiliary data from aftershock distribution, initial motions, air-waves from the main shock and geological surveys of the fault-area seems to support these findings. The phase-spectra of R_3 and R_4 were corrected for the propagation-phase and the instrumental phase-shift to obtain the initial phases at the source. The results for R_3 and R_4 are close. A rough estimate of the depth of faulting is obtained on the basis of the calculated strain-release and observed displacements at the fault. (Contractor's abstract)

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

CRUSTAL STRUCTURE OF THE ANDES FROM RAYLEIGH WAVE DISPERSION, by A. Cisternas. [1961] [8]p. incl. diagrs. tables, refs. (AFOSR-2965) (AF 49(638)910) Unclassified

Published in Bull. Seismol. Soc. Amer., v. 51: 381-388, July 1961.

Records from a Benioff short-period seismograph located at Huancayo, Peru, are digitalized and then passed through a low-pass filter to get the long-period waves. In this way the dispersion curves of Rayleigh waves for paths along the Andes can be computed from seismograms which otherwise would be unusable. The comparison with the empirical curve for a "normal" continental crust and with specially computed theoretical models indicates a crustal thickness of the order of 50 km. For periods between 20 and 25 sec, the observed group velocity shows abnormally low values. (Contractor's abstract)

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

LEAKING MODES IN THE CRUSTAL WAVEGUIDE. PART I. THE OCEANIC PL WAVE, by R. A. Phinney. [1961] [25]p. incl. diagrs. table. (AFOSR-2966) (AF 49(638)910) Unclassified

Also published in Jour. Geophys. Research, v. 66: 1445-1469, May 1961.

The problem of the seismic signal associated with the earliest P wave is treated by application of normal mode theory, in which the signal is regarded as a quasi-surface wave, coupled both to the motion of the earth's layered surface and to body waves propagating in the underlying media. Predictions made for the particular model assumed are relevant to explosion and earthquake sources. The oscillations following the initial P motion are explained. The transient solution obtained by Rosenbaum for leaking mode propagation in an acoustic waveguide has been generalized to describe propagation in an elastic halfspace overlain by a liquid layer. The early-arriving PL modes known from earthquake studies have been computed for several theoretical models to test the effect of the elastic constants on their dispersion and attenuation. Physical reasoning, based on harmonic plane wave models, appears inadequate for predicting many features of the exact dispersion and attenuation. The analogy between PL waves and normal modes in the case treated by Pekeris is exploited, and it is also believed that PL waves are related to an attenuated pseudo-surface wave of a free solid halfspace.

Late-arriving quasi-standing waves are treated briefly and their relevance to certain seismic phenomena is mentioned. (Contractor's abstract)

197

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

UPPER MANTLE STRUCTURE UNDER OCEANS AND CONTINENTS FROM RAYLEIGH WAVES, by K. Aki and F. Press. [1961] [14]p. incl. diagrs. tables, refs. (AFOSR-2967) (AF 49(638)910) AD 613745 Unclassified

Also published in Geophys. Jour., v. 5: 292-305, Oct. 1961.

Theoretical seismograms of Rayleigh waves based on several models of mantle structure are compared with actual records for various paths. It is found that the model 8099 of Dorman, Ewing and Oliver explains seismograms for Pacific paths but does not agree with records from Indian-Atlantic ocean paths in the period range shorter than about 100 s. The velocity of the Airy phase corresponding to the group velocity maximum is about 0.10 km/s lower for the Indian-Atlantic path than for the Pacific. This difference can be accounted for by reducing the shear velocity at the top of the mantle under the Indian and Atlantic oceans by about 0.1-0.2 km/s. The difference between the Pacific mantle and the Continental mantle can be explained either by a reduction in shear velocity of the low-velocity layer under the Pacific ocean or by making the low-velocity zone shallower. (Contractor's abstract)

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California U., Berkeley.

RAREFIED GAS DYNAMICS; PROCEEDINGS OF THE SECOND INTERNATIONAL SYMPOSIUM, California U., Berkeley, Aug. 3-6, 1960, ed. by L. Talbot. New York, Academic Press, 1961, 748p. incl. illus. diagrs. tables, refs. (Advances in Appl. Mech. Suppl. no. 1) (AFOSR-1728) (Sponsored jointly by Air Force Office of Scientific Research, International Union of Theoretical and Applied Mechanics, National Aeronautics and Space Administration, National Science Foundation, and Office of Naval Research) AD 268413 Unclassified

This symposium was comprised of 6 sessions. In all, 41 of the papers presented in these sessions are contained in the proceedings. Sections I and II of the symposium dealt with subject matter which falls mainly in the category of boundary problems. In Section I studies are made of 3 different types of surface interactions: energy exchange, chemical reactions, and sputtering. Recent developments in the area of molecular beam methods for studying surface interactions are reported. Free-molecule flow is discussed in Section II and several new methods for computing free-molecule flows are presented. The Maxwell-Boltzmann equation is generally accepted as the fundamental equation of rarefied gas dynamics for the entire range of conditions from continuum to free-mole flow. In recent years there has been increasing emphasis on the study of the linearized equation and on the use of simpler kinetic models and approximation methods which retain many of the features of the Maxwell-Boltzmann theory. Sections III, IV, and V contain a number of examples of such approaches. Investigations of shock wave structure are exemplified by several papers in Sections IV and V. The final Section deals with the topic of ionized gases at low density.

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California U. Dept. of Chemistry, Berkeley.

THE INFRARED SPECTRUM OF SOLID CARBON MONOXIDE, by G. E. Ewing and G. C. Pimentel. Feb. 1, 1961, 19p. incl. tables, refs. (AFOSR-242) (AF 49(638)1) AD 254304 Unclassified

Also published in Jour. Chem. Phys., v. 35: 925-930, Sept. 1961.

The infrared spectrum of solid CO at 20°K was examined in the fundamental and overtone region. Sharp features (band widths about 1 cm^{-1} are assigned to vibrational modes of the various isotopic species: $C^{12}O^{16}$, 2138.1 cm^{-1}; $C^{12}O^{17}$, 2112.3 cm^{-1}; $C^{13}O^{16}$, 2092.2 cm^{-1}; and $C^{12}O^{18}$, 2088.4 cm^{-1}. These frequencies are examined with the aid of existing theories of frequency shifts in condensed phases. A broad absorption (band width about 40 cm^{-1}) centered at 2208 cm^{-1} is assigned to combinations of the fundamental mode with lattice modes. Calculations suggest that that the lattice modes involved probably include translations as well as librations. (Contractor's abstract)

200

California U. Dept. of Chemistry, Berkeley.

HYDROGEN ABSTRACTION FROM HYDROCARBONS BY METHYL RADICALS FROM THE PHOTOLYSIS OF METHYL IODIDE IN SOLID NITROGEN, by C. D. Bass and G. C. Pimentel. Mar. 31, 1961, 21p. incl. tables, refs. (AFOSR-1067) (AF 49(638)1) AD 274797 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 3754-3758, Sept. 20, 1961.

Methyl iodide was photolyzed at 20°K in solid matrix materials, N_2, Kr, and Xe, containing hydrocarbons [C_2H_6 or $(CH_3)_3CH$] or deuterated hydrocarbons [CD_4, CH_3CD_3, or $(CH_3)_3CD$]. Hydrogen abstraction was studied by infrared detection of CH_4 and CH_3D. In the solid the abstraction products can be attributed to methyl radicals with an "effective temperature" in the range 1000-3000°K. Furthermore, the products obtained from photolysis of methyl iodide with ethane present as well as those from photolysis of ethyl

iodide in nitrogen, indicate that about 85% of the reactions probably occur within the cage at the site of photon absorption. These studies provide information concerning the dissipation of the energy of a 'hot" radical constrained within a reactive cage. (Contractor's abstract)

201

California U. Dept. of Chemistry, Berkeley.

INFRARED STUDIES OF FREE RADICALS AND UNSTABLE REACTION INTERMEDIATES, by G. C. Pimentel. Final rept. July 1, 1956-Feb. 28, 1961. Aug. 15, 1961, 11p. (AFOSR-1302) (AF 49(638)1) AD 435297 Unclassified

The specific novel applications of the matrix isolation method are listed as follows: (1) First infrared detection of reactive species: the detection of HCO. (2) Chemistry of reactive species: Free radical reactions can be studied under conditions where secondary reactions are interrupted. (3) Primary act of photolysis: Due to inert environment, the primary act of photolysis can be learned in the condensed phases. (4) Hydrogen bonding: Narrowing of bands of hydrogen bonded polymers gives this method power to segregate the infrared spectra of polymers of different size. The above are published in 19 reports.

202

California U. Dept. of Chemistry, Berkeley.

MOLECULAR ORBITAL CORRELATIONS IN ORGANIC CHEMISTRY, by A. Streitwieser, Jr. Final rept. Mar. 7, 1961 [43]p. incl. diagrs. tables, refs. (AFOSR-547) (AF 49(638)105) AD 255313 Unclassified

Experimental work and calculations were conducted to establish the validity of molecular orbital (MO) correlations in the following areas: (1) ionization potentials of organic compounds; (2) acidity of hydrocarbons; (3) acetolysis rates of arylmethyl tosylates; and (4) rates of base-catalyzed hydrogen-deuterium exchange of hydrocarbons. Acetolysis rate studies of compounds of the type, $ArCH_2OSO_2\ C_6H_4CH_3$ indicated that only fair correlations are obtained between MO predictions and experiment. The products of reduction of aromatic hydrocarbons with alkali metals and liquid ammonia are accounted for with the HMO theory. The deficiencies of the HMO theory arise mainly from its specific neglect of electron-repulsion terms which show up particularly in the treatment of charged species.

203

California U. Dept. of Chemistry, Berkeley.

AN HMO TREATMENT OF THE REDUCTION OF AROMATIC HYDROCARBONS WITH ALKALI METALS; REDUCTION OF FLUORANTHENE, by A. Streitwieser, Jr. and S. Suzuki. [1961] [35]p. incl. diagrs. tables, refs. (AFOSR-65-0214) (AF 49-(638)105) AD 611289 Unclassified

Also published in Tetrahedron, v. 16: 153-168, Dec. 1961.

Simple molecular orbital theory is applied to the metal-ammonia reduction of aromatic hydrocarbons. The theory is based on protonation at sites of highest electron density in the corresponding anions. Good agreement is observed between predicted and observed reduction products. The reduction of the non-alternant hydrocarbon fluoranthene takes an anomalous course that is not inconsistent with the theory. Evidence is presented to show that an initial dihydro-reduction product, 2,3-dihydrofluoranthene, undergoes a Michael addition by its conjugate anion to yield 1,2,2',3,3',10b-hexahydro-1,2'-bifluoranthyl. (Contractor's abstract)

204

California U. Dept. of Chemistry, Berkeley.

ACIDITY OF HYDROCARBONS. I. KINETICS OF EXCHANGE OF TOLUENE-α-d WITH LITHIUM CYCLOHEXYLAMIDE, by A. Streitwieser, Jr., D. E. Van Sickle, and W. C. Langworthy. [1959] [5]p. incl. diagrs. tables, refs. (AFOSR-65-0216) (AF 49(638)105) AD 611349 Unclassified

Presented in part at Sixteenth Nat'l. Org. Symposium of the Amer. Chem. Soc., Seattle, Wash., June 1959.

Also published in Jour. Amer. Chem. Soc., v. 84: 244-248, Jan. 20, 1962.

The kinetics of the proton exchange reaction between toluene-α-d and lithium cyclohexylamide in cyclohexylamine were studied at 50°C. The reaction is first order each in toluene-α-d and in monomeric lithium cyclohexylamide. Free ions are apparently not involved to a significant extent in the concentration range studied. Lithium cyclohexylamide appears to be in equilibrium with relatively inert dimers, trimers, etc. (Contractor's abstract)

205

California U. Dept. of Chemistry, Berkeley.

ACIDITY OF HYDROCARBONS. II. EFFECT OF METHYL SUBSTITUENTS IN THE EXCHANGE REACTION OF TOLUENE-α-d WITH LITHIUM CYCLOHEXYLAMIDE, by A. Streitwieser, Jr. and D. E. Van Sickle. [1959] [2]p. incl. diagr. tables, refs. (AFOSR-65-0217) (AF 49(638)105) AD 611350 Unclassified

Presented in part at Sixteenth Nat'l. Org. Symposium of the Amer. Chem. Soc., Seattle, Wash., June 1959.

Also published in Jour. Amer. Chem. Soc., v. 84: 249-250, Jan. 20, 1962.

The rates of exchange of several deuterated hydrocarbons with lithium cyclohexylamide in cyclohexylamine at 49.9°C give the following relative rates: toluene-α, 1.00; m-xylene-α-d, 0.60; p-xylene-α-d 0.29; ethylbenzene-α-d, 0.116, toluene-α-d, 0.0079. Because of the electron-donating character of methyl substituents, these results indicate a highly carbanionic transition state and provide evidence that such exchange rates are valid measures of the relative acidities of hydrocarbons. (Contractor's abstract)

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California U. Dept. of Chemistry, Berkeley.

ACIDITY OF HYDROCARBONS. III. PRIMARY ISOTOPE EFFECTS IN THE PROTON EXCHANGE OF TOLUENE AND ETHYLBENZENE WITH LITHIUM CYCLOHEXYLAMIDE, by A. Streitwieser, Jr., W. C. Langworthy, and D. E. Van Sickle. [1959] [4]p. incl. tables, refs. (AFOSR-65-0218) (AF 49-(638)105) AD 611351 Unclassified

Presented in part at Sixteenth Nat'l. Org. Symposium of the Amer. Chem. Soc., Seattle, Wash., June 1959.

Also published in Jour. Amer. Chem. Soc., v. 84: 251-254, Jan. 20, 1962.

Primary isotope effects were determined for the proton exchange reactions of toluene-α-d and -α-t and of ethylbenzene-α-d and -α-t with lithium cyclohexylamine. The k_D/k_T values average 3.0 ± 0.2, a rather high value that corresponds to $k_H/k_D = 12$. This high isotope effect is shown to rule out a one-step mechanism for the exchange and to implicate relatively stable intermediates of the carbanion type. (Contractor's abstract)

207

California U. Dept. of Chemistry, Berkeley.

ACIDITY OF HYDROCARBONS. IV. SECONDARY DEUTERIUM ISOTOPE EFFECTS IN EXCHANGE REACTIONS OF TOLUENE AND ETHYLBENZENE WITH LITHIUM CYCLOHEXYLAMIDE, by A. Streitwieser, Jr. and D. E. Van Sickel. [1959] [5]p. incl. diagrs. tables, refs. (AFOSR-65-0219) (AF 49-(638)105) AD 611352 Unclassified

Presented in part at Sixteenth Nat'l. Org. Symposium of the Amer. Chem. Soc., Seattle, Wash., June 1959.

Also published in Jour. Amer. Chem. Soc., v. 84: 254-258, Jan. 20, 1962.

Some secondary deuterium isotope effects were studied in the exchange reactions of hydrocarbons with lithium cyclohexylamide in cyclohexylamine; $k(C_6H_5CHDCH_3)/k(C_6H_5\text{-}CHDCD_3) = 1.11 \pm 0.03$, a result that is interpreted to indicate that the transition state has substantial carbanionic character. $3k(C_6H_5CH_2D)/k(C_6H_5CD_3) = 1.31$; analysis of this result suggests that the leaving deuterium and perhaps a lithium are close to the central carbon at the transition state. (Contractor's abstract)

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California U. Dept. of Chemistry, Berkeley.

ACIDITY OF HYDROCARBONS. V. STEREOCHEMISTRY AND MECHANISM OF THE PROTON EXCHANGE REACTIONS OF HYDROCARBONS IN CYCLOHEXYLAMINE, by A. Streitwieser, Jr., D. E. Van Sickle, and L. Reif. [1959] [3]p. incl. table, refs. (AFOSR-65-0220) (AF 49(638)105) AD 611353 Unclassified

Presented in part at Sixteenth Nat'l. Org. Symposium of the Amer. Chem. Soc., Seattle, Wash., June 1959.

Also published in Jour. Amer. Chem. Soc., v. 84: 258-260, Jan. 20, 1962.

The rate of racemization of optically active ethylbenzene-α-d with lithium cyclohexylamide in cyclohexylamine at 49.9°C is 2.8 times the loss of deuterium. This result is analyzed to show that replacement of the α-hydrogen by hydrogen in this system proceeds with 82% net retention of configuration. A mechanism of the exchange reaction is proposed which involves a 4-membered ring transition state in which specific asymmetric solvation by individual solvent molecules is not necessary to accommodate the results. (Contractor's abstract)

209

California U. Dept. of Chemistry, Berkeley.

THERMOLUMINESCENCE OF SOLID NITROGEN AFTER ELECTRON BOMBARDMENT AT 4.2°K, by B. Brocklehurst and G. C. Pimentel. Aug. 31, 1961, 18p. incl. table, refs. (AFOSR-1375) (AF 49(638)-944) AD 274798 Unclassified

Also published in Jour. Chem. Phys., v. 36: 2040-2046, Apr. 15, 1962.

Solid N annealed at 20°K and then bombarded with electrons at 4°K gives 3 glow peaks on warming, at 10°, 14.5°, and 19°K. Unannealed N gave broader peaks. A feeble, long-lived glow followed the normal afterglow after bombardment at 4°K. Thermal effects during warming were observed in 1 apparatus with radiation shielding at 77°K but they were not observed in a much more sensitive apparatus with radiation shielding at 4°K. The thermal effects were probably caused by an anomalous vapor pressure and loss of Dewar vacuum. The data are discussed with reference to 2 interpretations, the storage of ^2D excited N atoms and the recombination of ^4S atoms through diffusion. The latter explanation is preferred and a simple model is offered to account for the 3 diffusion activation enthalpies implied by the 3 thermoluminescence peaks. (Contractor's abstract)

210

California U. Dept. of Chemistry, Berkeley.

INFRARED SPECTRA OF AMMONIA SUSPENDED IN SOLID NITROGEN, by G. C. Pimentel, M. O. Bulanin, and M. Van Thiel. [1961] [7]p. incl. diagrs. tables, refs. (AFOSR-J683) (AF 49(638)944) AD 413627 Unclassified

Also published in Jour. Chem. Phys., v. 36: 500-506, Jan. 15, 1962.

Matrix isolation studies of the infrared spectra of ammonia suspended in solid nitrogen at 20°K are presented. Variation of the mol ratio of nitrogen to ammonia shows that monomeric NH_3 in solid nitrogen absorbs at 3440, 3332, 1620-1632, 1143, and 970 cm^{-1}. A large enhancement of ν_3 3440 cm^{-1}, occurs relative to ν_1, 3332 cm^{-1}, just as observed for the pure solid. The totally symmetric vibrations ν_1 and ν_2 are relatively sharp (half-widths are 1 and 1.5 cm^{-1}, respectively). The umbrella mode ν_2 shows no evidence of inversion nor of free rotation. The band at 1143 cm^{-1} is ascribed to ν_2 in combination with librational movement about the B axes. The constraints to movement within the nitrogen matrix cage seem to be larger than those reported for inert-gas matrices. Some results on the hydrogen bonding in dimeric and polymeric ammonia are reported. The dimer absorbs at 3404, 1004.5, 987 cm^{-1} and possibly as well at 3313, 3246 and 3237 cm^{-1}. (Contractor's abstract)

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California U. Dept. of Mathematics, Berkeley.

THE TORSION PONTRYAGIN CLASSES, by E. Thomas. June 1961, 8p. (Technical rept. no. 20) (AFOSR-668) (AF 49(638)79) AD 259876 Unclassified

Also published in Proc. Amer. Math. Soc., v. 13: 485-488, June 1962.

Torsion Pontryagin classes are expressed in terms of the standard characteristic classes of a real n-plane bundle over a paracompact space. The theorem contains three equivalent expressions for these classes.

212

California U. Dept. of Mathematics, Berkeley.

DIFFERENTIAL FORMS AND LIE ALGEBRA COHOMOLOGY FOR ALGEBRAIC LINEAR GROUPS, by G. Hochschild and B. Kostant. [June 1961] 34p. (Technical rept. no. 19) (AFOSR-681) (AF 49(638)-79) AD 259905 Unclassified

Also published in Illinois Jour. Math., v. 6: 264-281, June 1962.

G is an irreducible linear algebra group over a field F of characteristic zero, K a fully reducible algebraic subgroup over F, V a rational G-module (i.e., a module which is sum of finite-dimensional rational representation spaces of G), $\mathfrak{G}$ [respectively, $\mathfrak{k}$], the Lie algebra of G[K]. This paper relates the K-fixed part $H(\mathfrak{G}, \mathfrak{k}, V)^K$ of the relative Lie algebra cohospace $H(\mathfrak{G}, \mathfrak{k}, V)$, the rational cohomology group H (G, V) of G in the sense of G. Hochschild (Illinois Jour. Math., v. 5: 492-519, 1961) and a further cohomology space of which two equivalent definitions are given, one being the cohomology space $H(DCR^K)$ of the algebra of universal differential forms on the ring R^K of regular functions on G, defined over F which are invariant under left translations by elements of K. The results of this paper extend those of Hochschild above. It is also shown that G/K admits a structure of affine algebraic variety for which R^K is the coordinate ring over F. (Math. Rev. abstract, in part)

213

California U. Dept. of Mathematics, Berkeley.

DIFFERENTIAL FORMS ON REGULAR AFFINE ALGEBRA, by G. Hochschild, B. Kostant, and A. Rosenberg. Aug. 1961, 46p. incl. refs. (Technical rept. no. 21) (AFOSR-833) (AF 49(638)79) AD 263322 Unclassified

Also published in Trans. Amer. Math. Soc., v. 102: 383-408, Mar. 1962.

A mathematical discussion of the algebras of differential forms is treated as a special combination of linear algebra and homological algebra. There is specific identification of this particular exterior algebra as applied to canonical graded algebra based on the Tor functor and obtained by the cohomology of differential forms from the ext functor to a universal algebra i.e., Lie algebra. Attention is directed chiefly to a regular affine algebra, K-algebra, which is Noetherian with a finite Krull dimension, i.e., the largest non-negative integer.

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California U. Dept. of Mathematics, Berkeley.

ON FUNCTIONAL CUP-PRODUCTS AND THE TRANSGRESSION OPERATOR, by E. Thomas. June 1961, 20p. (Technical rept. no. 23) (AFOSR-910) (AF 49(638)79) AD 259907 Unclassified

Also published in Arch. Math., v. 12: 435-444, 1961.

Let g be a map from a topological space X to a topological space Y. Suppose that X and Y are the total spaces of respective proper triads and that g is a triad map. It is then possible, in certain cases, to express the functional cup-product in terms of an

ordinary cup-product. This is applied to obtain a classical result about the Hopf invariant and to obtain some new information about the cohomology rings of certain classifying spaces. (Contractor's abstract)

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California U. Dept. of Mathematics, Berkeley.

ON THE TRANSITIVITY OF HOLONOMY SYSTEMS, by J. Simons. [July 1961] 42p. (Technical rept. no. 22) (AFOSR-1000) (AF 49(638)79) AD 261659 Unclassified

Also published in Ann. Math., v. 76: 213-234, Sept. 1962.

A classification of possible candidates for the holonomy groups of manifolds having affine connections with zero torsion discloses only groups transitive on the unit sphere in the tangent space of the manifold, except in the case where the manifold is a symmetric space of rank greater than or equal to 2. An intrinsic proof of this rather startling fact, and an algebraic generalization of the notion of a holonomy group are given with a short, intrinsic proof of the result on transitivity. Although only that portion of the problem which has to do with Riemannian manifolds is treated, it is possible that the devices employed could be altered to pertain to other situations. (Contractor's abstract)

216

California U. [Dept. of Mathematics] Berkeley.

HOMOTOPY-COMMUTATIVITY IN ROTATION GROUPS, by I. James and E. Thomas. [1961] [4]p. (AFOSR-3349) [AF 49(638)79] Unclassified

Also published in Topology, v. 1: 121-124, Apr.-June, 1962.

In this paper, the authors show the rotation group R_m does not homotopy commute with R_n in R_{m+n-2} if $m + n > 4$ and may possibly homotopy commute in R_{m+n-1} only if $m + n = 4$ or 8 or $m-1$ and $n-1$ are divisible by different powers of 2. It is still unknown for example, if R_3 homotopy commutes with R_9 in R_{11}. This information follows from computation of the Steenrod squares in $X = S(RP^{m-1} * RP^{n-1})$ which show that over any bundle over X, the Stiefel-Whitney class $W_{m+n} = 0$ except for the possible values of m and n indicated, while if R_m and R_n did homotopy commute in R_{m+n-1}, there would be a bundle over $S(RP^{m-1} * RP^{n-1})$ with $W_{n+n} \neq 0$. (Math. Rev. abstract)

217

California U. [Dept. of Mathematics] Berkeley.

SCHEMATA OVER LOCAL RINGS, by M. J. Greenberg. [1960] [24]p. incl. refs. [AF 49(638)-603] Unclassified

Published in Ann. Math., v. 73: 624-648, May 1961.

The notion of algebraic ring is introduced. It happens that every Artin local ring has a natural structure of algebraic ring, so that the theory over a discrete valuation ring mod p^n, which is presented, can be developed equally equally well over any Artin local ring. It is within this general context that the work is presented. The construction of new varieties in the affine case proceeds as follows: in each polynomial equation with coefficients in the Artin local ring, coordinates can be substituted for the coefficients and the variables, obtaining an equivalent system of many polynomial equations in more variables, but now over the residue field. The construction is equivalent to the solution of a certain universal problem and from this all the functorial properties can be deduced.

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California U. [Dept. of Mathematics] Berkeley.

ON QUOTIENT VARIETIES AND THE AFFINE EMBEDDING OF CERTAIN HOMOGENEOUS SPACES, by M. Rosenlicht. [1961] [13]p. (Technical rept. no. 8) (AFOSR-27) (AF 49(638)603) AD 254675; PB 155607 Unclassified

Also published in Trans. Amer. Math. Soc., v. 101: 211-223, Nov. 1961.

Let G be an algebraic group operating regularly on an algebraic variety V. A quotient variety exists if the set V/G of orbits admits a structure of algebraic variety such that the natural projection of V onto V/G is a regular map having some natural properties, which in particular insure uniqueness. For this it is necessary that all orbits be closed and of the same dimension. This condition is sufficient when V is an affine variety and G is an algebraic torus. Remarks are made concerning quotient varieties, and a case of non-existence, where G is a torus, and V is quasi-affine. It is also shown that if G is unipotent, and V quasi-affine, then all orbits of G are closed.

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California U. [Dept. of Mathematics] Berkeley.

[ALGEBRAIC TRANSFORMATION GROUPS AND SPACES], by M. Rosenlicht. Final rept. Oct. 1, 1959-Sept. 30, 1961, 3p. (AFOSR-2873) (AF 49-(638)603) AD 430676 Unclassified

A brief resume is given of the work done on algebraic geometry. Descriptions are given of some

resulting reports: Algebraic rings, toroidal algebraic groups, quotient varieties and the affine embedding of certain homogeneous spaces, and questions of rationality for solvable algebraic groups over nonperfect fields.

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California U. Dept. of Mathematics, Berkeley.

DERIVATIONS OF COMMUTATIVE BANACH ALGEBRAS, by P. C. Curtis, Jr. Feb. 1961, 6p. (Technical rept. no. 1) (AFOSR-131) (AF 49(638)85) AD 254228 Unclassified

Also published in Bull. Amer. Math. Soc., v. 67: 271-273, May 1961.

Let A be a commutative semi-simple Banach algebra with a unit. Let D be a derivation of A into itself. It is an open question whether D must be 0. I. M. Singer and J. Wermer showed that if D is bounded as an operator, then D is 0. (Math. Ann., v. 129: 260-264, 1955). It is shown here that if A is assumed to be regular than every derivation is bounded and hence 0. It is proven more generally: Denote by Φ_A the maximal ideal space of A. If D is a derivation of A into $C(\Phi_A)$, then D is a bounded operator from A to $C(\Phi_A)$.

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California U. [Dept. of Physics] Berkeley.

PRESSURE DISSOCIATION, by M. S. Vardya. [1960] [1]p. [AF 49(638)299] Unclassified

Published in Astrophys. Jour., v. 132: 905, Nov. 1960.

At high gas densities ($\sim 10^{-2}$ gm cm^{-3}) and temperatures ($\sim 10^{4}$°K) the number of undissociated molecules predicted is decreased considerably if pressure dissociation, as well as thermal dissociation are considered. The effect on hydrogen molecules is discussed.

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California U. [Dept. of Physics] Berkeley.

COMPUTATIONAL RESEARCH IN ASTROPHYSICS, by L. Henyey. Final rept. Nov. 1961, 2p. (AFOSR-1734) (AF 49(638)299) Unclassified

Computational studies on the stages of stellar evolution, using models of stars, are reported. The programs have included calculations of (1) the dynamics of clusters; (2) the escape of gas from the solar corona; (3) the time behavior of cosmological models; and (4) stellar evolution. The program for the automatic calculation of stellar evolution has been largely finished and will be used to investigate all phases of evolution with allowance for all known physical effects and nuclear reactions.

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California U. [Dept. of Physics] Berkeley.

EQUILIBRIUM PROPERTIES OF HYDROGEN GAS FROM 5000° TO 20,000°K, by O. Sinanoglu, M. S. Vardya and others. [1961] [7]p. incl. diagr. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)299 and National Science Foundation) Unclassified

Published in Phys. Fluids, v. 5: 665-671, June 1962.

Equilibrium properties of hydrogen gas are calculated from 5000° to 20,000°K by considering it as a monatomic gas with imperfections. The usual "H_2 and H equilibrium" method is not suitable at high temperatures, even with anharmonicity corrections. Properties are obtained from the second virial coefficient B(T) of the monatomic gas and its derivatives. The Rydberg potential is used for the $^1\Sigma$ state and the best numerical potential for the $^3\Sigma$ state. Ionization, higher excited states, and quantum effects are examined. The third virial coefficient for H_3 is estimated and it is shown that properties from B(T) part alone are sufficient up to pressures of 1000 atm at 10,000°K and 13,000 atm at 20,000°K. Results are compared with those of the "equilibrium constant" approach. (Contractor's abstract)

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California U. Dept. of Physics, Berkeley.

ASYMPTOTIC BEHAVIOUR AND SUBTRACTIONS IN THE MANDELSTAM REPRESENTATION, by M. Froissart. [1961] 19p. (AFOSR-781) (AF 49(638)-327) AD 258895 Unclassified

Also published in Phys. Rev., v. 123: 1053-1057, Aug. 1, 1961.

It is proved that a 2-body reaction amplitude involving scalar particles and satisfying Mandelstam's representation is bounded by mathematical expressions at the forward and backward angles and at any other fixed angle in the physical region. Restrictions limit the freedom of choice of the subtraction terms to 6 arbitrary single spectral functions and 1 subtraction constant. (Contractor's abstract)

225

California U. [Dept. of Physics] Berkeley.

CONVERSION OF MUONIUM INTO ANTIMUONIUM, by G. Feinberg and S. Weinberg. [1961] [22]p. (AFOSR-782) (In cooperation with Columbia U.,

New York) (Sponsored jointly by Air Force Office of Scientific Research and Atomic Energy Commission under AF 49(638)327 and Office of Naval Research under Nonr-22260) AD 259003 Unclassified

Also published in Phys. Rev., v. 123: 1439-1443, Aug. 15, 1961.

A detailed analysis is made of the possible conversion of muonium into antimuonium in various environments. Assuming a typical $\bar{\mu}e\bar{\mu}e$ weak interaction gives a probability of 2.6×10^{-5} in vacuum, even in the presence of reasonable external electric fields. In a solid the probability is less by at least 10, and probably 20, orders of magnitude. In an inert gas the probability is roughly to be divided by the numbers of collisions during a muon lifetime, and hence is quite small unless the pressure at room temperature is less than about 10^{-4} atmospheres. Lowering the temperature does not help. A possible experiment is suggested. (Contractor's abstract)

226

California U. Dept. of Physics, Berkeley.

A SHAPE-INDEPENDENT THEORY OF HIGH ENERGY NUCLEON-NUCLEON SCATTERING, by L. A. P. Balázs. [1961] [43]p. incl. diagrs. tables, refs. (AFOSR-1074) (AF 49(638)327) AD 260958 Unclassified

Also published in Phys. Rev., v. 124: 602-611, Oct. 15, 1961.

A shape-independent formula for nucleon-nucleon phase shifts, approximately valid over wide energy ranges is derived, assuming only general properties of the wave function and potential. It is found to approximately reproduce the S, P, and D proton-proton phase shifts in the ranges 10-150 mev and 10-310 mev with 2, or at most 3, free parameters per state. A generalization, which includes part or all of the outer potential exactly, is derived at the same time. (Contractor's abstract)

227

California U. Dept. of Physics, Berkeley.

CROSS SECTIONS AT HIGH ENERGIES, by S. Weinberg. 1961 [9]p. (AFOSR-1075) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)327 and Office of Naval Research under Nonr-22260) AD 260959 Unclassified

Also published in Phys. Rev., v. 124: 2049-2050 Dec. 15, 1961.

If the difference $\sigma_+(E) - \sigma_-(E)$ of particle and antiparticle total cross sections changes sign at a finite number of energies, then the odd part $f_+(E) - f_-(E)$ of the forward scattering amplitude has a very useful representation, as a rational times a "Herglotz" function. The representation implies a correlation between the high-energy asymptotic behavior of $\sigma_+(E) - \sigma_-(E)$ and $f_+(E) - f_-(E)$. For example, if $[f_+(E) - f_-(E)]/E\ln^m E$ is bounded, and $m \leq \frac{1}{2}$ then we have the Pomeranchuk result that $\sigma_+(E) - \sigma_-(E) \to 0$. Even if $m > \frac{1}{2}$ it seems likely that although the difference of $\sigma_+(E)$ and $\sigma_-(E)$ may not tend to zero, their ratio does tend to one. (Contractor's abstract)

228

California U. Dept. of Physics, Berkeley.

SIMPLIFICATION OF THE TWO-BODY UNITARITY RELATION, by M. Froissart. [1960] 14p. (AFOSR-1176) (AF 49(638)327) AD 265983 Unclassified

Also published in Nuovo Cimento, Series X, v. 22: 395-401, Oct. 16, 1961.

A reduction is obtained in the number of integrations needed to compute the scattering amplitude from a potential by dispersion-theoretical methods. (Contractor's abstract)

229

California U. Dept. of Physics, Berkeley.

THE NEUTRINO PROBLEM IN COSMOLOGY, by S. Weinberg. Sept. 1961, 18p. (Rept. no. UCRL-9855) (AFOSR-1461) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)327 and Office of Naval Research under Nonr-22260) AD 267942 Unclassified

Also published in Nuovo Cimento, Series X, v. 25: 15-27, July 1, 1962.

The absence of an Olbers paradox for neutrinos shows that the average neutrino luminosity must fall off as we observe older and more distant parts of the universe. Unlike the situation for light, the paradox could not be avoided by any kind of red shift, and hence puts a strong constraint on cosmological speculation. The ambient neutrino flux turns out to be finite in the modern steady state or evolutionary cosmologies, and is estimated at about 10^4 neutrinos/sq cm-sec, a density less than that allowed by the Pauli principle by a factor of about 10^{-33}. Taking absorption of neutrinos into account does not affect these remarks, except that in the oscillating cosmologies there must recur periods when neutrino absorption is faster than neutrino emission. It is estimated that the onset of neutrino absorption for an oscillating universe comes when it has contracted by a (linear) factor of about 10^5, and absorption might not lower the neutrino population very much until the contraction reaches about 10^{14}. Even then there is no neutrino degeneracy. (Contractor's abstract)

230

California U. Dept. of Physics, Berkeley.

THE EIKONAL METHOD IN MAGNETOHYDRODYNAMICS, by S. Weinberg. Sept. 1961, 59p. (AFOSR-1546) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)327 and Office of Naval Research under Nonr-22260) AD 266038
Unclassified

Also published in Phys. Rev., v. 126: 1899-1909, June 15, 1962.

The eikonal method is extended to waves with several components propagating in inhomogeneous anisotropic media. Formulas are derived for the motion of wave packets, the change in amplitude along a ray path, and the corrections due to diffraction. The method is applied to pure magnetohydrodynamic disturbances, and the problem of computing ray paths in the ionosphere is discussed. One result is that the fraction of the energy of an isotropic disturbance that eventually gets as low as 200 km drops from .99 at 200 km to .2 at 450 km, rises again to .99 at 700 km, drops to .5 at 3000 km and continues dropping at greater altitudes. Energy trapped between 200 km and 700 km oscillates around 450 km with period 8.5 sec (at the geomagnetic equator). The eikonal method is also applied to a very general problem involving coupled magnetohydrodynamic, electrodynamic, and acoustic modes. (Contractor's abstract)

231

California U. [Dept. of Physics] Berkeley.

QUASI-ELASTIC NUCLEON-NUCLEUS SCATTERING AT HIGH ENERGY, by R. Karplus and Y. Yamaguchi. Aug. 1961 [25]p. incl. diagrs. tables, refs. (AFOSR-1614) (AF 49(638)327) AD 265982
Unclassified

Also published in Nuovo Cimento, Series X, v. 22: 589-603, Nov. 1, 1961.

The angular distribution for elastic nucleon-nucleon scattering at high energy is sharply peaked in the forward direction. As a consequence, there is an angular interval in nucleon-nucleus-scattering to which successive small-angle elastic nucleon-bound nucleon scatterings are more likely to contribute than a single nucleon-bound nucleon scattering through the angle of observation. Such plural collisions result in outgoing nucleons which have suffered a smaller energy loss than nucleons that are scattered from hydrogen at the same angle. The Fermi motion of the bound-nucleons produces a broadening in the energy distribution of the scattered nucleons, but displaces the center of the distribution only negligibly. The results of calculations with a simple model are in satisfactory agreement with the observations on proton-carbon scattering. (Contractor's abstract)

232

California U. Dept. of Physics, Berkeley.

MODIFIED LEE MODELS AND THE FIELD THEORETICAL DEFINITION OF ELEMENTARY PARTICLE, by F. Calogero. Oct. 1961 [107]p. incl. diagrs. (AFOSR-1890) (AF 49(638)327) AD 272206
Unclassified

Also published in Nuovo Cimento, Series X, v. 24: 614-656, May 16, 1962.

Exactly solvable models of field theories are introduced and discussed. In some of these models the physical states involve an infinite number of bare particles. Some solutions are also found, which depend in a nonanalytic way on the coupling constant: these solutions may appear as new elementary particles. The field theoretical definition of elementary particle is then discussed. The renormalized coupling constants are always assumed to be smaller than some critical values (depending on the form factors of the models), thereby excluding any pathological feature (such as ghost states, etc.). (Contractor's abstract)

233

California U. Dept. of Physics, Berkeley.

LAW OF CONSERVATION OF MUONS, by G. Feinberg and S. Weinberg. Feb. 1961, 10p. incl. refs. (AFOSR-1948) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)327, Atomic Energy Commission; and Office of Naval Research under Nonr-22260) AD 272207
Unclassified

Also published in Phys. Rev. Lirs., v. 6: 381-383, Apr. 1, 1961.

The apparent absence of muon-electron transitions without neutrinos leads one to suspect that there is a new conservation law forbidding them. Calculations of the rate of such processes, assuming no such law exists, indicate that it is hard to understand their absence in an intermediate boson theory of weak interactions. Even if there is no intermediate boson, the decay would lead to these processes in some order of perturbation theory, and arguments are given which indicate that any field theory of weak interactions may predict unacceptably large rates for these processes in the absence of a selection rule.

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California U. Dept. of Physics, Berkeley.

ELIMINATION OF THE INELASTIC CUT IN THE N/D METHOD, by M. Froissart. [1961] [2]p. (AF 49(638)327) Unclassified

Published in Nuovo Cimento, Series X, v. 22: 191-192, Oct. 1, 1961.

A method for treating contributions from the inelastic region, for problems to be solved by the N/D method, is proposed in order to reduce it to a problem without inelastic parts. The method does not lead to an equation involving principal-value integrals, and the final equations obtained are, in general, singular.

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California U. [Dept. of Physics] Berkeley.

STATISTICAL METHODS IN HIGH-ENERGY PHYSICS, by M. Kretzschmar. [1961] [40]p. incl. diagrs. tables, refs. [Rept. no. UCRL-9621] (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)327, National Academy of Sciences, and Office of Naval Research under Nonr-22260) Unclassified

Published in Ann. Rev. Nuclear Sci., v. 11: 1-40, 1961.

The Fermi model for multiple pion production is considered. Final-state interactions are discussed and consideration is given to phase-space integral calculation, thermodynamic approximation, and isotopic spin conservation. Charge states are analyzed. Applications of the statistical methods to meson production in nucleon-antinucleon annihilation, pion-nucleon interactions, and nucleon-nucleon interactions at 30 bev and at cosmic-ray energies are discussed.

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California U. [Dept. of Physics] Berkeley.

DISPERSION-THEORETICAL FITTING OF NUCLEON-NUCLEON SCATTERING, by L. A. P. Balázs. [1961] [6]p. incl. diagrs. table. (Sponsored jointly by Air Force [Office of Scientific Research under AF 49-(638)327] and Atomic Energy Commission) Unclassified

Published in Phys. Rev., v. 125: 2179-2184, Mar. 15, 1962.

A general approach based on partial-wave dispersion relations is presented for obtaining a formula for phase shifts which depends on only a small number of parameters. This approach does not make any specific assumptions on, or approximations of, the unphysical discontinuity, and involves only approximations of functions that are already known from the general framework of the theory. The method approximately reproduces the $^1S_0$ state in the 0-100 mev range, with 2 parameters determined from the low energy data and a third from a phase shift at a higher energy. (Contractor's abstract)

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California U. [Dept. of Physics] Berkeley.

THE GIANT E1 RESONANCE FOR DEFORMED NUCLEI, by S. G. Nilsson, J. Sawicki, and N. K. Glendenning. [1961] [22]p. incl. diagr. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)327 and Atomic Energy Commission) Unclassified

Published in Nuclear Phys., v. 33: 239-260, May 1962.

The random-phase approximation has been applied in particular to treat the giant E1 resonance of the deformed nucleus Mg^{24}. Two well separated peaks are predicted on the basis of reasonable force parameters. The backward-going graphs are found not to affect significantly the positions of the 1^- states or the relative distribution of the oscillator strength. On the other hand the Thomas-Kuhn-Reiche sum is diminished for the case of a Ferrell-Visscher force by a magnitude of up to 30% by the inclusion of ground state correlations. The violation of the TKR sum rule encountered in the shell-model calculations is thus reduced considerably. (Contractor's abstract)

238

California U. [Dept. of Physics] Berkeley.

HYPERFINE STRUCTURE AND NUCLEAR MOMENTS OF RaE(Bi^{210}), by S. S. Alpert, E. Lipworth, and others. [1961] [6]p. incl. diagrs. tables, refs. (AFOSR-3517) (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: 256-261, Jan. 1, 1962.

The magnetic-dipole interaction constant, a, and the electric-quadrupole interaction constant, b, have been measured for 5-day Bi^{210} (I = 1) in an atomic-beam experiment. The results are $|a| = 21.78 \pm 0.03$ mc/sec and $|b| = 112.38 \pm 0.03$ mc/sec, with $b/a = +5.160 \pm 0.007$. The nuclear magnetic-dipole and electric-quadrupole moments obtained from the interaction constants are $|\mu| = 0.0442 \pm 0.0001$ nm and $|Q| = 0.13 \pm 0.01$ barn, respectively. The signs of these moments are not determined by the experiment. The ordering of the hyperfine levels is F = 1/2, 5/2, and 3/2. The values of the hyperfine level separations are $\Delta\nu(F = 5/2 \leftrightarrow F = 3/2) = 194.93 \pm 0.09$ mc/sec, $\Delta\nu(F = 3/2 \leftrightarrow F = 1/2) = 220.19 \pm 0.08$ mc/sec. (Contractor's abstract)

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California U. [Dept. of Physics] Berkeley.

NUCLEAR SPIN, HYPERFINE STRUCTURE, AND NUCLEAR MOMENTS OF 6.8-DAY LUTETIUM-177, by F. R. Petersen and H. A. Shugart. [1961] [6]p. incl. diagrs. tables, refs. (AFOSR-3523) (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. 126: 252-257, Apr. 1, 1962.

The atomic-beam magnetic-resonance method has been used to measure the nuclear spin and hyperfine structure of 6.8-day Lu^{177} in the ground $^2D_{3/2}$ state and in the $^2D_{5/2}$ electronic state. The results are: I = 7/2; $^2D_{3/2}$: a = 194.84(2) mc/sec, b = 1466.71(12) mc/sec; $^2D_{5/2}$: a = 147.17(1) mc/sec, b = 1805.93(14) mc/sec. The uncorrected nuclear moments for Lu^{177} calculated from these measurements and from known constants of Lu^{175} are: μ_I = +2.217(10) nm, Q = +5.51(6) b. (Contractor's abstract)

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[California U. Dept. of Physics] Berkeley.

MAGNETIC DIPOLE AND ELECTRIC QUADRUPOLE INTERACTION CONSTANTS OF Bi^{210} (Abstract), by S. S Alpert, E. Lipworth and others. [1961] [2]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)339] and Atomic Energy Commission) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 74-75, Feb. 1, 1961.

The magnetic dipole interaction constant a and the electric quadrupole interaction constant b were measured for Bi^{210} (I = 1, $T_{1/2}$ = 5.0 days) using the method of atomic beams. These results were a = 21.78 ± 0.03 mc/sec and b = 112.38 ± 0.03 mc/sec. Sixteen "flop-in" resonances were observed including the 3 direct transitions (F = 5/2, m = 1/2 ⟷ F = 3/2, m = 1/2), (F = 3/2, m = 1/2 ⟷ F = 1/2, m = 1/2), and (F = 3/2, m = 1/2 ⟷ F = 1/2, m = 1/2). The radioactive isotope was produced from the stable metal by the reaction $Bi^{209}(n, \gamma)Bi^{210}$ in the Livermore Pool Type Reactor. Detection was accomplished by collection on sulfur-coated "buttons" which were counted in continuous flow beta counters.

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California U. [Dept. of Physics] Berkeley.

HYPERFINE STRUCTURE AND NUCLEAR MOMENTS OF LUTETIUM-177 (Abstract), by F. R. Petersen and H. A. Shugart. [1961] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)339] and Atomic Energy Commission) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 224, Apr. 24, 1961.

The hyperfine structure separations for radioactive lutetium-177 (I = 7/2) have been measured in both the $^2D_{3/2}$ and $^2D_{5/2}$ electronic states by the atomic beam magnetic resonance method. Seven "flop-in" transitions in the $^2D_{3/2}$ state and 10 in the $^2D_{5/2}$ state corresponding to the high field transition M_J = ±1/2 ⟷ ∓1/2 have been observed. The interaction constants a and b fitted to these observations are $a(^2D_{3/2})$ = 194.84(2) mc/sec, $b(^2D_{3/2})$ = 1466.71(12) mc/sec, $a(^2D_{5/2})$ = 147.17(1) mc/sec, $b(^2D_{5/2})$ = 1805.93(14) mc/sec. The uncorrected nuclear magnetic moment calculated from the interaction constant a is μ_I = +2.0(2) nm. The sign of the moment was determined from the g_I-dependent $\Delta F = \pm 1$ transitions for which the magnetic field dependence of the frequency was zero at high fields. The uncorrected nuclear electric quadrupole moment calculated from the interaction constant b is Q = +5.0(6) barns. Uncertainties in both moments will be considerably reduced when more precise measurements of the hyperfine structure and moments of stable Lu^{175}, currently in progress by G. J. Ritter and H. Lew, are published.

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California U. [Dept. of Physics] Berkeley.

NUCLEAR SPIN OF SCANDIUM-46 (Abstract), by F. R. Petersen and H. A. Shugart. [1961] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)339] and Atomic Energy Commission) Unclassified

Presented at meeting of the Amer. Phys. Soc., Mexico City (Mexico), June 22-24, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 363, June 22, 1961.

The nuclear spin I = 4 for radioactive scandium-46 ($T_{1/2}$ = 84 days) has been measured by the atomic-beam magnetic-resonance method. Three "flop-in" transitions in the $^2D_{5/2}$ electronic state and 2 in the $^2D_{3/2}$ electronic state have been observed at various fields from 5 to 75 gauss. These resonances provide unambiguous evidence for the assigned spin value and furnish preliminary values for the hyperfine-structure separations and nuclear moments of the isotope. The radiosotope was produced from stable metal by the reaction $Sc^{45}(n, \gamma)Sc^{46}$ in the Livermore pool-type reactor. Purity and identification of the isotope were established by pulse height analysis of the gamma ray spectrum. Resonance detection was accomplished by collecting the beam on sulfur-coated "buttons" which were subsequently counted in continuous-flow beta counters.

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California U. [Dept. of Physics] Berkeley.

NUCLEAR SPIN OF YTTRIUM-91 (Abstract), by F. R. Petersen and H. A. Shugart. [19( ] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)339] and Atomic Energy Commission) Unclassified

Presented at meeting of the Amer. Phys. Soc., Los Angeles, Calif., Dec. 27-29, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 514, Dec. 27, 1961.

The nuclear spin I = 1/2 for 58-day yttrium-91 has been measured by the atomic-beam magnetic-resonance method. Five resonances in the $^2D_{3/2}$ electronic ground state corresponding to the transition (2, 1 $\longleftrightarrow$ 2, 0) have been observed up to a field of 200 gauss. These resonances establish the spin of this isotope and provide preliminary information concerning its hyperfine structure and magnetic moment. The isotope was obtained from Oak Ridge National Laboratories as an aqueous solution of YCl_3. Anhydrous YCl_3 was reduced to yttrium metal with calcium filings prior to forming the yttrium beam. Identification and purity of the sample were checked by decay analysis. Resonance detection was accomplished by collecting the radioactive atoms on sulfur-coated "buttons" which were later counted in continuous-flow beta-counters. The observed spin is the same as for stable Y^{89}.

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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. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)339] and Atomic Energy Commission) Unclassified

Published in Phys. Rev., v. 125: 284-291, Jan. 1, 1962.

The atomic-beam magnetic-resonance method has been used to measure the nuclear spin and hyperfine-structure separations of 64-hr Y^{90}. The results are I = 2, $a(^2D_{3/2})$ = -169.749(7) mc/sec, $b(^2D_{3/2})$ = -21.602(27) mc/sec, $a(^2D_{5/2})$ = -85.258(6) mc/sec, $b(^2D_{5/2})$ = -29.716(38) mc/sec. The uncorrected nuclear moments calculated from these measurements are μ_I = -1.623(8) nm, Q = 0.155(3) b. (Contractor's abstract)

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California U. Dept. of Physics, Berkeley.

THERMODYNAMIC BEHAVIOR OF LIQUID HELIUM THREE IN ITS POSSIBLE SUPERFLUID PHASE. 1, by T. Soda and R. Vasudevan. [1961] [45]p. incl. diagrs. (AFOSR-631) (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under AF 49(638)508) AD 259867 Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 288, Apr. 24, 1961.

Also published in Phys. Rev., v. 125: 1484-1493, Mar. 1, 1962.

The thermodynamic behavior of liquid He^3 in its possible superfluid phase is investigated by extending the methods of Brueckner et al. They suggest that such a correlated phase can exist at very low temperatures due to the fact that there exist attractive D-state interactions near the Fermi surface. The free energy and the energy gap of the system for D-state interactions corresponding to different pure azimuthal modes are calculated at different temperatures. It is found that l = 2, m = 2 and l = 2, m = 1 modes correspond to the lowest free energy of the system near the critical temperature. In the intermediate range of temperatures the free-energy curves for the 2 modes, when the computations are made numerically, come out to be very nearly the same. But actually it can be shown by an analytical method that they are identical. The l = 2, m = 0 mode yields a higher free energy for all temperatures less than the critical temperature. The mixing of modes is investigated near the critical temperature. Any linear combination of all the modes l = 2, m = 0, 1, -1, 2, and -2 does not seem to lead to a lower free energy than that of the l = 2, m = ±2, and m = ±1 modes. The correlation lengths at different temperatures are also analyzed. The specific heat and entropy curves for the l = 2, m = 2 mode are given. (Contractor's abstract)

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California U. Dept. of Physics, Berkeley.

THE SECOND-ORDER OPTICAL POTENTIAL FOR PION-NUCLEAR SCATTERING, by R. R. Johnston and K. M. Watson. [1961] 31p. incl. tables, refs. (AFOSR-632) (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under AF 49(638)508) Unclassified

Also published in Nuclear Phys., v. 28: 583-597, Dec. 1961.

The optical model for high energy elastic scattering of pions by nuclei may be explicityl evaluated in terms of 2-nucleon correlations in nuclei

(neglecting tertiary and higher order correlations), using dispersion relations to give the relevant scattering amplitudes. Previous treatments of the effects of pair correlations have assumed specific nuclear models. In the present discussion it is shown how this may be done avoiding model-dependent assumptions. (Contractor's abstract)

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California U. [Dept. of Physics] Berkeley.

EXTENDED SHELL MODEL CALCULATIONS AND EFFECTS OF NONLINEARITY OF DENSITY MATRIX EQUATIONS (Abstract), by J. Sawicki and T. Soda. [1961] [1]p. [AF 49(638)508] Unclassified

Presented at meeting of the Amer. Phys. Soc., Mexico City, June 22-24, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 377-378, June 22, 1961.

Equations for the off-diagonal components of the single particle density matrix of a finite system of fermions are linearized with the inclusion of exchange terms taking into account part of the nonlinearity effect due to the exclusion principle. The leftover terms bilinear in the density operator are then "minimized" by a method somewhat similar to that discussed by Sawada and Sawada and Soda. The effect of the resulting correction terms is estimated on the example of the giant dipole state in O^{16} and is found small giving support to the random-phase approximation. A successive approximation perturbation procedure based on this method can be useful in applications to finite nuclei.

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California U. Dept. of Physics, Berkeley.

CYCLOTRON RESONANCE IN COPPER, by A. F. Kip, D. N. Langenberg, and T. W. Moore. [1961] [14]p. incl. diagrs. refs. (AFOSR-963) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)600 and Office of Naval Research) AD 451639 Unclassified

Also published in Phys. Rev., v. 124: 359-372, Oct. 15, 1961.

Extensive cyclotron resonance experiments in copper at 24 kmc/sec are described. The results are consistent with the Azbel-Kaner theory of cyclotron resonance in metals and with the known Fermi surface geometry. Stationary orbits (orbits having extremal effective mass and vanishing average velocity in the magnetic field direction) are found to dominate the cyclotron resonance signals in copper. The effective mass anisotropy of various classes of stationary orbits is reported. The effects of tipping the magnetic field slightly out of the plane of the sample surface and of the direction of the rf currents with respect to the magnetic field are described. (Contractor's abstract)

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California U. Dept. of Physics, Berkeley.

CYCLOTRON RESONANCE IN ALUMINUM, by T. W. Moore and F. W. Spong. [1961] [1]p. incl. diagrs. tables, refs. (AFOSR-1486) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)600 and Office of Naval Research) AD 454657 Unclassified

Also published in Phys. Rev., v. 125: 845-847, Feb. 1, 1962.

Preliminary results of cyclotron resonance experiments at 35 kmc/sec in aluminum having a relatively long relaxation time at 4.2°K are presented. Discrepancies and errors in earlier cyclotron resonance experiments are resolved. A tentative orbit identification scheme is proposed which indicates (a) that the second-zone Fermi surface is consistent with the single orthogonalized plane wave (OPW) model, and (b) that the third-zone Fermi surface is connected and that the connecting region is thicker than in the single OPW model. The effective masses obtained are compared with the values predicted by the single OPW model and with other experimental values, where pertinent. Departures of the effective mass value of orbits in the second zone from values given by the single OPW model are noted and may be attributable to electron-electron or electron-phonon effects. (Contractor's abstract)

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California U. Dept. of Physics, Berkeley.

BALLOON OBSERVATIONS OF AURORAL-ZONE X-RAYS, by R. R. Brown. [1961] [10]p. incl. diagrs. tables. (AFOSR-414) (Sponsored jointly by [Air Force Office of Scientific Research under AF 49(638)-873], Atomic Energy Commission, and Office of Naval Research) Unclassified

Also published in Jour. Geophys. Research, v. 66: 1379-1388, May 1961.

A series of balloon flights launched from the vicinity of College, Alaska, during June and July 1960 showed that auroral-zone x-rays are detectable with Geiger counters approximately 10% of the time at pressure altitudes in the range 10-15 mb. The results of these flights indicate that the daily flux of electrons with energies greater than 50 kev over the auroral zone is 6×10^{10} particles/cm^2. Late in a magnetic storm that started with a sudden commencement at 1701 UT on July 14, 1960, the average electron influx exceeded the daily rate by more than a factor of 25. (Contractor's abstract)

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California U. Dept. of Physics, Berkeley.

WEST-EAST MOTION OF AN AURORAL-ZONE

X-RAY EVENT, by R. R. Brown. [1961] [5]p. incl. diagrs. table, refs. (AFOSR-J874) (AF 49(638)873) Unclassified

Also published in Jour. Geophys. Research, v. 67: 31-35, Jan. 1962.

A west-east motion of an auroral-zone x-ray event was observed late in the magnetic storm of June 22-23, 1961. Time delays between x-ray bursts at balloon altitude and increases in ionospheric absorption of cosmic radio noise indicate that velocity components along the auroral zone of 200-300 m/sec are present in this type of an event. (Contractor's abstract)

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California U. [Dept. of Physics] Berkeley.

IONOSPHERIC EFFECTS OF SOLAR PROTONS, by R. R. Brown and R. A. Weir, Jr. [1960] [7]p. incl. diagrs. (AFOSR-J876) [AF 49(638)873] Unclassified

Presented at Symposium on Polar Cap Absorption, Kiruna Geophys. Observatory, Royal Swedish Acad. Sci., Helsinki (Finland), Aug. 8-11, 1960.

Also published in Arkiv Geofysik, v. 3: 523-529, 1962.

The attenuation of cosmic radio noise produced by the ionizing effects of solar flare protons has been calculated. These calculations, in conjunction with riometer observations during a polar cap event were used to estimate the flux of protons incident on the atmosphere. (Contractor's abstract)

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California U. Dept. of Physics, Berkeley.

ELEMENTARY DERIVATION OF THE DIELECTRIC CONSTANT OF AN IMPERFECT GAS, by A. N. Kaufman and K. M. Watson. [1961] [2]p. (AFOSR-J19) (Sponsored jointly by [Air Force Office of Scientific Research under AF AFOSR-62-121] and Atomic Energy Commission) AD 400385 Unclassified

Also published in Jour. Chem. Phys., v. 36: 439-440, Jan. 15, 1962.

A general formula for the "second Clausius-Mossotti coefficient" is obtained from elementary considerations of statistical mechanics. (Contractor's abstract)

254

California U. [Dept. of Physics] Berkeley.

THEORY OF COLLECTIVE EXCITATIONS OF SPHERICAL NUCLEI WITH PARTICULAR APPLICATION TO THE GIANT DIPOLE STATE, by J. Sawicki and T. Soda. [1961] [23]p. incl. tables, refs. (AFOSR-J20) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-121] and Office of Naval Research) AD 400451 Unclassified

Also published in Nuclear Phys., v. 28: 270-292, Dec. 1961.

The system of equations of motion for the components of the one-particle density matrix is linearized for a finite system of fermions interacting through a two-body "residual" force. Exchange terms are included. Equations corresponding to those of the "extended shell model" method are obtained for calculating collective states of spherical nuclei of definite angular momentum, parity, spin and isobaric spin, both in the j-j and L-S coupling scheme. Particular application and solution of such equations is obtained for the case of the giant dipole state of O^{16} by the use of finite range potentials with two different mixtures of exchange forces and radial shapes. The matrix elements are antisymmetrized and the "backward-going graphs" are included. Satisfactory agreement with experiment is obtained. The left-over terms bilinear in the density operator are then "minimized" by extracting their lowest order linear contribution. The resulting correction terms are estimated for the giant dipole state in O^{16} and found small, giving support to the random phase approximation. (Contractor's abstract)

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California U. Dept. of Physics, Berkeley.

ELECTRON SCATTERING FROM HYDROGEN, by C. Schwartz. [1961] [4]p. incl. diagrs. table. (AFOSR-J25) (Sponsored jointly by [Air Force Office of Scientific Research under AF AFOSR-62-121] and Office of Naval Research) AD 297115 Unclassified

Also published in Phys. Rev., v. 124: 1468-1471, Dec. 1, 1961.

Kohn's variational principle has been used to calculate s-wave elastic scattering of electrons from atomic hydrogen, using up to 50 trial functions of the type introduced by Hylleraas to describe the bound states of two-electron atoms. The phase shifts calculated at several energies up to 10 ev appear to have converged well, leaving residual uncertainties mostly less than one thousandth of a radian. Taking extra pains to include the effect of the long-range force at zero energy, we have also determined very accurate values for the scattering lengths.

256

California U. Dept. of Physics, Berkeley.

STATISTICAL THEORY OF THE DIELECTRIC CONSTANT OF AN IMPERFECT GAS, by A. N.

Kaufman and K. M. Watson. [1961] [13]p. incl. diagrs. refs. (AFOSR-J26) (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-62-121] and Atomic Energy Commission) AD 297116 Unclassified

Also published in Phys. Fluids, v. 4: 931-943, Aug. 1961.

By means of the linked-diagram expansion of the grand partition function of a molecular gas in an electrostatic field, an expression for the polarization P(R) of the gas is obtained. Spatial variation of the external electric field $E_0(R)$ requires an explicit treatment of long-range cooperative interactions between "clusters" of molecules. For fields that vary appreciably over microscopic dimensions, an integral relation is found relating the polarization P(R) to the electric field E(R). For fields varying negligibly over microscopic regions, an expression for the dielectric constant K of the gas is obtained, which is a generalization of the Clausius-Mossotti formula involving the density n and the temperature-dependent polarizabilities of m-molecule linked clusters. (Contractor's abstract, modified)

257

California U. Dept. of Physics, Berkeley.

VARIATIONAL CALCULATIONS OF SCATTERING, by C. Schwartz. [1961] [15]p. incl. diagrs. (AFOSR-J136) (Sponsored jointly by [Air Force Office of Scientific Research under AF AFOSR-62-121] and Office of Naval Research) AD 400187 Unclassified

Also published in Ann. Phys., v. 16: 36-50, Oct. 1961.

It was found that the behavior of calculated results using variational principles for scattering problems is rather different from that previously known for bound-state problems. As more and more adjustable terms are added to the trial function, the "stationary" value for the phase shift does not converge smoothly but may on occasion turn out to be grossly inaccurate. The phenomenon is displayed and partially analyzed, but not completely understood. The conclusion is that for a given amount of computational labor, a scattering phase shift may be determined only to an accuracy an order of magnitude worse than that of the analogous eigenvalue problem. (Contractor's abstract)

258

California U. Dept. of Physics, Berkeley.

IMPORTANCE OF ANGULAR CORRELATIONS BETWEEN ATOMIC ELECTRONS, by C. Schwartz. [1961] [5]p. incl. tables, refs. (AFOSR-J138) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-62-121, Atomic Energy Commission, and Office of Naval Research) AD 400077 Unclassified

Also published in Phys. Rev., v. 124: 1015-1019, May 1, 1962.

The results of some variational calculations on 2 atomic problems — the correlation energy in the ground state of 2-electron atoms, and elastic scattering of slow electrons from hydrogen atoms — are presented to show the relative importance of various angular components of the complete wave function. It is concluded that, as a general rule, the use of just (relative) s and p waves will give quite accurate answers, with only a few percent errors at most; but to obtain higher precision, the Legendre polynomial expansion should be abandoned in favor of the coordinate r_{12}. (Contractor's abstract)

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California U. [Electronics Research Lab.] Berkeley.

SAMPLED-DATA CONTROL SYSTEMS, by E. I. Jury. New York, Wiley and Sons, 1958, 453p. incl. diagrs. tables, refs. [AF 18(600)1521] Unclassified

The bulk of the material of this book was taught as a two-semester graduate course at Berkeley in the field of control systems. The book is considered a basic text in this field and includes substantial coverage of nonlinear systems. The first four chapters and chapter 8 are oriented toward the analysis problem. Chapters 5, 6, and 7 are directed toward synthesis. Chapter 9 presents an exact analysis and stability study of sampled-data systems with finite pulse width and the limitations of the z-transform.

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California U. Electronics Research Lab., Berkeley.

CONVOLUTION Z-TRANSFORM METHOD APPLIED TO CERTAIN NONLINEAR DISCRETE SYSTEMS, by E. I. Jury and M. A. Pai. Jan. 18, 1961, 28p. incl. diagrs. table, refs. (Series no. 60 ; issue no. 341) (AFOSR-200) (AF 18(600)1521) AD 252737; PB 155452 Unclassified

Also published in I. R. E. Trans. on Automatic Control, v. AC-7: 57-64, Jan. 1962.

The convolution z-transform method is applied to obtain an explicit solution of certain nonlinear difference equations. The explicit solution is often desired for system design as well as for obtaining the response for large intervals of time. In these difference equations which describe the physical discrete systems, it is assumed that the nonlinearities are small. This is necessitated by the form of solution applicable to the use of the convolution method. The advantage of the method is to systematize the procedure for the solution as well as to obtain results in a closed form. The convergence of the solution is discussed as well as applications to certain examples. The examples chosen are feedback sampled-data systems with nonlinearities in the forward and feedback paths, respectively. Explicit solution

in a closed form is obtained for the error as well as the output response. These results compare favorably with the numerical solution of the nonlinear difference as a recurrence relationship. (Contractor's abstract)

261

California U. Electronics Research Lab., Berkeley.

MINIMAL TIME REGULATOR PROBLEMS FOR LINEAR SAMPLED-DATA SYSTEMS (GENERAL THEORY), by C. A. Desoer and J. Wing. Feb. 14, 1961, 37p. incl. diagrs. refs. (Series no. 60; issue no. 346; AFCRL-149) (AFOSR-424) (Sponsored jointly by Air Force Cambridge Research Labs. as Scientific rept. no. 4 under AF 19(604)5466 and Air Force Office of Scientific Research under AF 18(600)-1521) AD 256853 Unclassified

Also published in Jour. Franklin Inst., v. 272: 208-228, Sept. 1961.

A sampled-data control system is considered in which the plant transfer function is a constant divided by an n^{th}-order polynomial in s. The control signal f(t) goes through a sampler of period T and a zero-order hold circuit. The problem is: given an arbitrary set of initial conditions, find the control f(t), satisfying $|f(t)| \leq 1$, and the corresponding optimal strategy to generate that control which will bring the system to equilibrium in the minimum number of sampling periods.

262

California U. Electronics Research Lab., Berkeley.

TWO THEOREMS CONCERNING REGULAR MARKOV CHAINS, by G. G. Lendaris. Feb. 27, 1961, 19p. (Series no. 60; issue no. 347) (AFOSR-480) (AF 18-(600)1521) AD 255355 Unclassified

A (weighted, directed) graph is associated to the transition matrix P and its graph theoretic properties are used to establish the proofs of the following two theorems: (1) If for an r x r non-negative matrix P = (p_{ij}) there exists an n > 0 such that $p_{ij}^{(n)} > 0$ for all i, j, then there is an $n' \leq N = r^2 - 2r + 2 = (r-1)^2 + 1$ such that $p_{ij}^{(n')} > 0$ for all i, j. (2) A Markov chain is regular if and only if the (directed) graph corresponding to its transition matrix has the following 2 properties: (a) there exists at least one (directed) closed path containing all nodes, and (b) the set of numbers $\{a_i\}$, representing the lengths of all the simple loops in the graph, be relatively prime.

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California U. Electronics Research Lab., Berkeley.

ON THE IDENTIFICATION AND ADAPTIVE CONTROL OF SAMPLED-DATA SYSTEMS, by G. G. Lendaris. Mar. 21, 1961 [79]p. incl. diagrs. table, refs. (Series no. 60; issue no. 351) (AFOSR-720) (AF 18-(600)1521) AD 259906 Unclassified

A procedure is presented for identifying a linear, lumped-parameter, time-invariant (at least during the measurement period), single-input system from its response to a step excitation. Then, an adaptive sampled-data control system is designed using a digital computer to perform this identification procedure and to act as the controller for the system. The system was actually built, and some experimental results are cited. This identification technique requires 2n + 1 measurements of the magnitude of the output, where n is the order of the system and the measurements are taken at equally spaced intervals of time. These measurements are used as the coefficients in n scalar equations whose n unknowns are the coefficients of the z-transformed characteristic equation of the system. This set of n scalar equations is solved for these coefficients (on a digital computer). For some applications, this characterization of the system is sufficient; when it is not, then this equation is factored to yield the system's z-plane poles, and from this, the corresponding s-plane poles are found. This procedure is independent of initial conditions and will work for any such system (even for the multiple eigenvalue case) the only restriction being that all the poles of the system be excited when the measurements are made. (Contractor's abstract)

264

California U. Electronics Research Lab., Berkeley.

A DISCRETE COMPENSATOR FOR SAMPLED-DATA SYSTEMS USING MAGNETIC CORES AS STORAGE ELEMENTS, by G. G. Lendaris. May 11, 1961, 39p. incl. illus. diagrs. (Series no. 60; issue no. 356) (AFOSR-1141) (AF 18(600)1521) AD 264355 Unclassified

The construction of a discrete compensator to be used in a sampled-data control system is described. The compensator employs a discrete delay line utilizing magnetic cores to store, in pulse-width-modulated form, the sampled values of the signal. This system requires no relays or stepping switches; everything is solid state except for the amplifiers used in the sample and hold circuits, demodulation integrators, and coefficient multiplication. This tapped delay line operates like a shift register. A group of toroidal cores with coils wound on them are connected in series. Each core is set to negative saturation; then a signal is impressed onto the first core in the chain for a certain period of time. Next, a reset signal is impressed onto this first core, and simultaneously a set signal of the same amplitude is impressed onto the second core. Thus the first step of the shifting is accomplished. This can be repeated as often as desired, depending only on how many cores are in the chain. (Contractor's abstract)

265

California U. Electronics Research Lab., Berkeley.

A SIMPLIFIED STABILITY CRITERION FOR LINEAR DISCRETE SYSTEMS, by E. I. Jury. June 14, 1961, 36p. incl. diagrs. tables, refs. (Series no. 60; issue no. 373) (AFOSR-1170) (AF 18(600)1521) AD 264678 Unclassified

Also published in Proc. Inst. Radio Engineers, v. 50: 1493-1500, June 1962.

A simplified analytic test of stability of linear discrete systems is obtained. This test also yields the necessary and sufficient conditions for a real polynomial in the variable z to have all its roots inside the unit circle in the z-plane. It is shown that for the test of a fourth-order system only a third-order determinant is required and for the fifth-order only two determinants are required. The test is applied directly in the z-plane and yields the minimum number of constraint terms. Stability constraints up to the fifth-order case are obtained and for the nth-order case are formulated. (Contractor's abstract)

266

California U. Electronics Research Lab., Berkeley.

[SAMPLED DATA CONTROL SYSTEMS], by E. I. Jury. Final technical rept. July 15, 1955-Sept. 30, 1961, 18p. incl. illus. diagr. refs. (Series no. 60; issue no. 401) (AFOSR-1171) (AF 18(600)1521) AD 264630 Unclassified

The material of this report is divided into 2 parts: (1) theoretical investigations and (2) experimental investigations. In the first part discussions are made of (a) linear theory, (b) statistical theory, (c) time-varying theory, (d) nonlinear theory (e) optimal control, (f) identification and adaptive control, (g) applications to other fields, and (h) other pertinent topics. In the section on experimental investigations, problems associated with simulation, programming and physical implementation of components and systems are discussed. Pictures illustrating the physical set-up of equipment and its purpose are presented, as well as references to published reports and papers.

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California U. Electronics Research Lab., Berkeley.

STATISTICAL STUDY OF PULSE WIDTH MODULATED CONTROL SYSTEMS (I), by S. C. Gupta and E. I. Jury. Sept. 12, 1961, 55p. incl. diagrs. tables, refs. (Series no. 60; issue no. 403) (AFOSR-1628) (AF 18(600)1521) AD 267895 Unclassified

Also published in Jour. Franklin Inst., v. 273: 292-321, Apr. 1962.

Efforts concern a statistical study of pulse width modulated control systems. The pulse width modulator (PWM) was first considered for positive signals only. The output of this was then compared with the output of the approximate model where the PWM was replaced with a sampler, saturating nonlinear element and a hold circuit based on equal area approximation. An example was worked to show that there is little error involved in the use of this approximation. Using this as the basis, the open loop case was worked out for Gaussian inputs. The results were tabulated and graphed. In the solution of the closed-loop system the difficulty of the calculation of the cross-correlation function was overcome by making another approximation based on the separability property of the Gaussian process. This facilitates the whole problem and the relationship of output mean square value to input is graphed for a simple example. (Contractor's abstract)

268

California U. Electronics Research Lab., Berkeley.

THE ANALYSIS OF NONLINEAR FEEDBACK SAMPLED-DATA SYSTEMS, by M. A. Pai. June 20, 1961 [71]p. incl. diagrs. table, refs. (Series no. 60; issue no. 384) (AFOSR-1791) (AF 18(600)1521) AD 271763 Unclassified

Various techniques are available for the analysis of nonlinear sampled-data systems. Most of these methods use either the phase plane approach or the describing function technique. Since the performance of such a system is described, at sampling instants, by means of a difference equation, an approach based on the difference equation would seem to be both natural and direct. The principle of complex convolution for a transform is explained and its geometrical interpretation is given. It is shown how the application of the convolution transform is both direct and simple with respect to solving nonlinear difference equations when the equation is given in scalar form. Dependence of the convergence of the solution on the initial value and the degree of nonlinearity is pointed out. It is concluded that for difference equations of second order and higher, this method involves too much laborious computation to justify its use. A simple method is presented for examining free oscillations in a sampled-data system containing either relay or a saturating amplifier. In addition, a certain analytical technique, analogous to that for differential equations, is developed to investigate the stability of forced oscillations for certain types of nonlinear difference equations.

269

California U. Electronics Research Lab., Berkeley.

STABILITY STUDY OF PULSE-WIDTH MODULATED AND NONLINEAR SAMPLED-DATA SYSTEMS, by T. Nishimura. Apr. 4, 1961, 68p. incl. diagrs. refs. (Series no. 60; issue no. 353) (AFOSR-2268) (AF 18-(600)1521) AD 273858 Unclassified

The fundamental equation that describes limit cycles in nonlinear sampled-data systems was derived.

The equivalence of limit cycles with finite pulsed systems having a periodically varying sampling-rate was observed, and the methods of analysis applied to the latter were extended to obtain these limit cycles with the aid of final value theorem. This fundamental equation is modified and simplified under certain assumptions as it can be applied to systems both with and without integrators. The limitation on the longest period of saturated and unsaturated oscillation is investigated and the critical gain for their existence is derived, starting from the modified fundamental equation. Also, the stability of limit cycles and the equilibrium point is considered, based on Neace's method. Various kinds of non-linearities, namely, pulse-width modulation, relay saturating amplifier with linear zone, and quantized level amplifier are discussed. Self-excited oscillations are mainly examined, as well as the possible existence and stability of limit cycles, however, the method can be extended to forced oscillations. (Contractor's abstract)

270

California U. [Electronics Research Lab.] Berkeley.

ADDITIONS TO STABILITY CRITERION FOR LINEAR DISCRETE SYSTEMS, by E. I. Jury. [1961] 7p. (AFOSR-3920) (AF 18(600)1521) Unclassified

Also published in I. R. E. Trans. on Automatic Control, v. AC-5: 342-343, Sept. 1961. (Title varies)

In a preceding note, the author discussed a simplified form of the Schür-Cohn criterion that can be readily applied to the stability test of linear discrete systems. A further identification is described in which one of the constraints (depending on the evaluation of an n-th order determinant) is replaced by two auxiliary constraints of a simple nature.

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California U. [Electronics Research Lab.] Berkeley.

NOTES ON THE STABILITY CRITERION FOR LINEAR DISCRETE SYSTEMS, by E. I. Jury and B. H. Bharucha. [1961] [3]p. [AF 18(600)1521] Unclassified

Published in I. R. E. Trans. on Automatic Control, v. AC-6: 88-90, Feb. 1961.

It is shown that the evaluation of the Schür-Cohn determinants can be simplified considerably, so that the manipulations involved in testing for the zeros of a polynomial are comparable to those using the "transformed" Routh-Hurwitz criterion, thus avoiding the bilinear transformation. For an n-order polynomial in z, the test for stability involves evaluating determinants up to order n.

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California U. [Electronics Research Lab.] Berkeley.

OPTIMIZATION PROCEDURES FOR SAMPLED-DATA AND DIGITAL CONTROL SYSTEMS, by E. I. Jury. [1959] [11]p. incl. diagrs. refs. [AF 18(600)-1521] Unclassified

Presented at Fifth meeting of the Swiss Federation of Automatic Control, Lausanne (Switzerland), May 20, 1959.

Published in Sci. Elec., v. 7: 16-26, Mar. 1961.

This paper discusses the main features of optimization procedures for control systems. The optimization procedure is based on minimizing the mean squared error (difference between actual and desired output). Physical realizability and stability conditions are included in the procedure for obtaining the digital transfer function $D^*(z)$. The method of approach is based on the modified z transform and certain features of this method are briefly indicated. The extension of this method to the use of digital computers as means of compensation and filtering in a feedback path and to systems with pure delays and of finite pulse width are indicated. (Contractor's abstract, in part)

273

California U. [Electronics Research Lab.] Berkeley.

ON THE EVALUATION OF THE STABILITY DETERMINANTS IN LINEAR DISCRETE SYSTEMS, by E. I. Jury. [1961] [5]p. incl. diagrs. [AF 18(600)1521] Unclassified

Published in I. R. E Trans. on Automatic Control, v. AC-7: 51-55, July 1962.

In this note it is shown that for obtaining the stability condition of an n-order polynomial in the z plane, only one (n-1) order determinant need be evaluated. This major simplication is of importance to obtain the stability constraints when the coefficients of the polynomial are given other than numbers.

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California U. [Electronics Research Lab.] Berkeley.

HIGH-FREQUENCY EFFECTS OF THE POTENTIAL MINIMUM ON NOISE, by J. R. Whinnery. [1959] [13]p. incl. diagrs. refs. [AF 49(638)102] Unclassified

Published in I.R. E. Trans. on Electron Devices, v. ED-7: 218-230, Oct. 1960.

A physical model of the compensation phenomenon in space-charge reduced shot noise is discussed and first applied to a planar diode of infinite spacing short-circuited to ac effects. Analysis of both the time response and frequency response shows that

parameters of the potential minimum are very important to the degree of noise compensation or over-compensation, and for certain parameters the internal feedback mechanism of returning charges may cause a self oscillation without external stimuli, or in other words a building-up to saturation levels of noise phenomena in these frequency ranges. The short-circuited diode of finite spacing is analyzed in both the frequency domain and time domain, and an approximate correction to the results found as a function of total transit angle across the diode. In particular, the factor produces appreciable decreases in the reduction factor in the vicinity of certain transit angles across the diode, and as the Tien dips occur in these general ranges, the finite diode spacing is believed to be a strong candidate for explanation of these dips. (Contractor's abstract, in part)

275

California U. Electronics Research Lab., Berkeley.

SPACE-CHARGE INSTABILITIES IN ELECTRON DIODES AND PLASMA CONVERTERS, by C. K. Birdsall and W. B. Bridges. Jan. 26, 1961, 29p. incl. diagrs. table, refs. (Series no. 60; issue no. 343) (AFOSR-387) (AF 49(638)102) AD 258890 Unclassified

Also published in Jour. Appl. Phys., v. 32: 2611-2618, Dec. 1961.

Space-charge instabilities in diodes were found to produce variations in potential and current that are larger than predicted from classical static analyses and, moreover, which produce sustained electrokinetic oscillations. The classical static solution is reviewed and the new transient solution is presented briefly. As applications, tentative explanations are offered for recent observations of extra shot-noise smoothing and of oscillations in thermionic converters. (Contractor's abstract)

276

California U. [Electronics Research Lab.] Berkeley.

GENERAL ANALYSIS OF OPTICAL, INFRARED, AND MICROWAVE MASER OSCILLATOR EMISSION, by J. R. Singer and S. Wang. Mar. 21, 1961, 8p. incl. diagrs. refs. (Series no. 60; issue no. 352) (AFOSR-388) (AF 49(638)102) AD 256632 Unclassified

Also published in Phys. Rev. Ltrs., v. 6: 351-354, Apr. 1, 1961.

The equations governing coherent emission from quantum mechanical amplifiers (microwave, infrared, and optical masers) are generalized, using either electric or magnetic dipole transitions. It is found that an amplitude modulation of the output is to be expected from all maser oscillators except those in which excited atoms are supplied at a notably greater rate than the depopulation rate due to coherent induced emission. The analysis also suggests that energy population inversions of electric dipole moments can be performed using coherent light sources in the same manner as with magnetic dipole moments. It appears, therefore, that modulation of an optical or infrared maser may be easily accomplished by varying the population of excited states through control of the pumping energy. This modulation may be both by absorption and by amplification.

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California U. Electronics Research Lab., Berkeley.

ELECTRON-STREAM KINETIC-POWER SECOND-ORDER TERMS AS OBTAINED FROM MacCOLL'S MEAN VALUES, by C. K. Birdsall. [1961] [6]p. (Series no. 60; issue no. 348) (AFOSR-482) (AF 49-(638)102) AD 255832 Unclassified

Also published in Jour. Appl. Phys., v. 33: 236-237, Jan. 1962.

MacColl (Bell System Tech. Jour., v. 39: 365, 1960) has given some mean-value results for traveling-wave-tube circuit voltage and current and for stream density and velocity. This note presents (a) some discussion of his results: (b) some extensions which produce second-order velocity and density values, useful in power calculations; and (c) the dilemma of a change in time-averaged density but none in voltage. (Contractor's abstract)

278

California U. Electronics Research Lab., Berkeley.

COHERENT OPTICAL EMISSION FROM MOLECULAR BEAMS, by I. Gorog. Nov. 20, 1961, 29p. incl. diagr refs. (Series no. 60; issue no. 418) (AFOSR-1978) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)102 and Army Research Office under DA-ARC(D)-31-124-G151) AD 275428 Unclassified

The feasibility of constructing an optical maser in which the excited atoms are obtained as products of photodissociation of alkali-halides is considered. It is shown that by confining the active particles to a molecular beam an excess reduction in the output linewidth can be obtained. The case of a rubidium-iodide system is treated in detail. Photodissociation is achieved by pumping at 2537A and induced emission occurs at 7800A corresponding to the $Rb^{I}(5p \rightarrow 5s)$ transition. The calculations show that maser oscillation in such a system is possible. (Contractor's abstract, in part)

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California U. Electronics Research Lab., Berkeley.

A SPIN-ECHO MEMORY FOR A CARRIER TYPE

DIGITAL COMPUTER, by L. K. Wanlass. Aug. 28, 1961, 149p. incl. illus. tables, refs. (Series no. 60; issue no. 399) (AFOSR-2767) (AF 49(638)102)
AD 284290 Unclassified

Electron spin-echo was studied as a possible carrier digital computer memory element at microwave frequencies. A general study is made of solid state paramagnetic crystals as possible storage materials. Spin-spin and spin-lattice relaxation times are considered in general, and were measured for calcite, silicon, and other crystals. A study was made of cross-relaxation in calcite using a stimulated spin-echo technique. A decrease in the potential storage time of this crystal by a factor of 8000 is reported due to this relaxation mechanism. Detailed measurements were made on the spin-echo signals obtainable at microwave frequencies, and usable amplitude echoes are reported for many crystals and impurity concentrations. A study of noise sources and signal to noise ratios was made. An original system for storing the phase of phase script information pulses was investigated. A complete carrier computer regenerative memory system using two spin-echo devices and a single connecting channel was considered. The storage capacity of the memory device was theoretically determined. (Contractor's abstract)

280

California U. Electronics Research Lab., Berkeley.

THE EMISSION, PULSE-LEVEL INVERSION, AND MODULATION OF OPTICAL MASERS, by J. R. Singer and S. Wang. [1961] [9]p. incl. diagr. refs. (AFOSR-JC2) (AF 49(638)102) Unclassified

Presented at Second Internat'l. Conf. on Quantum Electronics, Berkeley, Calif., Mar. 23-25, 1961.

Also published in Advances in Quantum Electronics, New York, Columbia U. Press, 1961, p. 299-307.

It is shown that for any two-level optical or microwave maser system, the interaction between the radiation field and the radiating molecules results in an amplitude modulation of the radiation output. When the rate of excitation of active molecules is sufficiently large, the output may be essentially smooth at equilibrium, but rather unusual conditions are required to observe a constant amplitude output. A combined amplitude and pulse position modulation method is discussed which is suitable for information transmission with an optical maser. Pulse inversion can be accomplished using partially coherent light. Pulse inversion optical masers can be efficiently modulated by use of a pulse position code.

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California U. [Electronics Research Lab.] Berkeley.

STIFFNESS OF ELECTRON BEAMS, by J. L. Palmer and C. Süsskind. [1961] [9]p. incl. refs. (AFOSR-J63) [AF 49(638)102] Unclassified

Also published in Jour. Electronics and Control, v. 10: 365-373, May 1961.

A new parameter for use with electron-beam devices is defined as a quantitative measure of the extent to which the beam withstands the effects of transverse forces. The new figure of merit can be used to compare the effectiveness of various methods of constraining the beam, as illustrated by application to the cases of space-charge-balanced flow (including Brillouin flow and immersed flow), periodic focusing, Harris flow, E- and C-type flow, and M-type flow. Stiffness is defined as the rate of change of force (in the direction transverse to that of beam travel) that acts to restore a displaced electron to its equilibrium trajectory in a laminar beam. (Contractor's abstract)

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California U. Electronics Research Lab., Berkeley.

STIMULATED SPIN-ECHO MEASUREMENT OF CROSS-RELAXATION IN NEUTRON-IRRADIATED CALCITE, by L. K. Wanlass and J. Wakabayashi. [1960] [3]p. incl. illus. diagr. (AFOSR-J64) [AF 49-(638)102] Unclassified

Also published in Phys. Rev. Ltrs., v. 6: 271-273, Mar. 15, 1961.

The Hahn spin-echo technique was used at 8.807 kmc/s to study stimulated epr spin echoes occurring due to cross relaxation between the three spectral lines of neutron-irradiated calcite at 1.5°K. Results obtained show that when the normal spin-lattice relaxation time T_1 is longer than the cross relaxation time, T_{21}, this technique yields a single exponential decay curve to the T_{21}. The value obtained at 1.5°K is T_{21} = 600 μsec (T_1 = 5 ± 2 sec). The use of this technique for studying inhomogeneously broadened lines is considered.

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California U. Electronics Research Lab., Berkeley.

PHASE STABILITY IN FREQUENCY MULTIPLIERS, by R. R. Dimmick. June 2, 1961, 43p. incl. illus. diagrs. tables, refs. (Series no. 60; issue no. 366) (AFOSR-1014) (Sponsored jointly by Air Force Office of Scientific Research, Department of the Army, and Office of Naval Research under AF 49(638)1043)
AD 265755 Unclassified

Work is described pertaining to phase stability of frequency multipliers with particular emphasis on class C vacuum-tube frequency multiplier chains. Various sources of phase perturbations were considered and experimental work performed to establish the magnitude of their effects on a practical device. Temperature variation was found to be the most serious source of phase instability. A general discussion of frequency standards is included and the need for frequency multipliers in the translation of a

standard frequency is pointed out. Frequency multiplier chains are discussed and the class C multiplier selected for the major portion of the work because of the simplicity of its design and its general use. Sources of phase perturbation considered include tube noise, temperature variation, and supply-voltage variation. The effects of such sources were determined on an experimental multiplier chain and recommendations were made regarding multiplier chain design. Indications were that frequency errors due to phase perturbations could be held to less than $1:10^{11}$ with suitable precautions. It is suggested that a similar program on semiconductor multiplier chains would be of interest. (Contractor's abstract)

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California U. Electronics Research Lab., Berkeley.

THE SCATTERING OF MICROWAVES FROM MULTIPLE SPHERES, by K. A. Moe and D. J. Angelakos. June 2, 1961 [39]p. incl. diagrs. (Series no. 60; issue no. 365) (AFOSR-1136) (Sponsored jointly by Air Force Office of Scientific Research, Department of the Army, and Office of Naval Research under AF 49(638)1043) AD 265754 Unclassified

An approximate method of calculating the back scattered energy of certain types of arrays of spheroids using geometrical optics is applied to the case in which spheres are merged to a single sphere. Supplementary data were assimilated which allows the determination of the relative back scattered energy for all angles of incidence. Thus there exists an accurate experimental spectrum of the back scattering cross-section of these arrays for the range of separations at which the individual scattering hypothesis cannot be reasonably assumed. (Contractor's abstract)

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California U. Electronics Research Lab., Berkeley.

MICROWAVE PROPAGATION IN AROMATIC COMPOUNDS, by N. Kusnezov. June 13, 1961 [78]p. incl. diagrs. tables, refs. (Series no. 60; issue no. 369) (AFOSR-1187) (Sponsored jointly by Air Force Office of Scientific Research, Department of the Army, and Office of Naval Research under AF 49(638)1043) AD 265790 Unclassified

An investigation of those electrical properties of aromatic compounds which are related to their potential uses as microwave modulators or mixers is presented. The study includes: repeat measurements of conductivity and variations of conductivity of aromatic materials as functions of the intensity and frequency of the irradiating light, measurement of the Hall constants of the materials, investigation of the variation of the dielectric constant of the materials in x-band range in the dark and while irradiated by light, and investigation of the x-band magneto-optical properties of the materials. Interest was centered upon the photosemiconducting compounds and the materials used were anthracene, naphtalene, and phtalocyanine. (Contractor's abstract)

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California U. Electronics Research Lab., Berkeley.

CORRELATION PROCESSES IN ANTENNA ARRAYS, PART II, by I. W. Linder. June 13, 1961, 28p. incl. diagrs. table. (Series no. 60; issue no. 371) (AFOSR-1348) (Sponsored jointly by Air Force Office of Scientific Research, [Army Research Office (Durham)], and Office of Naval Research under AF 49(638)1043) AD 267894 Unclassified

Investigations concern the use of statistical correlation techniques in combining the voltages induced on the elements of a receiving antenna array. Analysis was made of the nonlinear processes in these arrays when both signal and distributed noise sources are present. The effect of distributed noise was analyzed, resulting in an expression for element spacing which will minimize the undesired noise voltage induced on the array. Channel capacities of linear and of nonlinear arrays were then compared. These results are employed to construct nonlinear arrays which will optimize the S/N or will provide a minimum beamwidth in the antenna directional pattern. (Contractor's abstract)

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California U. Electronics Research Lab., Berkeley.

A VARIATIONAL SOLUTION FOR THE SCATTERING OF ELECTROMAGNETIC PULSES FROM A CYLINDER OF FINITE LENGTH, by W. J. Welch. Aug. 11, 1961, 27p. incl. diagrs. (Series no. 60; issue no. 392) (AFOSR-1534) (Sponsored jointly by Air Force Office of Scientific Research, Department of the Army, and Office of Naval Research under AF 49(638)1043) AD 265853 Unclassified

The problem of the scattering of an essentially plane electromagnetic pulse by a thin metallic cylinder of finite length is treated by means of a variational formula derived in an earlier paper (I. R. E. Trans. on Antennas and Propagation, v. AP-8: 68, Jan. 1960). The pulse is a delta function, and it is assumed that the current induced on the scatterer is a damped sinusoid with the frequency of oscillation such that the cylinder is one half wavelength long and the damping is calculated by a related variational technique. The time dependence of the echo at a large distance from the cylinder is plotted for two different thicknesses of the cylinder. (Contractor's abstract)

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California U. Electronics Research Lab., Berkeley.

OPTICAL MASER BY THE METHOD OF ELECTRON

EXCITATION, by L. Lin. Sept. 27, 1961, 17p. incl. diagrs. refs. (Series no. 60; issue no. 407) (AFOSR-1639) (Sponsored jointly by Air Force Office of Scientific Research, Department of the Army, and Office of Naval Research under AF 49(638)1043) AD 267896 Unclassified

A method of achieving optical maser oscillation by electron excitation was investigated. In this scheme, atoms in the ground level, upon collision with incident electrons, made transitions to excited levels. It was shown that maser oscillation is possible between 2 excited levels, if certain conditions are satisfied. A simple model was used for general analysis, and an Hg vapor system was utilized as an example. (Contractor's abstract)

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California U. Electronics Research Lab., Berkeley.

A CIRCUIT MODEL FOR A SILICON MESA TRANSISTOR, by H. T. Chua. July 31, 1961, 65p. incl. diagrs. refs. (Series no. 60; issue no. 386) (AFOSR-1697) (Sponsored jointly by Air Force Office of Scientific Research, Department of the Army, and Office of Naval Research under AF 49(638)1043) AD 268667 Unclassified

A study is presented on the behavior of the mesa transistor as the active component in a video amplifier. The drift potential across the base was found, and the internal parameters of the transistor based on the one dimensional analysis were obtained by solving the continuity equation. Simple calculations of the parameters were made and used, together with the knowledge of the physical dimensions, to develop the equivalent circuit. The method of measurements of the parameters is discussed, then follow the actual measurements which are compared, wherever possible, with the calculated values. The equivalent circuit and the measured parameters were finally used in a simple video amplifier circuit. From the calculated and measured response of the amplifier, the equivalent circuit of the mesa transistor was simplified and found to be similar to that of a normal transistor. (Contractor's abstract)

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[California U. Electronics Research Lab., Berkeley]

STABILITY OF A CLASS OF DISCRETE CONTROL SYSTEMS CONTAINING NONLINEAR-GAIN ELEMENTS, by S. Kodama. [1961] 18p. incl. diagrs. tables, refs. (AFOSR-1747) (Sponsored jointly by Air Force Office of Scientific Research, Department of the Army, and Office of Naval Research under AF 49(638)1043) Unclassified

Also published in I. R. E. Trans. on Automatic Control, v. AC-7: 102-109, Oct. 1962.

An attempt is made to find an explicit stability gain sector for a class of autonomous discrete control systems containing a nonlinear gain element. A quadratic form Lyapunov function is assumed and the Aizerman technique is used to find such a stability sector. A method to select the quadratic Lyapunov function to maximize the width of the sector is suggested. (Contractor's abstract)

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California U. Electronics Research Lab., Berkeley.

HIGH FREQUENCY TRANSISTOR OSCILLATORS, by J. W. Kenny. June 9, 1961, 41p. incl. illus. diagrs. table. (Series no. 60; issue no. 368) (AFOSR-1749) (Sponsored jointly by Air Force Office of Scientific Research, Department of the Army, and Office of Naval Research under AF 49(638)1043) AD 269522 Unclassified

The operation of high frequency class-C alloy junction transistor oscillators is studied by use of a simplified version of the block-diagram representation for the transistor as developed by Bruun. For the simplified version of the block-diagram representation used, unilateral operation of the transistor is assumed. Expressions approximating the transistor time delay, peak ac input voltage, and the collector current pulse cutoff time are derived by use of the block-diagram equations. An analog circuit, derived from the block-diagram equations, is used to study the class-C operation of a typical alloy junction transistor, and the results of this study are found to compare accurately with the actual transistor operation. (Contractor's abstract)

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California U. Electronics Research Lab., Berkeley.

NEURO MUSCULAR CONTROL: POSSIBLE SUBJECT FOR BIONIC STUDY, by G. G. Furman. Aug. 11, 1961, 32p. incl. diagrs. refs. (Series no. 60; issue no. 393) (Sponsored jointly by Air Force Office of Scientific Research, Department of the Army, and Office of Naval Research under AF 49(638)1043) AD 270452 Unclassified

Although the neuromuscular systems responsible for the activation of skeletal muscles in mammals are known to contain feedback, only an incomplete picture of their function can be pieced together from present information. The dynamic role of the minute muscle-length transducers (muscle spindles) that are scattered among the main motor fibers is discussed in some detail and the important papers are summarized. Some physiologists have exhibited great ingenuity in their investigations of neuromuscular control, but these workers have often been reluctant to apply the powerful and highly germane analytical techniques of control system theory and the statistical theory of communication. As a result it appears that they have approached the limits of their methods. The present report proposes that the extensive preparatory surgery frequently performed on laboratory animals to minimize random activity often produces unphysiological preparations. Ordinary statistical methods should make it possible to deal with the noise

introduced by working with intact, chronic animals. The important benefits to both physiology and engineering that a control engineer's approach to neuromuscular systems can be expected to produce are discussed and various experiments are suggested. (Contractor's abstract)

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California U. Electronics Research Lab., Berkeley.

DETERMINATION OF PHYSICAL PARAMETERS OF DRIFT TRANSISTORS HAVING A DIFFUSED COLLECTOR JUNCTION, by A. R. Boothroyd. Aug. 11, 1961, 31p. incl. diagrs. (Series no. 60; issue no. 391) (AFOSR-2118) (Sponsored jointly by Air Force Office of Scientific Research, Department of the Army, and Office of Naval Research under AF 49-(638)1043) AD 274237 Unclassified

A procedure for the determination of physical parameters of drift transistors with a diffused collector junction was developed on the assumption of a device model with exponential base grading. Only relatively low-frequency measurements are involved. Studies were made of a double-diffused silicon mesa unit and the results obtained suggest that the theory used may be adequate for practical application, despite discrepancies between the assumed model and the actual device. Good correlation between certain known design values of physical parameters of the device, and the values deduced from measurements, was obtained. More investigation is necessary, however, to establish the conditions of validity, accuracy and possible need for further elaboration of the approach presented. (Contractor's abstract)

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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-2234) (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 under G-9106 and G-15965, and Office of Naval Research under Nonr-22253) AD 270449 Unclassified

This is a first issue of what is hoped to be a sequence of notes on system theory. The purpose of these notes is (1) to provide an auxiliary publication medium for short contributions by the students and faculty who are engaged in research in systems and related areas; and (2) to contribute to the development of system theory as a basic scientific discipline. The following 14 papers are presented: (1) A note on Tsypkin's locus, by A. R. Bergen; (2) Simple oscillations in continuous relay control systems with linear plant, by A. Chang; (3) Complete controllability and a basic fact about linear mappings, by C. A. Desoer; (4) A theorem concerning compact and cyclic sequences, by A. Gill; (5) Simulation of probabilistic finite-state systems, by A. Gill; (6) A summary of a simplified stability for linear discrete systems, by E. I. Jury; (7) A summary of a stability criterion for linear discrete systems in a table form, by E. I. Jury and J. Blanchard; (8) A note on the inverse z-transformation, by E. I. Jury and C. A. Galtieri; (9) Reachability of states of a linear, time-invariant system, by H. Kwakernaak; (10) Construction of a probabilistic finite state machine, by G. Machol; (11) A note on complete controllability, by B. Whalen; (12) The necessi- for nonlinear decoding for the binary symmetric channel, by T. J. Wagner; (13) A simplifying notation for n-variable calculus, by B. Whalen; and (14) On the notion of inverse in continuous-state systems, by L. A Zadeh.

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California U. Electronics Research Lab., Berkeley.

THE EQUIANGULAR PLANE SPIRAL ANTENNA, by R. Sussman. Sept. 15, 1961, 57p. incl. diagrs. (Series no. 60; issue no. 406) (AFOSR-2265) (Sponsored jointly by Air Force Office of Scientific Research, Department of the Army, and Office of Naval Research under AF 49(638)1043) AD 274238 Unclassified

The equiangular plane spiral antenna belongs to the class of frequency independent antennas. The electromagnetic field of the equiangular plane spiral antenna with a finite number of arms is investigated. The pattern, the phase variation and the polarization of the field of spiral antennas with a small number of arms, as generated by various methods of excitation, are examined. A method of decomposing any complicated feeding arrangement into a set of basic feedings was developed. This method can be applied to any equally spaced plane antenna with any number of arms. Measurements on 2-, 4-, and 6-arm spiral antennas were performed. Results show that the solution recently found for the limiting case of a spiral antenna which has an infinite number of arms, can serve as a good approximation to antennas with a small number of arms. Some correction terms, which depend on the number of arms, are introduced into the solution of the infinite arm antenna, so as to get a still better approximation. (Contractor's abstract, modified)

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California U. Electronics Research Lab., Berkeley.

THE MINIMUM PERIOD OF OSCILLATION OF SIMPLE TUNNEL DIODE OSCILLATORS, by D. K. Lynn, R. S. Pepper, and D. O. Pederson. Aug. 2, 1961, 37p. incl. diagrs. (Series no. 60; issue no. 388) (AFOSR-2275) (Sponsored jointly by Air Force Office of Scientific Research, Department of the Army, and Office of Naval Research under AF 49(638)1043) AD 274236 Unclassified

A study was made of th minimum period of oscillation, regardless of waveshape, for a class of electronic oscillators, one member of which is a tunnel-diode oscillator having a resistive-inductive load. Analysis shows that the minimum period of oscillation is never obtained for a harmonic mode of oscillation. The results are confirmed by experiment.

Two methods of solution of the tunnel-diode oscillator equation are used. Computer solutions are used for cases of highly nonsinusoidal oscillations. If a cubic polynomial approximation to the tunnel-diode negative resistance characteristic is used, analytic solutions are found by means of a perturbation technique (Lindstedt method). From the piecewise linear solutions it is seen that there are many factors that influence the shape of the curve of period oscillation with the load parameter. The tunnel diode oscillator may operate as a soft oscillator, hard oscillator, or be truly bistable. The conditions for determining the type of operation are given. (Contractor's abstract)

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California U. Electronics Research Lab., Berkeley.

TRANSISTOR BANDPASS AMPLIFIERS OF WELL-DEFINED PERFORMANCE, by A. R. Boothroyd. Dec. 1961, 26p. incl. illus. (Series no. 60; issue no. 424) (AFOSR-2448) (Sponsored jointly by Air Force Office of Scientific Research, Department of the Army, and Office of Naval Research under AF 49-(638)1043) AD 277370 Unclassified

A discussion of basic stability and gain considerations in active two-port networks is followed by an analysis of the conditions under which the transducer gain may be well-defined, in the sense of being affected little by changes in active device parameters. Two methods of achieving well-defined performance, involving mismatching or loading with loss elements respectively at the ports, are treated, and shown to lead to simple design procedures for both single and transformer-coupled cascaded stages. It is also shown that by suitably loading the ports with dominant imaginary terminations the gain characteristic may be made well-defined and analytic in form over wide frequency range. Practical examples of transistor bandpass amplifiers illustrate the theory and show that common-base stages are particularly appropriate for amplifiers of the type considered. In the examples quoted the bandwidth is of the same order as the bandcenter frequency. (Contractor's abstract)

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California U. [Electronics Research Lab.] Berkeley.

A SOLUTION TO THE FREQUENCY-INDEPENDENT ANTENNA PROBLEM, by B. R. Cheo, V. H. Rumsey, and W. J. Welch. [1961] [8]p. incl. diagrs. (Series no. 60; issue no. 428) (AFOSR-3496) ([Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)1043] and Signal Corps under DA 36-039-sc-349) AD 427641 Unclassified

Also published in I. R. E. Trans. on Antennas and Propagation, v. AP-9: 527-534, Nov. 1961.

A solution of Maxwell's equations is obtained for an antenna consisting of an infinite number of equally spaced wires in the form of coplanar equiangular spirals. Radiation amplitude patterns obtained from this solution agree closely with measurements on two-element spiral antennas. The phase pattern shows the approximate validity of a phase center at a distance behind the antenna which decreases with the tightness of the spiral. The current distribution shows increased attenuation with increase in the tightness of the spiral, thus showing how the frequency-independent mode depends on the curvature. A remarkable feature of the solution is that the current consists of an inward traveling wave at infinity when the antenna is excited in that sense which produces an outward wave at the center. (Contractor's abstract)

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California U. Electronics Research Lab., Berkeley.

STATISTICAL STUDY OF PULSE WIDTH MODULATED CONTROL SYSTEMS (II), by S. C. Gupta. Nov. 13, 1961, 55p. incl. illus. tables, refs. (Series no. 60; issue no. 414) (AFOSR-2442) [AF AFOSR-62-70] AD 276999 Unclassified

Computer solutions using IBM 704 Fortran monitor coding of closed loop pulse width modulator (PWM) systems are considered. Examples with simple linear plants with two types of input correlation functions are considered. The case of the pure integrator is also discussed. Modifications for delay element are given. Signal plus noise was considered for the open loop case and a simple example is given. Optimization using a first order discrete compensation is achieved both for open loop case and the closed loop case. (Contractor's abstract)

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California U. Electronics Research Lab., Berkeley.

ON THE ROOTS OF A REAL POLYNOMIAL INSIDE THE UNIT CIRCLE AND A STABILITY CRITERION FOR LINEAR DISCRETE SYSTEMS, by E. I. Jury and J. Blanchard. Dec. 26, 1961, 28p. incl. illus. tables, refs. (Series no. 60; issue no. 425) (AFOSR-2443) [AF AFOSR-62-70] AD 277000 Unclassified

Necessary and sufficient algebraic conditions for the roots of a real polynomial to lie inside the unit circle, in a table form, are given. In this form, the constraints are obtained only by evaluation of second order determinants. The connection and identity between the stability criterion established and a previously obtained criterion are compared. The table is valuable if the coefficients of the real polynomial are given in numbers. Conditions on the numbers of the roots inside, outside, or on the unit circle are also discussed under the cases when the determinants are zero or non-zero. Necessary and sufficient conditions are formulated for all the roots to be inside a circle of radius sigma or less than unity, and also the conditions when the roots are to lie between plus and minus unity in the z-plane. Various examples from discrete systems are presented which illustrate the applications of the new stability criterion and the

other conditions formulated in this report. In the conclusion, the various analytical stability criteria applied to linear discrete systems are compared, with emphasis on the advantageous applications of each of the criteria.

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California U. Electronics Research Lab., Berkeley.

THE IDENTIFICATION OF LINEAR SYSTEMS, by G. [G.] Lendaris. June 26, 1961, 12p. incl. illus. (AFOSR-J12) (AF AFOSR-62-70) AD 400383 Unclassified

Also published in Trans. Amer. Inst. Elec. Engineers, v. 81 (Pt. II): 231-242, Sept. 1962.

For abstract see item no. 263 under AF 18(600)1521.

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California U. Electronics Research Lab., Berkeley.

PROOF OF A GENERAL RELATIONSHIP USED IN THE STABILITY TEST OF LINEAR DISCRETE SYSTEMS. AN ADDENDUM TO A SIMPLIFIED STABILITY 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] 8p. (Series no. 60; issue nos. 373 and 425) (AF AFOSR-62-70) AD 285176 Unclassified

In the stability criterion developed for the linear discrete systems, the following general relationship is used to reduce the stability constraints. $\Delta_k = A_k^2 - B_k^2 = 1/2[(A_{k+1} + B_{k+1})(A_{k-1} - B_{k-1}) + (A_{k+1} - B_{k+1})(A_{k-1} + B_{k-1})]$, $k = 2, 3, \ldots, n-1 = A_{k-1}A_{k+1} - B_{k-1}B_{k+1}$ where $A_k \pm B_k$ are given in the Appendix. The proof is based on the combined use of 3 propositions. The reader should be familiar with item nos. 265 and 300, Vol. V, in order to follow the details of the proofs.

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California U. Inst. of Engineering Research, Berkeley.

THE EFFECT OF PLASTIC DEFORMATION ON SELF-DIFFUSION IN NICKEL, by A. R. Wazzan, J. Mote, and J. E. Dorn. Apr. 18, 1961, 30p. incl. diagrs. tables, refs. (Technical rept. no. 3; series no. 14; issue no. 3) (AFOSR-961) (AF 49(638)58) AD 257188 Unclassified

The coefficient of self-diffusion of nickel single crystals undergoing plastic deformation was measured for strain rates ranging from 0.0085 to 0.055 hr^{-1} at temperatures of 948 ± 1.5°K and 1021 ± 1.5°K. It was found that the coefficient of self-diffusion increased with an increase in strain rate at a constant temperature and decreased with an increase in temperature at constant strain rate. These results are discussed in terms of a model which assumes that vacancies are produced by the motion of jogged screw dislocations and the thermally activated climb of edge dislocations, and that vacancies anneal by migrating to fixed sinks, namely dislocation lines. The analysis indicates that the motion of jogged screws may be an unimportant source for vacancies at these temperatures and strain rates. (Contractor's abstract, modified)

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California U. [Inst. of Engineering Research] Berkeley.

INFLUENCE OF WAVE REFLECTIONS ON THE DEVELOPMENT OF DETONATION, by A. J. Laderman and A. K. Oppenheim. [1961] [5]p. incl. illus. diagrs. table, refs. (AFOSR-1680) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)166] and National Aeronautics and Space Administration) Unclassified

Also published in Phys. Fluids, v. 4: 778-782, June 1961.

One of the most significant features of the transition from deflagration to detonation is the dynamics of wave interactions occurring in the course of the process. Of particular interest is the effect of waves reflected from the closed end. The present study was based on a streak self-light photograph of a stoichiometric hydrogen-oxygen flame accelerating to detonation, and a simultaneous pressure transducer record taken at the closed end of the tube in the vicinity of the source of ignition. The photograph revealed considerable information on the flow field behind the flame, so that with the additional pressure measurement it was possible to deduce specific data on the changes of state in the gas, and the dynamic effects of wave reflections on the initiation of the process. The results were rationalized by means of a gas wave dynamic analysis yielding sufficiently complete wave diagrams of the phenomena to assess their importance with respect to the transition from deflagration to detonation. (Contractor's abstract)

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California U. [Inst. of Engineering Research] Berkeley.

INITIAL FLAME ACCELERATION IN AN EXPLOSIVE GAS, by A. J. Laderman and A. K. Oppenheim. [1961] [32]p. incl. illus. diagrs. refs. (AFOSR-3524) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)166 and National Aeronautics and Space Administration) AD 420681

Also published in Proc. Royal Soc. (London), v. 268A: 153-180, July 10, 1962.

Pressure waves generated by a flame during the initial phase of its acceleration in a detonation tube filled with a stoichiometric hydrogen + oxygen mixture are studied. The process was observed by

means of streak schlieren photography with simultaneous pressure measurements at several stations in the tube. Experimental records revealed in considerable detail the characteristics of pressure waves and yielded information on the structure of the reaction zone with a noticeable effect of the transition from a wrinkled laminar to a turbulent flame. Marked influence of the mode of ignition (electrical obtained by spark discharge, chemical by pilot flame, and thermal by glow coil) on the process of flame acceleration was demonstrated. It is shown that the generation of pressure waves by the flame can be accounted for by the change in the rate of heat release brought about by the increase in the surface area of the combustion front. The computed acceleration of the flame and the structure of the pressure wave ahead of it were in a satisfactory agreement with experimental observation. (Contractor's abstract)

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California U. Inst. of Engineering Research, Berkeley.

A COMPARISON BETWEEN LANGMUIR PROBE AND MICROWAVE ELECTRON DENSITY MEASUREMENTS IN AN ARC HEATED LOW DENSITY SUPERSONIC WIND TUNNEL, by L. Talbot, J. E. Katz, and C. L. Brundin. Jan. 27, 1961, 19p. incl. illus. (Rept. no. HE-150-185; series no. 132; issue no. 3) (AFOSR-336) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)502] and Atomic Energy Commission) AD 251634 Unclassified

Abstract presented at meeting of the Amer. Phys. Soc., Mexico City, June 22124, 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 369, June 22, 1961.

Also published in Phys. Fluids, v. 6: 559-565, Apr. 1963.

Measurements were made of the electron density in low-density supersonic plasma jet flow by the stagnation point Langmuir probe method and by a microwave interferometric technique. The two methods yielded results in reasonably good agreement. It was also possible to obtain some information on the radial distribution of ionization in the jet from the microwave measurements. An attempt to determine the electron temperature by measurement of the microwave power radiated from the jet was not successful. (Contractor's abstract)

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California U. Inst. of Engineering Research, Berkeley.

A NOTE ON THE STAGNATION-POINT LANGMUIR PROBE, by L. Talbot. Dec. 15, 1961, 6p. incl. illus. (Rept. no. HE-150-195; series no. 132; issue no. 4) (AFOSR-1065) (AF 49(638)502) AD 271646 Unclassified

The stagnation-point Langmuir probe theory is presented, valid for supersonic flow with completely frozen but low degree of ionization. It is shown that under certain cold-wall conditions, diffusion and compression within a region of the stagnation point of the boundary layer act to exactly balance one another, with the result that the ion density remains constant throughout this region, and thus the probe characteristic curve exhibits a nearly constant ion saturation limit. (Contractor's abstract)

308

California U. [Inst. of Engineering Research] Berkeley.

DIAGNOSTIC STUDIES OF A LOW DENSITY ARC HEATED WIND TUNNEL STREAM, by F. S. Sherman and L. Talbot. [1961] [18]p. incl. diagrs. refs. (AFOSR-1450) (AF 49(638)502) Unclassified

Presented at ARS Internat'l. Hypersonics Conf., Cambridge, Mass., Aug. 16-18, 1961.

Also published in Prog. in Astronaut. and Rocketry, v. 7: 581-598, 1962.

Investigations were made of the local flow properties of an arc heated low density hypersonic argon jet by means of several different probe techniques. These included impact and static pressure probes, free molecular flow and stagnation point heat transfer probes, and a stagnation point Langmuir double probe. Results presented include axial and radial surveys of impact pressure and computed stagnation temperature, and radial surveys of ion density and electron temperature, and electrical conductivity computed from these latter quantities. It is pointed out that interpretation is difficult of measurements with continuum flow probes, such as the stagnation point heat transfer and static pressure probes, because the probes are subject to important viscous effects, and that some of these effects are associated with the relatively unexplored transition flow regime of rarefied gas dynamics. Further development of high temperature free molecular flow probes and of nonaerodynamic methods for flow measurements is desirable. (Contractor's abstract)

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California U. Inst. of Engineering Research, Berkeley.

FUNDAMENTAL ANALYSIS OF VARIOUS DYNAMIC STABILITY PROBLEMS FOR MISSILES, by T. J. Coakley, E. V. Laitone, and W. L. Maas. June 1961, 96p. incl. diagrs. refs. (Series no. 175; issue no. 1) (AFOSR-1019) (AF 49(638)818) AD 259127 Unclassified

A theoretical analysis is made for special cases of the short period and the phugoid or long period oscillations of a non-rolling high speed missile that has a longitudinal plane of symmetry. The linearized equations of

motion with time dependant coefficients are derived for short period oscillations of a hypersonic ballistic missile during rapid acceleration or deceleration. It is also shown that the effect of accelerated motion is strikingly different on either the w, q or α oscillations. An explicit relation is derived that shows that the atmospheric density gradient will produce a large decrease in the period of the phugoid oscillation, and that this effect increases with the velocity until near orbital speeds are approached. A new parameter is found which predicts the altitude at which the aerodynamic oscillations of a re-entry missile will effec- -ly begin. This new parameter allows the development t uni-versal curve which can be used for predicting th. gh altitude oscillations of hypersonic re-entry ballist missiles for the linear pitching moment case. (Contractor's abstract)

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California U. Inst. of Engineering Research, Berkeley.

THE ANGULAR DISTRIBUTION OF SPUTTERED POTASSIUM ATOMS, by R. P. Stein and F. C. Hurlbut. Jan. 15, 1961, 1v. incl. illus. table. (Rept. no. HE-150-170; series no. 20; issue no. 129) (AFOSR-540) (Sponsored jointly by Air Force Office of Scientific Research and Office of Naval Research under Nonr-22245) AD 253764 Unclassified

The angular distributions of potassium particles issuing from a potassium surface under bombardment by noble gas ions were observed under moderately good vacuum conditions. Sputtered potassium atoms were detected for incident ion energies above approx 15 ev and useful observations of angular distributions were obtained for incident ion energies in the range 50 to 450 ev for all available values of the incident angle. A means was discovered for the discrimination between the total sputtered flux and that fraction of it possessing particle energies above a certain threshold. The apparatus and experimental procedures are described and the observed distribution patterns and the 2-collision sputtering mechanism is discussed, along with related observations. (Contractor's abstract)

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California U. Inst. of Engineering Research, Berkeley.

EXPERIMENTAL DETERMINATION OF PITCHING MOMENT AND DAMPING COEFFICIENTS OF A CONE IN LOW DENSITY, HYPERSONIC FLOW, by W. L. Maas. Oct. 9, 1961 [32]p. incl. illus. diagrs. table. (Rept. no. HE-150-190; series no. 20; issue no. 135) (Sponsored jointly by Air Force Office of Scientific Research and Office of Naval Research under Nonr-22245) AD 266787 Unclassified

Values of stability derivatives were determined experimentally for cones with semi-vertex angles of 45° and 9°. The results were compared with theoretical estimates and with other experimental data. The function of angle of attack was found to be positive, indicating negative damping. The influence of viscous effects upon these results is discussed. The experiment was conducted with freely oscillating models in hypersonic, low density flow, and was one of the first dynamic stability tests performed under these flow conditions. The instability is a marked deviation from the ordinary assumption of positive stability and certainly warrants further study and investigation. The cause of the instability remains undetermined; the effects of viscous flow and shedding of vortices is discussed in this connection.

312

California U. [Materials Research Lab.] Berkeley.

TENSILE BEHAVIOR OF LITHIUM FLUORIDE, by D. B. Hoover and J. Washburn. [1961] [11]p. incl. illus. diagrs. (Technical rept. no. 4; series no. 150; issue no. 4) (AFOSR-436) (AF 49(638)601) AD 254821 Unclassified

Also published in Jour. Appl. Phys., v. 33: 11-14, Jan. 1962.

Two large crystals of LiF were grown by the Czochralski technique. The crystals were annealed for 1 wk at 490°C and cooled at 45°C/hr. Rectangular specimen bars, approximately 1.25-x 0.10 x 0.04-in. were cleaved from these crystals and heated again for 24 hr at 490°C. Further heat treatment tended to remove surface dislocation loops introduced by cleavage and handling of specimens. After polishing, specimens were mounted and tested in tension at about 0.006 in./in./min. Fifteen specimens that were prepared according to the above procedure were compared with 16 into which mobile surface half loops had been introduced. The following conclusions were made: (1) When the number of slip band sources is small, the yield stress is a function of the number of slip bands that are nucleated. (2) When large numbers of sources are present the yield stress is probably close to the min required to move dislocations in the crystal. (3) A slip band on a given [110] $(1\bar{1}0)$ system is a more effective barrier to subsequent growth of intersecting bands on the 4 systems that cut through it at 60° than it is to slip on the 1 other system that cuts through it at 90°. (Contractor's abstract)

313

California U. [Minerals Research Lab.] Berkeley.

X-RAY STRAIN MEASUREMENT TECHNIQUES FOR CERAMIC BODIES, by L. N. Grossman and R. M. Fulrath. [1961] [5]p. incl. illus. diagrs. table. (AFOSR-438) (AF 49(638)4) Unclassified

Presented at Twelfth Pacific Coast Regional meeting of the Amer. Ceram. Soc., Seattle, Wash., Oct. 17, 1959.

Also published in Jour. Amer. Ceram. Soc., v. 44: 567-571, Nov. 1, 1961.

X-ray diffractometer techniques for measuring triaxial and biaxial strain in ceramic bodies are described. The results of the techniques as applied to model ceramic systems using Al_2O_3 and ThO_2 crystal phases connected with various glasses in the system Na_2O-B_2O_3-SiO_2 are presented. It is shown that internal stresses due to expansion coefficient mismatches occur in these systems and that their magnitudes often exceed the bulk strength of the body. Further applications of the techniques are discussed.

314

California U. [Minerals Research Lab.] Berkeley.

THE THERMODYNAMICS OF SOLID IRON AT ELEVATED TEMPERATURES, by P. D. Anderson and R. Hultgren. [1961] [4]p. incl. tables, refs. (Technical note no. 6; series no. 137; issue no. 6) (AFOSR-4009) (AF 49(638)83) AD 409487 Unclassified

Also published in Trans. Metall. Soc. AIME, v. 224: 842-845, Aug. 1962.

Heat contents of extremely pure iron were measured over the range 300° to 1433°K, using a diphenyl ether calorimeter. Results from 3 samples containing widely differing impurities agreed with one another and with previously reported results at higher temperatures (1184° to 1809°K) by Olette and Ferrier. From these data a table of heat contents of iron has been prepared which is believed to be more accurate than those previously available. Cp values have been derived which are consistent with these heat contents, with the best experimental Cp data, and with the thermodynamic conditions of equilibrium between bcc and fcc iron. The opinion is expressed that low-temperature extrapolations of presently known Cp values for γ-Fe are not reliable. (Contractor's abstract)

315

California U. School of Public Health, Berkeley.

AIR IONS AND PHYSIOLOGICAL FUNCTION, by A. P. Krueger. [1961] [9]p. incl. diagrs. refs. (AFOSR-845) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)669, California U. Committee on Research, and National Institutes of Health) Unclassified

Also published in Jour. Gen. Physiol., Suppl., v. 45: 233-241, Mar. 1962.

Although gaseous ions possess no obvious physical properties which would predict a capability to influence living cells or tissues they can be shown to produce functional changes. The physiological effects so far demonstrated are limited in extent. In the mammalian trachea air ion action appears to depend upon the release of bound 5-hydroxytryptamine by CO_2 and upon O^--induced acceleration of its metabolic destruction. (Contractor's abstract)

316

California U. School of Public Health, Berkeley.

STUDIES ON THE EFFECTS OF GASEOUS IONS ON PLANT GROWTH. II. THE CONSTRUCTION AND OPERATION OF AN AIR PURIFICATION UNIT FOR USE IN STUDIES ON THE BIOLOGICAL EFFECTS OF GASEOUS IONS, by A. P. Krueger, J. C. Beckett and others. [1961] [8]p. incl. diagrs. tables. (AFOSR-1071) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)669, California U. Committee on Research, and National Institutes of Health) Unclassified

Also published in Jour. Gen. Physiol., v. 45: 897-904, May 1962.

Air pollutants seriously interfere with the maintenance of unipolar ionized atmospheres required in experimenting with the biological effects of gaseous ions. The construction and operation of an air purification unit designed to reduce air pollution to tolerable levels are described; it has functioned satisfactorily in conducting experiments with plants and animals. (Contractor's abstract)

317

California U. School of Public Health, Berkeley.

STUDIES ON THE EFFECTS OF GASEOUS IONS ON PLANT GROWTH. I. THE INFLUENCE OF POSITIVE AND NEGATIVE AIR IONS ON THE GROWTH OF AVENA SATIVA, by A. P. Krueger, S. Kotaka, and P. C. Andriese. [1961] [17]p. incl. diagrs. tables, refs. (AFOSR-2260) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)669, California U. Committee on Research, and National Institutes of Health) Unclassified

Also published in Jour. Gen. Physiol., v. 45: 879-895, May 1962.

Exposure of Avena sativa seedlings to unipolar ionized atmospheres of either charge produced statistically significant stimulation of growth as measured by mean stem length, integral elongation, and dry weight. The extent of growth increase was related to the atmospheric ion density and this in turn determined the magnitude of current flow to ground. The minimal current measured in the ground circuit and capable of producing a measurable difference in growth was 4.3 to 4.6 x 10^{-13} amp/plant. (Contractor's abstract)

318

California U., La Jolla.

A DIGITAL SEISMOGRAPH SYSTEM FOR MEASURING EARTH NOISE, by F. A. Haubrich and H. M. Iyer. [1961] [15]p. incl. diagrs. (AFOSR-1208) (AF 49(638)905) Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 52: 87-94, Jan. 1962.

A digitally recording seismograph station has been installed at La Jolla to record and study earth noise in the frequency range 0.1 to 1 cps. The system is capable of recording 4 channels of information plus time on paper tape at sample rates of up to 3 times/sec with a dynamic range of 90 db. Preliminary analyses of the digital records show that the spectral peak between 0.1 and 0.2 cps exhibits properties consistent with Rayleigh waves arriving from the southwest mixed with isotropic noise. (Contractor's abstract)

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California U. [Dept. of Physics] La Jolla.

RENORMALIZATION OF MANY-FERMION MOMENTUM-SPACE DISTRIBUTIONS IN HIGHER RANDOM PHASE APPROXIMATIONS, by N. R. Werthamer and H. Suhl. [1961] [5]p. (AFOSR-1696) [AF 49(638)-1038] Unclassified

Presented at meeting of the Amer. Phys. Soc., Los Angeles, Calif., Dec. 27-28, 1961.

Abstract also published in Bull. Amer. Phys. Soc., Series II, v. 6: 520, Dec. 27, 1961.

Also published in Phys. Rev., v. 125: 1402-1406, Feb. 15, 1962.

The approach to the many-fermion problem known as the method of higher random phase approximations (RPA) is given a more rigorous formulation. It is shown that the previous heuristic procedures for evaluation of the second RPA are justified, in that expectation values of plane wave operators with respect to the true ground state may validly be replaced by their values in the unperturbed Fermi state. This property of momentum-space occupation renormalization is conjectured to hold also to higher orders of RPA than the second. (Contractor's abstract)

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California U. [Dept. of Physics] La Jolla.

THEORY OF MAGNETIC RESONANCE IN THE HEAVY RARE EARTH METALS, by B. R. Cooper, R. J. Elliott and others. [1961] 47p. incl. refs. (AFOSR-2103) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)1038 and National Science Foundation) AD 284478 Unclassified

Also published in Phys. Rev., v. 127: 57-68, July 1, 1962.

The spin wave spectrum was calculated from a Hamiltonian including anisotropic exchange, axial and hexagonal anisotropy and magnetic fields for the various types of magnetic order which are known to occur in the heavy rare earth metals Tb-Tm. Particular attention is paid to those spin waves which can be excited by radiation. Because of the high anisotropy most resonances will occur in the infrared where they will be difficult to observe. However, those phases which show either ferromagnetic ordering with moments in the hexagonal planes, or spiral configurations of the moments in those planes, should display a microwave resonance when a suitably chosen magnetic field is applied in that plane. In the spiral phases an additional resonance may also be observed. (Contractor's abstract)

321

California U. [Dept. of Physics] La Jolla.

DECOUPLING OF BLOCH BANDS IN THE PRESENCE OF HOMOGENEOUS FIELDS, by G. H. Wannier and D. R. Fredkin. [1961] [6]p. (AFOSR-3664) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)1038] and Office of Naval Research) Unclassified

Also published in Phys. Rev., v. 125: 1910-1915, Mar. 15, 1962.

Following up an earlier communication (Phys. Rev., v. 117: 432, 1960), wave functions are then constructed which are valid if a charge moves in a superposition of a periodic electric potential and a uniform magnetic field. The wave functions are not themselves solutions of the Schroedinger equation, but yield the traditional effective Hamiltonian for this problem. Contrary to the electric field case the manifold of states linked by the "band index" does not form a Bloch band; the reason is that the cellular transforms of the Bloch-like functions are modified by the Peierls phase. At present, the derivation of these results is in closed form, but justifiable only "to all powers of the magnetic field." This was also the case for the previous electric derivation. The limitation may not be genuine. It is proved directly that the existence of closed Bloch bands in the presence of a homogeneous electric field; the case of free electrons is given as an example. One expects from this that the new results for the magnetic field are at least in part also independent of the power series method used for their justification. The procedure is then extended to crossed electric and magnetic fields. (Contractor's abstract)

322

California U. Brain Research Inst., Los Angeles.

IMPEDANCE MEASUREMENTS IN BRAIN TISSUE OF ANIMALS USING MICROVOLT SIGNALS, by W. R. Adey, R. T. Kado, and J. Didio. [1961] [20]p. incl.

diagrs. refs. (AFOSR-2286) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)686 and Public Health Service under M-3708, B-1883, and M-5763) AD 611482 Unclassified

Also published in Exper. Neurol., v. 5: 47-66, Jan. 1962.

A technique is described for measurement of cerebral impedance with signals in the tissues of 1 to 20 μv amplitude, and having a current density of the order of 10^{-13} amp/μ^2 of electrode surface at 1000 c/sec. The system will resolve a 1%-shift in resistive impedance, and is limited in sensitivity only by the input noise of the differential amplifier. Using chronically implanted coaxial electrodes in the cat for both EEG and impedance measurements, certain clear and consistent changes in impedance were observed, particularly in the dendritic layer of hippocampal pyramidal cells and in the septum, in response to somatic, olfactory, visual, and auditory stimuli, and to changing physiological states of consciousness, as well as drug-induced changes during barbiturate anesthesia and the effects of hallucinogenic agents. Certain repeatable changes were also observed during hippocampal seizures. Physiological peripheral stimuli all produced a transient decrease in impedance in the hippocampal dendritic layer. Arousal from normal sleep was also followed by a baseline shift towards a lower impedance. Waning of consciousness was accompanied by a return to a higher level. Normal sleep was accompanied by trains of very regular sinusoidal waves in the septum at about 3 c/min. During Nembutal anesthesia, there was a marked increase in impedance in hippocampal dendritic layers, and a return to pre-drug levels with recovery of consciousness. A psychotomimetic cyclohexamine drug produced a converse series of changes. Seizures induced in the hippocampus by septal stimulation were accompanied by small rapid perturbations in impedance, and followed by rhythmic impedance changes at about 1 c/sec, occurring on a rising impedance baseline. Differences were noted between impedance changes in the initial seizure episodes and those occurring from identical stimulation 10 days later. The possible relationship of these impedance changes to ionic shifts and volume changes between neuronal elements (or both) and glial tissue, and the extracellular space is discussed, with reference to a possible modulating influence by glial tissue on electronic phenomena in dendrites. (Contractor's abstract)

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California U. Brain Research Inst., Los Angeles.

EEG RECORDS FROM CORTICAL AND DEEP BRAIN STRUCTURES DURING CENTRIFUGAL AND VIBRATIONAL ACCELERATIONS IN CATS AND MONKEYS, by W. R. Adey, J. D. French and others. [1960] [7]p. incl. illus. diagrs. refs. (AFOSR-2287) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)686 and Public Health Service under B-1883, B-485, and B-611) Unclassified

Presented at Thirteenth annual conf. on Electrical Techniques in Med. and Biol., Washington, D. C., Oct. 31-Nov. 2, 1960.

Also published in I. R. E. Trans. on Bio-Med. Electronics, v. BME-8: 182-188, July 1961.

Electroencephalographic records have been taken from deep regions of the brains of cats and monkeys with chronically implanted electrodes during centrifugal and shaking accelerations comparable to booster forces. Histological and x-ray controls have indicated that displacement of the electrodes does not occur, and that damage to brain tissue is comparable with nonaccelerated animals. A transistorized EEG amplifier suitable for recording in satellite biopack environments has been developed. In centrifuge tests, transverse accelerations up to 8 g were associated with rhythmic "arousal" patterns of slow waves in hippocampal regions of the temporal lobe during increasing or decreasing acceleration. Longitudinal accelerations between 5 and 6 g produced blackouts after 30 to 40 sec, with flattening of EEG records, and frequently with induction of epileptic seizure activity in temporal-lobe leads. Shaking tests suggested that vibrational acceleration may be associated with the intermittent "driving" of the cerebral rhythms, in a fashion resembling photic driving, at shaking rates from 11 to 15 cps, and from 22 to 30 cps. (Contractor's abstract)

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California U. [Brain Research Inst.] Los Angeles.

COMPUTER TECHNIQUES IN CORRELATION AND SPECTRAL ANALYSES OF CEREBRAL SLOW WAVES DURING DISCRIMINATIVE BEHAVIOR, by W. R. Adey, D. O. Walter, and C. E. Hendrix. [1961] [24]p. incl. diagrs. refs. (AFOSR-2289) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)686 and Public Health Service under B-1883, B-610, and B-811) Unclassified

Also published in Exper. Neurol., v. 3: 501-524, June 1961.

Data reducing and computing techniques have been applied to EEG records taken during training from 5 cats with implanted electrodes and having records typical of 75 other implanted animals. Implanted electrodes were placed in dorsal and ventral parts of the hippocampal arch, the adjacent entorhinal cortex, and in subcortical areas, including subthalamus, and mesencephalic reticular formation, and in visual and sensorimotor cortex. Animals were trained in T-maze approach and in delayed response tests, both to food rewards. EEG records were manually digitized for presentation to a digital computer (IBM 709) Inherent rhythmicity of hippocampal records was examined in auto-correlations in "waiting" records prior to approach performance, and during approach. Pre-approach records showed a wide spectrum, with a 3 or 4 c/sec dominant frequency. Approach records showed a dominant frequency in a narrow range at 6 c/sec. Cross-correlations of approach records from different parts of the hippocampal arch in the

fully trained animal showed a highly consistent phase pattern in different correct trials on the same day, and on different days. By contrast, incorrect responses were characterized by a markedly different pattern, which was consistent for the incorrect responses on different days. Lability of frequencies in extrahippocampal slow-wave bursts during approach minimized the value of simple cross-correlation analysis. More comprehensive cross-spectral analysis has been initiated and represents an innovation in EEG data analysis. It has confirmed phase pattern shifts between records of correct and incorrect responses. The possible role of wave processes in cerebral systems in integration and transfer of information is discussed. (Contractor's abstract)

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California U. [Brain Research Inst.] Los Angeles.

THE PHYSIOLOGIC BASIS OF CARDIAC ARREST DURING ANESTHESIA, by R. W. Porter and J. D. French. [1960] [4]p. incl. diagr. (AFOSR-J172) ([Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)686] and National Institute of Mental Health under M-2432) AD 400434
Unclassified

Also published in Amer. Jour. Surgery, v. 100: 354-357, Aug. 1960.

Experiments were performed on 19 cats and 5 monkeys anesthetized with either sodium pentothal or ether. It was demonstrated clearly that cardiac arrest was the result of a striking increase in the excitability of the cardiac reflex which occurred at a specific depth of anesthesia. This reflex hyperexcitability in turn correlated precisely with a change in reactivity of the reticular formation, signaled by the appearance within it of a long latency evoked response. It may be presumed, therefore, that the reflex hyperexcitability leading to cardiac arrest was central in origin and indicated a drug-induced distortion of visceral reflex control normally mediated by the reticular formation.

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California U. [Brain Research Inst.] Los Angeles.

DIURNAL ACTIVITY CYCLES IN MONKEYS UNDER PROLONGED VISUAL-PATTERN DEPRIVATION, by D. F. Lindsley, R. H. Wendt and others. [1961] [8]p. incl. diagrs. refs. (AFOSR-J1061) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)686, Office of Naval Research under Nonr-23333, and Public Health Service under B-1883) AD 420290 Unclassified

Also published in Jour. Compar. and Physiol. Psychol., v. 55: 633-640, 1962.

Two macaque monkeys, 1 rhesus and 1 cynomolgus, were raised, from 3 wk of age for 1 yr, in an environment isolated from patterned auditory stimulation by white noise and deprived of light except for 1 hr of unpatterned light stimulation each day. The activity of the 2 monkeys was continuously monitored by a stabilimeter system. Analysis of the records revealed intrinsic diurnal activity cycles which were anchored to the period of light stimulation and shifted position on an absolute time scale when the light-stimulation period was shifted. Dropping of feeding periods or shifting the feeding schedule had no such effect on the activity cycle. With each shift in the light schedule a transition period of 3 to 5 wk was required before the activity cycle stabilized in a new location relative to the light. (Contractor's abstract)

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California U. Brain Research Inst., Los Angeles.

SUBTHALAMIC LESIONS: EFFECTS ON LEARNED BEHAVIOR AND CORRELATED HIPPOCAMPAL AND SUBCORTICAL SLOW-WAVE ACTIVITY, by W. R. Adey, D. O. Walter and others. [1961] [14]p. incl. diagrs. refs. (AFOSR-J1062) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)686 and Public Health Service under B-1883)
AD 420288 Unclassified

Also published in A.M.A. Arch. Neurol., v. 6: 194-207, Mar. 1962.

Trains of slow waves appearing in discriminative motor activity in T-maze training and in a delayed-response situation were examined in cats with chronically implanted electrodes. Regular 6 c/sec activity appeared in hippocampal structures during the approach performance and was accompanied by similar bursts of slow waves in diencephalic areas, including subthalamus and midbrain reticular substance, and in the sensorimotor area of the cerebral cortex. Successive electrocoagulation of the subthalamic zones produced temporary alterations in discriminative performance. During the period of impaired performance, there was a loss of normal slow-wave patterns, which returned with recovery of behavioral discriminative capacity. These subthalamic lesions produced a loss of awareness of the opposite half of the environment resembling in many ways the defects recently described following midbrain lesions. The study suggests that such defects may arise from lesions over a considerable rostrocaudal extent of midbrain and diencephalon, and relate particularly to interference with normal interrelationships between rhinencephalic structures and subcortical regions.

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California U. Brain Research Inst., Los Angeles.

EEG STUDIES OF HIPPOCAMPAL SYSTEM IN THE LEARNING PROCESS, by W. R. Adey. [1961] [22]p. incl. illus. diagrs. refs. (AFOSR-J1063) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)686 and Public Health Service under B-1883) Unclassified

Also published in Physiologie de L'Hippocampe: Colloques Internationaux du Centre National de la Recherche Scientifique, Montpellier (France)(Aug. 24-26, 1961), Paris, Centre National de la Recherche Scientifique, No. 7: 203-224, 1962.

Patterns of slow wave activity in the hippocampal system of cats and monkeys in the course of learning certain discriminative motor performances were studied. Certain very regular trains of waves at approximately 6 c/sec appeared in dorsal hippocampal areas and in entorhinal cortex during the approach to the food reward. Extinction of the response led to disappearance of this regular wave train. Its appearance in these structures was singularly unadapting throughout the training period, and it occurred equally in correct and incorrect performances. Administration of psychotomimetic and hallucinogenic cyclohexamine drugs abolished all regular slow wave activity in hippocampal structures and loss of learned behavioral performance coincided with disruption of hippocampal and entorhinal 6 c/sec bursts of slow waves during the approach. Rhythmic slow wave discharges were noted in extra-hippocampal structures, including subthalamus, rostral midbrain reticular formation and primary visual and somatic cortical areas. They were most clearly phase-locked to the hippocampal discharges only at onset. Small subthalamic lesions produced major changes in EEG records during the learned discrimination. There was a temporary loss of awareness of the opposite half of the environment. EEG records showed a virtual disappearance of rhythmic hippocampal discharges, and concurrent slow wave train in midbrain reticular formation and visual cortex were much reduced. Computer studies indicated high consistency in phase patterns within the hippocampal system and the occurrence of shifts in these patterns from untrained to trained states in the same animal. In the fully trained animal, there were consistent differences in phase patterns between correct and incorrect responses. (Contractor's abstract)

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California U. Brain Research Inst., Los Angeles.

USE OF CORRELATION ANALYSIS IN EEG STUDIES OF CONDITIONING, by W. R. Adey. [1960] [5]p. incl. diagrs. (AFOSR-J1064) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)686 and Public Health Service under B-1883 and B-611) AD 420296 Unclassified

Presented at Conf. on Computer Techniques in EEG Analysis, California U., Los Angeles, Oct. 29-30, 1960.

Also published in Electroencephalog. and Clin Neurophysiol., Suppl. 20: 41-45, 1961.

An IBM 709 computer has been used to study auto- and crosscorrelation functions in EEG records in cats during training. The studies have been directed at the patterns of slow wave activity in both cortical and subcortical structures during acquisition of conditioned reflexes. They have been conducted exclusively in animals in training in a series of discriminative performances for food rewards. Autocorrelations of hippocampal and entorhinal records during the intertrial periods in T-maze testing, and in the delay period of delayed response testing, have indicated a strong periodicity at 3-4 c/sec. By contrast, autocorrelations during the approach period were almost sinusoidal, with a dominant frequency at 5.5-6.5 c/sec. The studies have indicated that the frequency of the "approach burst" remains unchanged from early to late training, over a period of many weeks. Crosscorrelations of records from different parts of the hippocampal arch and from the adjacent entorhinal area showed a high consistency of phase patterns in early training. In the same animal, crosscorrelations in late training showed an entirely converse phase pattern. Cross-spectra analyses revealed a striking difference between correct and incorrect responses in a fully trained animal. Correct responses consistently showed a hippocampal-entorhinal phase difference of 20-30° over a spectrum from 2-20 c/sec, whereas in incorrect responses a sharp reversal of phase pattern occurred at 5 c/sec.

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California U. Brain Research Inst., Los Angeles.

NEUROPHYSIOLOGICAL ASPECTS OF SPACE FLIGHT, by W. D. Winters, R. T. Kado, and W. R. Adey. [1961] [30]p. incl. illus. diagrs. refs. (AFOSR-J1066) (AF 49(638)686) AD 420298 Unclassified

Presented at Symposium on Manned Lunar Flight, Denver, Colo., Dec. 29, 1961.

Also published in Advances in Astronaut. Sci., v. 10: 181-209, Dec. 1961.

The results of studies simulating a 14-day lunar flight indicate that a fully restrained monkey can survive and perform adequately during this period. The EEG patterns during simulated launch and reentry centrifuge profiles as well as during the period of restraint were not altered. LSD-25 studies reveal that drug-induced seizures occur at lower doses when administered to animals in a relatively sensory-deprived environment. Furthermore, the appearance of this seizure activity may alter the animal's performance. It is apparent from these studies that EEG evidence of seizure activity is seen during periods of high acceleration associated with cerebral anoxia. During this time the animals are incapable of performing learned discriminative tasks. During the periods of frequency locking noted in the vibration studies, the same type of behavior disorganization would be expected.

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California U. [Brain Research Inst.] Los Angeles.

A TRANSISTORIZED PREAMPLIFIER FOR FIELD

STUDY OF EEG, by R. T. Kado and W. R. Adey. [1961] [1]p. (AFOSR-J1067) (AF 49(638)686)
AD 419571 Unclassified

Also published in Digest Fourth Internat'l. Conf. on Medical Electronics, New York (July 1961), Conf. Committee for Publication, 1961, p. 172.

A differential input preamplifier is described which has been designed and constructed to operate under severe physical stresses. The major design considerations were the need for a mechanically sound structure, low noise characteristics, high input impedance, and a high voltage gain. Structural rigidity, compactness, and some temperature stability were obtained by assembling the amplifier in and around a magnesium core suitably drilled for the various component parts. The transistors and coupling capacitors were mounted in the core. After assembly and testing, the amplifier was encapsulated in a high impact epoxy resin using vacuum techniques to form a solid unit which is shock resistant. Physically the complete amplifier is 6" long by 1-3/4" deep by 7/8" wide and weighs 8 oz. The amplifier has successfully withstood vibration testing from 5-2000 c/sec over 30 min periods in all 3 planes and 25 g peak accelerations at resonance.

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California U. Brain Research Inst., Los Angeles.

BRAIN FUNCTION. [VOL. I.] CORTICAL EXCITABILITY AND STEADY POTENTIALS; RELATIONS OF BASIC RESEARCH TO SPACE BIOLOGY; PROCEEDINGS OF THE FIRST CONFERENCE, Los Angeles, Calif., 1961, ed. by M. A. B. Brazier. Berkeley and Los Angeles, California U. Press, 1963, 394p. incl. illus. diagrs. tables, refs. (UCLA Forum in Medical Sciences no. 1) (AFOSR-65-1496) (AF 49-(638)948) 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. The present volume deals with the factors and mechanisms maintaining and controlling the excitability of the brain, with particular reference to the physiological role of steady potentials. The topics discussed include: synaptic organization, metabolic changes in the cortex during excitation and depression, changes in cortical potentials in learning, in wakefulness and sleep, and in seizures, and finally, the relation of basic neurological research to space science.

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California U. Dept. of Astronomy, Los Angeles.

ANALYSIS AND STANDARDIZATION OF ASTRODYNAMIC CONSTANTS, by M. W. Makemson, R. M. L. Baker, Jr., and G. B. Westrom. [1960] [20]p. incl. tables, refs. (Astrodynamical rept. no. 12) (AFOSR-128) (AF 49(638)498) AD 263782 Unclassified

Presented at Seventh annual meeting of the Amer. Astronaut. Soc., Dallas, Tex., Jan. 16-18, 1961.

Also published in Jour. Astronaut. Sci., v. 8: 1-13, 1961.

Also published in Advances in Astronaut. Sci., v. 8: 274-293, 1961.

Physical astronomical constants are among the most precisely known constants in nature. With the advent of astronautics, however, an even higher degree of precision is required and additional constants, not normally associated with astronomy, must be included. In this paper, the constants associated with astronautics are called "astrodynamic constants." These constants are analyzed and an effort is made to standardize them. The astrodynamic constants are classified into heliocentric, geocentric, selenocentric, planetocentric, and atmospheric constants. (Contractor's abstract)

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California U. Dept. of Astronomy, Los Angeles.

RECENT ADVANCES IN ASTRODYNAMICS, 1961, by R. M. L. Baker, Jr. and M. P. Francis. [Jan. 1961] [82]p. incl. refs. (Astrodynamical rept. no. 13) (AFOSR-2551) (In cooperation with Lockheed Aircraft Corp., Burbank, Calif.) (AF 49(638)498)
AD 277357 Unclassified

The review surveys eight subdivisions within astrodynamics: geometry, coordinate systems and ephemerides; astrodynamic constants (including heliocentric, genocentric, lunar and planetary, and atmospheric constants); orbit determination; orbit perturbations (gravitational and non-gravitational); orbit prediction (using both special and general perturbation techniques); applications (orbit selection and optimization, low thrust orbits, geocentric orbits, lunar, planetary and interplanetary orbits); observation theory; and attitude dynamics. Each subdivision is introduced and a number of the outstanding research papers in each area are mentioned. Specifically, an effort is made to delineate voids in our knowledge and to point up areas of profitable future research in astrodynamics.

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California U. Dept. of Astronomy, Los Angeles.

1961 EPHEMERIDES OF JUPITER'S NINTH AND TWELFTH SATELLITES, by S. Herrick, L. Averill, and T. O. Montgomery. [1961] [2]p. incl. table. (AF 49(638)498) Unclassified

Published in Publ. Astronom. Soc. Pacific, v. 73: 168-169, Apr. 1961.

The ephemerides given for Jupiter's ninth and twelfth satellites cover the period from Apr. 21 to Oct. 28, 1961, and are based on integrations which include

sun and Saturn perturbations. The ephemeris for Jupiter IX is based on Nicholson's orbit and that of Jupiter XII, on an orbit originating from a differential correction from variant orbits integrated by Dr. Paul Herget.

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California U. [Dept. of Astronomy] Los Angeles.

PROCEEDINGS OF THE TWELFTH INTERNATIONAL ASTRONAUTICAL CONGRESS, Washington, D. C., Oct. 1961, ed. by R. M. L. Baker, Jr. and M. W. Makemson. Vienna, Springer-Verlag and New York, Academic Press, 1963, 2v. incl. illus. diagrs. tables, refs. (AF 49(638)498) Unclassified

The twelfth congress was represented by a gathering of over 300 foreign representatives from 30 different countries. Scientific papers were presented in the technical sessions in French or English only. The present 2 volumes contain in all, 63 full-length articles, 21 summaries, and 34 titles. Scientific papers and round table discussions covered the following topics: (1) space propulsion, (2) orbit theory in astrodynamics, (3) guidance, control, and geodesy in astrodynamics, (4) optimization theory in astrodynamics, (5) landing guidance in astrodynamics, (6) energy conversion, (7) trends in combustion research resulting from exploration in space, (8) bioastronautics (9) exploration of the solar system by radar and radio astronomy, (10) high performance combustion systems, (11) space communications, (12) vehicles, (13) instrumentation, and (14) structures.

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California U. Dept. of Chemistry, Los Angeles.

THE CRYSTAL AND MOLECULAR STRUCTURES OF [3, 3]PARACYCLOPHANE AND RELATED SUBSTANCES (Abstract), by P. K. Gantzel, C. L. Coulter, and K. N. Trueblood. [1960] [2]p. incl. diagr. (AFOSR-TN-60-605) (AF 49(638)719) Unclassified

Presented at Fifth Internat'l. Cong. of Crystallography, Cambridge (Gt. Brit.), Aug. 15-24, 1960.

Also published in Acta Cryst., v. 13: 1042-1043, Dec. 10, 1960.

The structure of [3, 3]paracyclophane has been determined. This compound forms crystals of space group $P2_1/n$, with a = 9.715 ± 0.01, b = 8.138 ± 0.01, c = 8.524 ± 0.01A, β = 90.69 ± 0.03°, z = 2. Since the molecules are centrosymmetric and are of approximately known shape, only 2 vectors are needed to locate either of the 9 carbon atoms in the asymmetric unit. An observed Fourier map revealed the position of the ninth carbon atom. After least-squares refinement, a difference synthesis indicated reasonable positions for all hydrogens. If the 15 intensities are omitted, R is 8.2%. The intramolecular non-bonded distances between the rings are (a) 3.29 and (b) 3.13A. The benzene rings are displaced parallel to one another, are folded slightly about an axis parallel to the long direction of the molecule, and are bowed 6.4° at each end. The average values of the angles within the aromatic rings are 116.8 ± 0.4° at the atoms to which the methylene bridges are joined and 121.3 ± 0.4 at the other 4 atoms. Before corrections for thermal vibration, the average aromatic C-C bond angle distance is 1.386 ± 0.004 A, the average single bond distances are 1.506 and 1.530 ± 0.005 A. The bond angles in the bridges are α, 113.5; β, 117.2; and γ, 115.8. The corresponding dihedral angles are 65° and 70°. A detailed comparison is made of the geometries of these different molecules, and in particular of the distortions in both the aromatic rings and the aliphatic bridges.

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California U. Dept. of Chemistry, Los Angeles.

DISSOCIATION OF HALOGENS IN SHOCK WAVES, by H. Hiraoka and R. Hardwick. [1961] [6]p. incl. diagrs. tables. (AFOSR-1790) [AF 49(638)733] Unclassified

Presented at Second AFOSR Contractor's meeting on Chemical Kinetics of Propulsion, Illinois Inst. of Tech. Armour Research Foundation, Sept. 11-12, 1961. (AFOSR-1417; AD 265513)

Also published in Jour. Chem. Phys., v. 36: 1715-1720, Apr. 1962.

The rate of dissociation of Cl_2 has been measured at high temperatures in a shock tube. The temperature dependence curves, regardless of Cl_2 concentration, are fitted by invoking 4° of freedom of internal motion and an activation energy of 48 kcal. From the temperature T_H at which the decrease of Cl_2 optical density through dissociation matches the increase due to the cooling, by reaction enthalpy, the dissociation energy of Cl_2 has been calculated. The agreement with the well-known spectroscopic value gives a confirmation of the shock-tube temperature measurements and of many assumptions made in the other calculations. (Contractor's abstract)

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California U. Dept. of Chemistry, Los Angeles.

THERMAL DECOMPOSITION OF NITRYL CHLORIDE IN SHOCK WAVES, by H. Hiraoka and R. Hardwick. [1961] [10]p. incl. diagrs. tables, refs. (AFOSR-2544) [AF 49(638)733] AD 275885 Unclassified

Also published in Jour. Chem. Phys., v. 36: 2164-2169, Apr. 1962.

The thermal decomposition of NO_2Cl in Ar and in O_2 as well as that of pure NO_2Cl was studied from 600° to 1000°K at concentrations of 0.001 to 0.01 mol/l using a shock wave technique. In general, the

results are compatible with earlier, low temperature measurements. The activation energy for pure NO_2Cl decomposition is about 2.5 kcals/mol less than that for $NO_2Cl + Ar$ or $NO_2Cl + O_2$. This is compared to the drop in activation energy calculated from the differences in energy transfer efficiency assuming deactivation on every collision. (Contractor's abstract)

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California U. Dept. of Chemistry, Los Angeles.

ISOTOPE SIZE EFFECT IN VAN DER WAALS RADII AND THE BARRIER TO ROTATION AROUND THE CARBON-CARBON SINGLE BOND, by W. F. Libby. [1961] [1]p. (AFOSR-562) (AF 49(638)901) Unclassified

Also published in Jour. Chem. Phys., v. 35: 1527, Oct. 1961.

The isotope size effect is used to investigate the 2.85 kcal/mol barrier to internal rotation in ethane, and to check the possibility of using isotopic substitution to prove whether the extra stability of the staggered form is due to repulsive interference of the hydrogen atoms in the eclipsed state. It is concluded that the lack of sensitivity of the barrier height to isotopic substitution is a strong argument that steric repulsion between hydrogens is not the principal cause of the barrier to hindered rotation.

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California U. Dept. of Chemistry, Los Angeles.

TRITIUM GEOPHYSICS, by W. F. Libby. [1961] [16]p. incl. diagrs. tables, refs. (AFOSR-2162) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)901, California U. Research Committee, and California U. Water Resources Center) Unclassified

Also published in Jour. Geophys. Research, v. 66: 3767-3782, Nov. 1961.

Rainfall from the northern and southern hemispheres has been analyzed for tritium. During the spring, summer, and early fall of 1959, in the northern hemisphere there was a peak in tritium fallout which was proportional to the peak in Sr^{90} fallout, whereas in the southern hemisphere there was no appreciable increase in either the tritium or the Sr^{90} fallout. It seems clear, therefore, that the peak in the northern hemisphere was due to the Russian nuclear bomb tests of October 1958, which injected large amounts of tritium and Sr^{90} into the stratosphere. The proportionality of the two fallout curves suggests that single molecules of water and fine particulate matter have the same residence time in the stratosphere and that the mixing of the stratospheric air with tropospheric air followed by rainfall scavenging must be the mechanism for removal of both from the atmosphere. The general rise in the tritium level due to hydrogen-bomb explosions was found to be proportional to the total energy release, even though the bombs were fired under a variety of conditions. Therefore, rain and ground-water data can be interpolated and extrapolated so as to supply values for the tritium levels where samples were not collected and measured.

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California U. Dept. of Chemistry, Los Angeles.

INDUSTRIAL USES OF ISOTOPES, by W. F. Libby. [1961] [23]p. incl. tables, refs. (AFOSR-3288) (AF 49(638)901) Unclassified

Also published in Ann. Rev. Nuclear Sci., v. 11: 461-483, 1961.

In the first section of this paper, the uses in industry which exist because isotopes are chemically identical, or nearly identical, with the ordinary nuclides constituting the main part of the element, are discussed. These include their applications to the study of nutrition of farm animals, milk producing in grazing animals, and estimating lean meat content in live animals. Uses of radioactive isotopes that do not take advantage of the fact that the isotopes have the same chemical characteristics as the nonradioactive partner nuclides in the element include their use as radioactive nonisotopic tracers; i.e., in attrition studies, and as radiation sources for gauging. Probably the most important is the beta thickness gauge. The principal present industrial uses of isotopic radiation are plant mutations for production of superior crop plants, pest control, and power sources. Potential new applications to food preservation are also discussed, as well as limitations on isotope uses which public health requires.

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California U. Dept. of Engineering, Los Angeles.

STRESS FIELD IN POLYCRYSTALLINE METALS AT INITIAL STAGE OF PLASTIC DEFORMATION, by T. H. Lin, S. Uchiyama and others. Jan. 1961, 68p. incl. diagrs. refs. (Rept. no. 61-6) (AFOSR-530) (AF 49(638)20) AD 259282 Unclassified

The stress fields caused by the following cases are analytically computed: (1) uniform slip in a cubical crystal at the interior of the aggregate; (2) non-uniform slip in a cubical crystal in the interior; (3) non-uniform slip in 2 closeby crystals in the interior, and (4) uniform slip in a crystal at the surface of the aggregate. In cases (1) and (4), the critical shear stress in the sliding crystal is uniform but the resolved shear stress is not. These 2 cases computed give stress fields caused by inclusions uniformly transformed in shape and give approximate stress fields for sliding work-hardening crystals in an aggregate. In cases (2) and (3), the resolved shear stresses in the slipped region equal to its critical shear stresses and these 2 cases give the stress fields caused by sliding work-hardening crystals in the aggregate.

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California U. Dept. of Engineering, Los Angeles.

ROTATION OF CRYSTALS UNDER AXIAL STRAIN, by T. H. Lin and B. Lieb. [1961] [15]p. incl. diagrs. (AFOSR-3593) (AF 49(638)20) Unclassified

Also published in Jour. Mech. and Phys. Solids, v. 10: 65-72, Jan. 1962.

Deformation texture of a polycrystalline aluminum under compression is calculated with the assumption that individual crystals suffer the same strain as the aggregate. The sequence of active slip systems is calculated with the consideration of elastic strain. The most slipped system is taken to be least hardened. Latent systems on active planes are assumed to be less hardened than those on latent planes. The active slip systems, the rotation vector, and the orientation of a crystal at any stage of loading are calculated at 1% successive incremental strains. The distribution of preferred orientations at 30% compression is shown. It has been found that crystals of a range of orientations slide and rotate toward a common end orientation ($\theta = 84.9°$, $\Phi = 28.0°$). (Contractor's abstract)

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California U. [Dept. of Engineering] Los Angeles.

STRESS FIELD IN METALS AT INITIAL STAGE OF PLASTIC DEFORMATION, by T. H. Lin, S. Uchiyama, and D. Martin. [1961] [10]p. incl. diagrs. refs. (AFOSR-3629) (AF 49(638)20) Unclassified

Also published in Jour. Mech. and Phys. Solids, v. 9: 200-209, July 1961.

The initial stage of plastic deformation of a fine grained aggregate with slip occurring only in the most favorably oriented crystals is studied. The elastic modulus of the individual crystals is taken to be isotropic. The sliding crystals are assumed to be cubical in shape and located at the interior of the aggregate. Work-hardening in the sliding crystal is considered. The analogy of plastic strain gradient and body force in producing stress field in an elastic medium is developed. This analogy is applied to calculate the slip and stress fields caused by (1) one sliding crystal and (2) two sliding crystals spaced at a clear distance of half the crystal width. This shows the interaction effect of slips in two nearby crystals. From these stress fields, the residual stress may be easily obtained and the Bauschinger effect is clearly shown.

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California U. [Dept. of Engineering] Los Angeles.

OPTIMUM NONLINEAR BANG-BANG CONTROL SYSTEMS WITH COMPLEX ROOTS. I. SYSTEM SYNTHESIS, by P. Chandaket and C. T. Leondes. [1960] [12]p. incl. diagrs. (AF 49(638)438) Unclassified

Published in Trans. Amer. Inst. Elec. Engineers, v. 80 (Pt. II): 82-95, May 1961.

The optimum switching criterion for second-order predictor control systems with complex characteristic roots are derived. Though the derivation is rather lengthy, the final result of the optimum switching boundary is reduced to a pattern where it can be determined easily by using an electronic analog computer. Due to the practical difficulty of mechanizing the nonlinear controller which is required in this off-on type servosystem, a compromise switching boundary which was examined in an analog computer study is suggested. The compromise switching boundary is composed of only the zero-loop boundary (Γ_p and Γ_n) of the optimum system and the rest of this boundary extends along the error axis. The analog study of a second-order system of this type is presented wherein the approximate switching boundary is used in a system with the damping ratio 0.2. The system time response to step, ramp, and sinusoidal input are recorded. The results obtained are satisfactory.

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California U. [Dept. of Engineering] Los Angeles.

OPTIMUM NONLINEAR BANG-BANG CONTROL SYSTEMS WITH COMPLEX ROOTS. II. ANALYTICAL STUDIES, by P. Chandaket, C. T. Leondes, and E. C. Deland. [1960] [7]p. incl. diagrs. (AF 49-(638)438) Unclassified

Published in Trans. Amer. Inst. Elec. Engineers, v. 80 (Pt. II): 95-101, May 1961.

The scope and utility of the synthesis described in part I of this paper are verified by analytical studies of the dynamic response capabilities of the systems. The results of the analog studies indicate that the error response of a system using the compromise switching boundary is slightly slower than that of the optimum system. The compromise optimum system is nevertheless nearly as fast as the optimum system, which results in the conclusion that the compromise optimum nonlinear control system can be used effectively, particularly since in many cases system error may be expected to be maintained at a small value.

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California U. [Dept. of Engineering] Los Angeles.

SIGNAL FLOW GRAPH THEORY FOR LINEAR TIME-VARIABLE SYSTEMS, by E. B. Stear and A. R. Stubberud. [1960] [7]p. incl. diagrs. refs. (AF 49-(638)438) Unclassified

Published in Trans. Amer. Inst. Elec. Engineers, v. 80 (Pt. I): 695-700, Jan. 1962.

Techniques are presented for the analysis of linear, time-variable systems through signal flow graph concepts, based on the combinatorial properties of linear differential equations. The concepts of

stability and sensitivity of linear, time-variable systems, which are described by linear differential equations, are discussed. A linear, time-variable feedback system is analyzed to aid in clarification. (Contractor's abstract)

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California U. [Dept. of Engineering] Los Angeles.

SYNTHESIS OF QUASI-STATIONARY OPTIMUM NONLINEAR CONTROL SYSTEMS. PART I. SYNTHESIS CONSIDERATIONS, by P. Chandaket and C. T. Leondes. [1960] [7]p. incl. diagrs. (AF 49(638)438) Unclassified

Published in Trans. Amer. Inst. Elec. Engineers, v. 80 (Pt. II): 313-319, Jan. 1962.

Synthesis techniques are developed for optimum nonlinear control systems of the quasi-stationary class wherein the controller configuration depends on a knowledge of certain information about the input to the system. In this manner the range of inputs for which the system is optimum has been significantly extended. The synthesis techniques have been developed in detail for second- and third-order systems, but the techniques are directly extendable to higher-order systems.

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California U. [Dept. of Engineering] Los Angeles.

SYNTHESIS OF QUASI-STATIONARY OPTIMUM NONLINEAR CONTROL SYSTEMS. PART II. EXTENSIONS IN MECHANIZATION CONCEPTS, by P. Chandaket and C. T. Leondes. [1960] [6]p. incl. diagrs. (AF 49(638)438) Unclassified

Published in Trans. Amer. Inst. Elec. Engineers, v. 80 (Pt. II): 319-325, Jan. 1962.

Optimum "bang-bang" or relay-type control systems for which the plant or controlled system is described by a linear differential equation of higher order than the second, present a practical mechanization problem in that function generators of high order are required in realizing the system. Such function generators are fairly complicated and expensive. This paper presents techniques which permit realization of the optimum system but which require only single-variable function generators.

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California U. [Dept. of Engineering] Los Angeles.

ON THE APPLICATION OF LYAPUNOV'S SECOND METHOD TO THE SYNTHESIS OF NONLINEAR CONTROL SYSTEMS, by A. Stubberud, C. T. Leondes, and M. Margolis. Jan. 1961, 11p. incl. illus. (Rept. no. 61-3) (AFOSR-218) (AF 49(638)438) AD 252814; PB 155308 Unclassified

Presented at Western Electronic Show and Convention, San Francisco, Calif., Aug. 1961.

An approach to the design of nonlinear compensation networks is presented. The design procedure is based on Lyapunov's second method, a method of examining the stability of a set of differential equations. A Lyapunov function is formed for the control system under question, and this function is then manipulated to minimize the system settling time. A method for generating Lyapunov functions for a particular class of feedback control systems is discussed. Some examples of the design procedure are presented. The chief merits of the design procedure are: (1) the nonlinear system which is determined will not introduce instability into the system; and (2) the nonlinear differential equations of the system need not be solved; thus eliminating many of the computational difficulties associated with nonlinear design. (Contractor's abstract)

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California U. [Dept. of Engineering] Los Angeles.

ON THE OPTIMUM SYNTHESIS OF RANDOM SAMPLING MULTIPOLE FILTERS WITH STATIONARY INPUTS, by H. C. Hsieh. Feb. 1961, 39p. incl. diagrs. (Rept. no. 61-8) (AFOSR-569) (AF 49(638)-438) AD 257318 Unclassified

Also published in Trans. Amer. Inst. Elec. Engineers, v. 80 (Pt. II): 239-247, Nov. 1961.

The synthesis of multipole filter whose inputs are stationary stochastic processes and are randomly sampled is considered. Each input will consist of signal and noise. The sampling process of each input is described by probability density functions of various orders and is assumed to be statistically independent from those of the others and also from the input processes. The system under investigation is linear and time invariant. The power spectral densities of inputs before sampling are assumed to be rational functions in s. In case the spectral densities after sampling are not rational functions in s, they have to be approximated by this type of function. Since the signals usually have power concentrated in low frequencies, appropriate approximants for these non-rational functions will introduce negligible error in designing.

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California U. Dept. of Engineering, Los Angeles.

THE THEORY OF TIME OPTIMAL PROCESSES IN LINEAR SYSTEMS, by R. V. Gamkrelidze, tr. by E. [B.] Stear, A. T. Maljuta and others. Jan. 1961, 33p. (Rept. no. 61-7) (AFOSR-472) (In cooperation with Space Technology Labs., Inc., Los Angeles, Calif.) [AF 49(638)438] AD 257316 Unclassified

Equations are found for the optimal controls and optimal trajectories in the case of one control parameter. The synthesis problem for linear optimal

systems, also with one control parameter, is considered. The methods developed for the case of one control parameter are generalized to include linear systems with several control parameters.

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California U. Dept. of Engineering, Los Angeles.

A TECHNIQUE FOR THE SYNTHESIS OF LINEAR, NON-STATIONARY FEEDBACK SYSTEMS. PART I. THE APPROXIMATION PROBLEM, by A. R. Stubberud. Oct. 1961, 21p. incl. diagrs. refs. (Rept. no. 61-51) (AFOSR-1741) (AF 49(638)438) AD 274230 Unclassified

A technique for the synthesis of linear, non-stationary feedback systems is presented. This analysis deals with the approximation problem, i.e., a method is developed whereby a realizable weighting function which produces a desired output when subjected to a polynomial input can be generated. Certain conditions which must be fulfilled by the outputs are also developed. (Contractor's abstract)

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California U. Dept. of Engineering, Los Angeles.

A TECHNIQUE FOR THE SYNTHESIS OF LINEAR, NON-STATIONARY FEEDBACK SYSTEMS. PART II. THE SYNTHESIS PROBLEM, by A. R. Stubberud. Oct. 1961, 15p. incl. diagrs. refs. (Rept. no. 61-71) (AFOSR-1742) (AF 49(638)438) AD 274231 Unclassified

A technique for the synthesis of linear, non-stationary feedback systems is presented. A method is developed whereby a given weighting function can be synthesized as a feedback system. The problem of synthesizing a nonstationary weighting function as a feedback system when constrained by a fixed plant is also solved. A differential equation algebra which allows the solution of these problems is developed. (Contractor's abstract)

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California U. Dept. of Engineering, Los Angeles.

SYNTHESIS OF SHAPING FILTERS FOR NONSTATIONARY STOCHASTIC PROCESSES AND THEIR USES, by E. [B.] Stear. Aug. 1961 [67]p. incl. diagrs. refs. (Rept. no. 61-50) (AFOSR-2036) (AF 49(638)-438) AD 274207 Unclassified

This study considers the problem (usually called the shaping filter problem) of synthesizing linear systems whose responses to white noise input processes and appropriate sets of random initial conditions will be stochastic processes whose covariance functions are prescribed functions of 2 variables. Exact solutions to the shaping filter problem are presented for certain special cases and some discussion of predictability of the processes is presented. Attention is then focused on the general problem and by means of the Schauder fixed point theorem and by Picard's method of successive approximations the existence of physically realizable shaping filter is established for a large class of separable covariance functions. The question of the uniqueness of the shaping filter and its relationship to the covariance matrix of the set of random initial conditions is investigated. It is shown that if an appropriate set of random initial conditions is specified, then the weighting function of the shaping filter is unique up to a multiplicative factor of ± 1. The further requirements on the covariance function in order to guarantee that the shaping filter can be characterized by a finite-order, linear differential equation with continuous coefficients are given, as well as certain lesser requirements which permit easy analog simulation. (Contractor's abstract)

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California U. [Dept. of Engineering] Los Angeles.

A STATISTICAL MEASURE OF THE EFFECTIVENESS OF ADAPTATION IN CONTROL SYSTEMS, by R. A. Nesbit. [1961] [7]p. incl. diagrs. refs. (AFOSR-4222) (AF 49(638)438) Unclassified

Presented at I. R. E. Internat'l. Convention, New York, Mar. 20-23, 1961.

Also published in I. R. E. Internat'l. Convention Record, Pt. 4: 18-24, 1961.

A statistical measure of the effectiveness of adaptive variation of one or more control parameters is developed in terms of the environmental parameter's distribution. This measure allows the evaluation and comparison of different types of control systems and is applicable to linear and nonlinear systems with one or many control variables. The concept of ideal adaptive control with respect to a particular control parameter is defined, and the definition used to compare a given control system with the ideal adaptive system. The comparison shows where adaptive control is not needed as well as where it is desirable. System reliability is easily incorporated in the comparison. The technique is applied to a simple control system to demonstrate the different types of parameter variations and their effect on the value of an adaptive controller. (Contractor's abstract)

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California U. [Dept. of Mathematics] Los Angeles.

ASYMPTOTIC EFFICIENCY IN POLYNOMIAL ESTIMATION, by P. G. Hoel. [1960] [6]p. (AFOSR-3036) [AF AFOSR-60-24] Unclassified

Also published in Ann. Math. Stat., v. 32: 1042-1047, Dec. 1961.

Asymptotic formulas are obtained for the generalized variance of the least squares estimates in polynomial regression under the assumption that the basic random

variables are those of a stationary stochastic process, or a slight generalization of such a process. These formulas are used to study the information obtained by increasing the number of observational points in an interval and by increasing the length of the interval. (Contractor's abstract)

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California U. [Dept. of Mathematics] Los Angeles.

SOME PROPERTIES OF OPTIMAL SPACING IN POLYNOMIAL ESTIMATION, by P. G. Hoel. [1961] [8]p. (AFOSR-3037)[AF AFOSR-60-24] Unclassified

Also published in Ann. Inst. Stat. Math. (Tokyo), v. 13: 1-8, 1961.

In the usual model of linear regression with uncorrelated random variables of equal variance and with regression function $\theta' f(x) = \Sigma_1^k \theta_i f_i(x)$, $x \in X$, suppose, as is the case for univariate polynomial regression, that a design D* which (approx, neglecting concern about fractional observations) minimizes the generalized variance can be obtained using only k values of the independent variable x. (It follows that D* takes equal numbers of observations at these values). Under this assumption the author proves that, for $1 \leq L \leq k$, this same D* minimizes the max over $x_1, \cdots x_L \in X$ of the generalized variance of the estimates of $\theta' f(x_i)$, $i = 1, \cdots, L$ (using also, the reviewer believes, the assumption that k points suffice for the latter problem, which they do in the polynomial case). In the polynomial ca.., D* is also optimum for estimating $d\,\theta' f(x)/dx$ at any number of points. (Math. Rev. abstract, in part)

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California U. Dept. of Physics, Los Angeles.

SIMPLE REALISTIC TREATMENT OF NUCLEAR DIRECT-INTERACTION PROCESSES, by I. E. McCarthy and D. L. Pursey. [1960] [13]p. incl. diagrs. refs. (Sponsored jointly by Air Force [Office of Scientific Research under AF 49(638)717] and National Science Foundation) Unclassified

Published in Phys. Rev., v. 122: 578-590, Apr. 15, 1961.

Physical arguments are used to predict qualitatively the effect on direct-interaction differential cross sections of the distortion of the wave functions of the scattered particle. These qualitative predictions are confirmed by calculations using a simple but fairly realistic model for the wave function distortion in (α, α') scattering. The model used is based on examination of the properties of optical model wave functions. Good fits to experimental data are found using the model for (α, α') scattering in the energy range 20-40 mev for scattering angles less than 90°. Features of direct-interaction processes involving nucleons are interpreted in terms of a focus in the optical model wave functions for these particles, but detailed calculations are not presented. (Contractor's abstract)

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California U. [Dept. of Physics] Los Angeles.

OPTICAL-MODEL ANALYSIS OF ELASTIC SCATTERING OF PROTONS ON CARBON AT INTERMEDIATE ENERGIES, by J. S. Nodvik, C. B. Duke, and M. A. Melkanoff. [1961] [13]p. incl. diagrs. tables, refs. (AFOSR-1344) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)717], Atomic Energy Commission, and National Science Foundation) Unclassified

Also published in Phys. Rev., v. 125: 975-987, Feb. 1, 1962.

Differential cross sections and polarizations for the elastic scattering of protons by carbon at energies between 7 and 20 mev have been analyzed according to the diffuse-surface optical model of the nucleus. The model parameters were varied systematically, the best fits to the experimental data being determined by a method of least squares. Various forms of the absorptive part of the potential were investigated, although the main part of the analysis was carried out with a surface-plus-volume absorption potential. It was found that the model could not account satisfactorily for the data below about 12 mev, and the presentation of results is limited to the region $11.85 \text{ mev} \leq E_{lab} \geq 19.4 \text{ mev}$. Excellent fits can be obtained over the latter region with generally reasonable values of the model parameters, although some features of their behavior as a function of energy remain to be explained. The most striking feature of the results is the thin absorptive shell and small volume absorption which characterizes the potential. Although the predicted reaction cross sections appear generally too low, the experimental data are not sufficiently precise to warrant drawing a definite conclusion. (Contractor's abstract)

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California U. Dept. of Physics, Los Angeles.

THE STRONG COUPLING IN A SPACE WITH TORSION, by R. Finkelstein and W. Ramsay. [1961] [25]p. (AFOSR-1552) (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. 17: 379-403, Mar. 1962.

A generally covariant field theory, characterized by an asymmetric metric, an asymmetric connection, and an arbitrary gauge group is investigated as a possible formal basis for the experimentally observed strong couplings. Transposition invariance is put

into correspondence with TCP invariance. The parts of the connection irreducible under both coordinate and gauge groups are identified with the independent boson fields. Representations of the strong and electromagnetic couplings of the baryon-meson system are found, subject to the same dynamical uncertainties as global and unitary symmetry. In the simplest version the pion and kaon fields correspond to the Hermitian torsion, while the vector bosons, including the photon, correspond to the anti-Hermitian torsion. (Contractor's abstract)

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California U. [Dept. of Physics] Los Angeles.

K* AND K MESON POLE CONTRIBUTIONS TO LEPTONIC Λ DECAY, by R. E. Norton. [1961] [4]p. incl. refs. (AFOSR-2002) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)717] and National Science Foundation) Unclassified

Also published in Phys. Rev., v. 126: 1216-1219, May 1, 1962.

An attempt is made to calculate the leptonic Λ decay rate on the known K_{3}^{e} and K_{2}^{μ} decay rates. Unsubtracted dispersion relations are written for the relevant matrix elements of the strangeness-changing vector weak current and the absorptive parts are approximated by retaining only the contribution from the K*. In this way the vector current contribution to the Λ decay is related to the known K_{3}^{e} rate, the known effective π-K-K* coupling constant, and the as yet unknown Λ-p-K* coupling constant. The latter coupling constant will hopefully be determined soon from extrapolation of the associated production data. The axial vector contribution to Λ decay is related to the K_{2}^{μ} decay rate by writing unsubtracted dispersion relations for the divergence of this current and approximating the absorptive parts by keeping only the contribution of the K meson. The numerical consequences of this calculation can only be evaluated once the Λ-p-K* is determined, but a crude estimate suggested by "unitary symmetry" yields a leptonic Λ decay rate a few times smaller than is now suggested experimentally. (Contractor's abstract)

364

California U. [Dept. of Physics] Los Angeles.

RUNAWAY MODES IN MODEL FIELD THEORIES, by S. Coleman and R. E. Norton. [1961] [7]p. incl. refs. (AFOSR-2003) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)717] and National Science Foundation) AD 611492 Unclassified

Also published in Phys. Rev., v. 125: 1422-1428, Feb. 15, 1962.

Within the framework of linear quantum field theories, a general study is presented of the existence and removal of runaway modes-solutions of the equations of motion which exhibit a real exponental time dependence. It is hoped that this work will yield insight into the corresponding problem in physically realistic theories. It is shown that runaway modes occur only when the Hamiltonian is not positive definite, and that they occur in linear quantum theories whenever they appear in the corresponding classical theories. Three methods are proposed for eliminating these unphysical modes. One is analog of the method used by Dirac in classical electron theory; the other 2 are believed to be new.

365

California U. Dept. of Physics, Los Angeles.

ON THE THEORY OF NUCLEAR REACTIONS, by R. Lipperheide. [1961] [45]p. incl. refs. (AFOSR-2488) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)717] and National Science Foundation) AD 611457 Unclassified

Also published in Ann. Phys., v. 17: 114-158, Jan. 1962.

A system of equations for the description of nuclear reactions is derived in which rigorous account is taken of the effects of the recoil of the target nucleus, the presence of hard cores in the 2-body interactions, and the Pauli exclusion principle. The elastic and inelastic scattering processes are described in terms of "equivalent potentials." The relation between the equivalent potential in the elastic channel and the optical model potential is established. A self-consistent scheme for the approximate calculation of the phenomenological optical model potential is proposed. (Contractor's abstract)

366

California U. Dept. of Physics, Los Angeles.

SYSTEMATICS OF BETA-DECAY MATRIX ELEMENTS, by S. A. Moszkowski. [1961] [7]p. incl. tables, refs. (AFOSR-J332) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49-(638)717], Army Research Office, and National Science Foundation) Unclassified

Also published in Proc. Rutherford Jubilee Internat'l. Conf., Manchester (Gt. Brit.) (Sept. 4-9, 1961), New York, Academic Press, 1961, p. 689-695.

Recent developments in β decay which shed some light on nuclear matrix elements are outlined. Studies of the β decay of strongly deformed nuclei, isotopic spin conservation, and first forbidden non-unique decays are discussed. Characteristics of the β decays of Ce^{141} and Bi^{210} are described.

367

California U. Dept. of Physics, Los Angeles.

SPINOR FIELDS IN SPACES WITH TORSION, by R. Finkelstein. [1960] [22]p. (AFOSR-J333) [AF 49-(638)717] AD 408010 Unclassified

Also published in Ann. Phys., v. 12: 200-221, Feb. 1961.

It is suggested that the short-range interactions lead to a torsion of physical space, as gravitational interactions lead to its curvature. The existence of torsion implies 2 kinds of parallelism, (+) and (-), which in turn imply 2 types of spinor field, ψ (+) and ψ (-). If the geometry is symmetric with respect to (+) and (-) parallelisms, then ψ (+) and ψ (-) have no vector or electromagnetic coupling, and the geometry may be called neutral. The simplest neutral geometry with variable torsion is derivable from a Lagrangian in which a pseudoscalar Yukawa field (the torsion potential) is coupled by pseudovector coupling to ψ (+) and and ψ (-). If the geometry does not have neutral symmetry, then ψ (+) and ψ (-) behave like a charge doublet. The hypercharge and the parity of this charge doublet are determined by the weight of the spinor under general coordinate transformations. It follows from the model that leptonic (m = 0) particles are not coupled to the torsion. (Contractor's abstract)

368

California U. Dept. of Physics, Los Angeles.

ELEMENTARY INTERACTIONS IN SPACES WITH TORSION, by R. Finkelstein. [1961] [27]p. (AFOSR-J334) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)717] and National Science Foundation) AD 408055 Unclassified

Also published in Ann. Phys., v. 15: 223-249, Aug. 1961.

Parallel transfer is generalized to allow for the existence of a local gauge group. In spaces with torsion such a group may be introduced in a natural way and physically interpreted as a generalization of the electromagnetic gauge group. It is possible to construct simple theories of this type, which correctly represent the isospin symmetries of the known fields. According to the program here proposed the local connection of microspace is restricted by the symmetries of the observed fields; the dynamics is then determined by the curvature of space, just as in the known macroscopic limit. In the models here considered the discrete groups are not discussed and all conservation laws are exact. (Contractor's abstract)

369

[California U. Dept. of Physics, Los Angeles.]

THE PARAMETERS OF THE OPTICAL MODEL POTENTIAL AND THEIR PHYSICAL INTERPRETATION, by D. S. Saxon. [1960] [15]p. incl. table, refs. (AFOSR-J336) [AF 49(638)717] AD 408057 Unclassified

Also published in Proc. Internat'l. Conf. on Nuclear Structure, Kingston, Ont. (Canada) (Aug. 29-Sept. 3, 1960), Toronto U. Press, 1960, p. 197-211.

The optical model parameters, determined phenomenologically from the analysis of experimental data, are summarized. The possible physical significance of these parameters are discussed. The uniform volume absorption potential contains 6 parameters and the surface absorption potential, 7. Proton reaction cross sections were measured for Al, Ar, Ni, Cu, and Zn. They were also calculated using the volume absorption potential. The scattering of deuterons, He^3, α particles, and mesons (K) was also studied by this method. With one exception, very little progress was made in connecting the effective potential and the optical-model potential. This exception, high energy scattering at small angles, is discussed.

370

California U. [Dept. of Physics] Los Angeles.

NUCLEAR MATTER CALCULATIONS USING THE SEPARATION METHOD, by B. L. Scott and S. A. Moszkowski. [1961] [7]p. incl. diagrs. tables. (AFOSR-J337) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)717], Army Research Office, Atomic Energy Commission, and National Science Foundation) AD 408063 Unclassified

Also published in Nuclear Phys., v. 29: 665-671, Feb. 1962.

The convergence of the separation method for calculating the 2-body reaction matrix is established for central interactions by comparing the separation method results to those obtained by solving the integral equation numerically. A spin-dependent central well which approximately satisfies 2-body data as well as giving reasonable nuclear saturation properties is presented. (Contractor's abstract)

371

California U. [Dept. of Physics] Los Angeles.

OPTICAL-MODEL ANALYSIS OF ELASTIC SCATTERING OF PROTONS BY CARBON AT 11 TO 20 MEV (Abstract), by J. S. Nodvik, C. B. Duke, and M. A. Melkanoff. [1961] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49-(638)717], Atomic Energy Commission, and National Science Foundation) Unclassified

Presented at meeting of the Amer. Phys. Soc., Mexico City, Mex., June 22-24, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 367, June 22, 1961.

An extensive analysis of the elastic scattering of protons by carbon over the energy range 11-20 mev has been carried out with an optical-model potential which includes a Gaussian surface absorption and a spin-orbit coupling. Experimental data at small energy intervals from several laboratories was fitted by means of an automatic search program utilizing UCLA's IBM 709 and 7090 computers. This analysis has yielded remarkably good fits to the differential cross sections and qualitative fits for the polarizations and reaction cross sections. The values of the model parameters and their behavior as a function of energy is generally reasonable except that the surface thickness associated with the real part of the potential shows some systematic increase with energy, and the surface absorption is generally limited to a thin shell. Anomalous behavior of the parameters in the 17-18 mev region are discussed.

372

California U. [Dept. of Physics] Los Angeles.

ON THE SHAPE OF THE IMAGINARY PART OF THE OPTICAL MODEL POTENTIAL, by M. A. Melkanoff, D. S. Saxon, and J. S. Nodvik. [1961] [2]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)717], Atomic Energy Commission, and National Science Foundation) Unclassified

Published in Proc. Rutherford Jubilee Internat'l. Conf., Manchester (Gt. Brit.) (Sept. 4-8, 1961), New York, Academic Press, 1961, p. 411-412.

An indication of the shape of the imaginary part of the optical model potential has been obtained from analyses of p-C and p-Cu scattering at intermediate energies. Absolute minima are found in the X^2 deviation between calculated and experimental angular distributions. The shape of the X^2 surface near the minimum provides information on the acceptable range of parameters. For carbon, the volume absorption is generally less than 2 mev and the surface absorption is confined to a shell less than 1 fermi thick. For copper, the volume absorption at 17 mev appears to be rather less than 5 mev. (Contractor's abstract)

373

California U. Dept. of Physics, Los Angeles.

THE MANY BODY PROBLEM OF O^{16}, by H. S. Köhler. [1961] [2]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. Rutherford Jubilee Internat'l. Conf., Manchester (Gt. Brit.) (Sept. 4-8, 1961), New York, Academic Press, 1961, p. 415-416.

The nuclear many body problem of O^{16} was investigated by the reaction matrix theory. The single particle wavefunctions were taken to be those of a harmonic oscillator. The reaction matrix was calculated by the separation method. The 2-nucleon interaction was represented by a spin-independent potential of exponential shape and with a hard core. Only the first order term and the dispersion correction were calculated. A minimum in total energy was obtained of -2 mev/A (exp)-8 mev/A) at a root mean square radius of 2.74 fermis (exp 2.57 fermis). (Contractor's abstract)

374

California U. [Dept. of Physics] Los Angeles.

ON THE PROOF OF PARAMETRIC DISPERSION RELATIONS, by H. M. Fried and D. L. Pursey. [1961] [2]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)717] and National Science Foundation) Unclassified

Published in Phys. Rev., v. 124: 1281-1283, Nov. 15, 1961.

Parametric dispersion relations for the connected time-ordered Green's functions, conjectured by Nishijima on the basis of perturbation theory, are shown to exist for the special case of decay processes. Extension of the proof to the more interesting situations of scattering and production depends upon the possibility of continuing 1 or more of the energy variables to negative values. (Contractor's abstract)

375

California U. [Dept. of Physics] Los Angeles.

ON THE SEPARATION METHOD FOR CALCULATING THE NUCLEAR REACTION MATRIX, by H. S. Köhler. [1961] [12]p. incl. diagr. refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)717] and National Science Foundation) Unclassified

Published in Ann. Phys., v. 16: 375-386, Dec. 1961.

The separation method for calculating the nuclear reaction matrix that was presented by Moszkowski and Scott has been investigated. Estimates are made which suggest that their dispersion, interference, and Pauli corrections are underestimated. A modification in the treatment of these terms is presented that gives considerable improvement. The treatment also permits good insight into the nature of the approximation. The errors in the new method are discussed. An alternative approximation that involves an iteration of the dispersion correction is also suggested. (Contractor's abstract)

376

California U. [Dept. of Psychology] Santa Barbara.

EFFECTS OF GROUP MEMBERSHIP ON

RISK-TAKING BEHAVIOR, by B. G. Lonergan and G. C. McClintock. Dec. 1960, 34p. incl. tables, refs. (Technical note no. 1) (AFOSR-94) (AF 49-(638)794) AD 252295 Unclassified

Also published in Psychol. Repts., v. 8: 447-455, June 1961.

The social influence of a group on individual risk-taking was studied. The theoretical and empirical framework for this study is discussed under the separate headings of Normative Behavior, Risk-Taking Behavior, and Defining Group. The assumptions and measurement procedures employed are discussed in a subsequent section. (Contractor's abstract)

377

Cambridge Language Research Unit (Gt. Brit.).

EXPERIMENTAL RESEARCH WORK ON INFORMATION STRUCTURES, by E. W. Bastin. Annual rept. no. 1, Jan. 1-Dec. 31, 1960. Mar. 6, 1961 [19]p. incl. diagrs. (AFOSR-855) (AF 61(052)331) AD 257974 Unclassified

The PACE (Brussels, Belgium) analog computer equipment is being used to investigate a physical interpretation of a calculus, (namely the calculus defined by the program of instructions for the computer). In the case under review the calculus is the set of instructions for the PACE equipment set up according to certain rules together with everything the machine turns out, and the interpretative freedom of the model is being used to attack problems that arise at both large and small ends of our measurement scale, and especially in the fundamental questions underlying the physics of elementary particles, where it is acknowledged that classical concepts of space and time break down. The experiments show the correct form for the representation of mass in an information structure.

378

Cambridge Language Research Unit (Gt. Brit.).

SELF ORGANIZING MECHANISMS AS MODELS FOR SCIENTIFIC THEORIES, by E. W. Bastin and K. S. Jones. July 20, 1961 [15]p. incl. diagrs. (AFOSR-1442) (AF 61(052)331) AD 264866 Unclassified

The current state of theoretical physics makes it urgently desirable to develop a theory which is initially non-metrical for the discussion of problems that arise on the very large and on the very small scale, and from which metrical physics can be deduced as a special case. It is shown that the idea of control is inherently capable of providing a calculus into which basic physical concepts can be incorporated which has the required initially non-metrical properties. The physical ideas that replace the cartesian assumption are derived from the properties of a self-organizing mechanism, and this application of the principles of self-organizing mechanisms suggests others in more general fields. (Contractor's abstract)

379

Cambridge Language Research Unit (Gt. Brit.).

HIERARCHIES OF DESCRIPTIVE LEVELS IN PHYSICAL THEORY, by A. F. Parker-Rhodes. 1961, 28p. (AFOSR-5051) (AF 61(052)331) AD 416504 Unclassified

It is shown that if we attempt to build up a mathematical system for the description of physical phenomena, on the assumption that the essential observations are two-valued, so that the appropriate algebra is the field of characteristic two, we are led to formulate a hierarchical system. The principal entities in this system are matrices over the field J2 whose orders increase in successive levels. A rule for constructing the various levels of the hierarchy is given, and it is shown that in non-trivial cases the number of levels is always finite. (Contractor's abstract)

380

Cambridge Language Research Unit (Gt. Brit.).

A NEW MODEL OF SYNTACTIC DESCRIPTION, by A. F. Parker-Rhodes. [1961] [37]p. incl. diagrs. tables, refs. (Paper no. 34) (AFOSR-J573) [AF 61-(052)331] AD 414779 Unclassified

Also published in Proc. Internat'l. Conf. on Machine Translation of Languages and Applied Language Analysis, Teddington (Gt. Brit.) (Sept. 5-8, 1961), London, Her Majesty's Stationery Office, v. 1: 25-62, 1962.

This paper is intended to contain a fully mathematical model of syntactic structure. The use of lattice theory, which is the mathematical basis of the paper, is not merely formal, but is employed to find algorithms. The algorithms are used to predict what will be the syntactic function of a compound substituent when given those of its components. A strong point in favor of the theory is that it makes use of the possibility of forming direct products of lattices. The theory also has a certain predictive value.

381

[Cambridge Language Research Unit (Gt. Brit.)]

THE IDEA OF SIZE IN LARGE-SCALE PHYSICS, by E. W. Bastin. [1961] [3]p. (AFOSR-J712) [AF 61-(052)331] AD 415445 Unclassified

Also published in Proc. Cambridge Philos. Soc., v. 57: 848-850, Oct. 1961.

Modern cosmology depends upon the assumption of the exact constancy of the velocity of light irrespective of the ways photons may be in interaction with atoms and on the interpretation of the red shift as indicating a galactic recession over great distances.

Independent evidence to support this assumption becomes progressively more slender as the distances we say we observe become greater.

382

Cambridge Language Research Unit (Gt. Brit.).

SEMANTIC MESSAGE DETECTION FOR MACHINE TRANSLATION, USING AN INTERLINGUA, by M. Masterman. [1961] [39]p. incl. diagrs. tables, refs. (Paper no. 36) (AFOSR-J545) (Sponsored jointly by [Air Force Office of Scientific Research under AF 61-(052)542], National Science Foundation, and Office of Naval Research) Unclassified

Also published in Proc. Internat'l. Conf. on Machine Translation of Languages and Applied Language Analysis, Teddington (Gt. Brit.) (Sept. 5-8, 1961), London, Her Majesty's Stationery Office, v. 2: 437-475, 1962.

Also published in part in Semantic Problems in Language; Colloquium rept., Cambridge (Gt. Brit.) (Sept. 9-10, 1961), 1962, p. 6-14. (AFOSR-4501)

The purpose of this paper is to draw attention to a semantic feature of language which must be well understood before it is possible that machines should be programmed to do genuine machine translation, that is, the argument, or message of any piece of discourse. Failure to detect the message can prove misleading, even when the machine though it does not detect the message is programmed to detect many features of the input language's grammar and syntax, and when it is provided with a considerable bilingual dictionary. The trouble with present systems is that even when they are successful, they will retrieve subject matter but not detect message, and for purposes of machine translation this is not enough. A model of the system T' is described in this paper, of which the major constituent is the Thesaurus T.

383

Cambridge Language Research Unit (Gt. Brit.).

SEMANTIC PROBLEMS IN LANGUAGE; COLLOQUIUM REPORT, Cambridge (Gt. Brit.) Sept. 9-10, 1961. 1962, 229p. incl. diagrs. tables, refs. (Rept. no. ML 163) (AFOSR-4501) (AF 61(052)545) AD 296224 Unclassified

The colloquium was comprised of 6 sessions during which papers were presented on the following topics: (1) the nine semantic horrors, (2) the Guberina hypothesis: semantic squares, (3) sememes, (4) "scale" analysis of meaning, (5) semantic grouping, and (6) semantic fields.

384

Cambridge U. Cavendish Lab. (Gt. Brit.).

STRUCTURAL INVESTIGATIONS, BY X-RAY DIFFRACTION METHODS, OF TRANSITION METAL ALLOYS, by W. H. Taylor. Final technical rept. Aug. 21, 1961, 40p. incl. tables, refs. (AFOSR-1849) (AF 61(052)50) AD 272205 Unclassified

Procedures for the determination of electron distributions in transition metal alloys were studied. The intensities of x-ray diffraction were measured on an absolute scale. If the unit cell of the structure was small and of high symmetry the powder-pattern could be used; measurements on CoAl, NiAl and Cr were continued. For more complex structures single-crystal methods were necessary. Methods of placing the intensities on an absolute scale and of testing for freedom from the effects of extinction were devised. Equipment for x-ray fluorescence analysis of minute single crystals used to obtain the x-ray data was designed and built. The importance of the crystal symmetry both in influencing the selection of suitable alloy structures for detailed examination, and in its bearing on the interpretation of the experimental measurements, was studied. The AlMn, AlFe and AlMo systems, and a group of sigma-phases and related structures were studied.

385

[Cambridge U.] Cavendish Lab. (Gt. Brit.).

THE STRUCTURE OF THE μ-PHASE Co_7Mo_6, by J. B. Forsyth and L. M. d'Alte da Veiga. [1961] [12]p. incl. diagrs. tables, refs. (AFOSR-2166) (AF 61(052)50) Unclassified

Also published in Acta Cryst., v. 15: 543-546, June 1962.

The μ-phase structure of Co_7Mo_6 has been confirmed by making single-crystal measurements. The atomic parameters show some significant changes when compared with those in μFe_7W_6, and the interatomic distances in Co_7Mo_6 are compared with those in other transition-metal phases. The distribution of atoms in the available sites appears to be completely ordered. (Contractor's abstract)

386

[Cambridge U.] Cavendish Lab. (Gt. Brit.).

THE MAGNETIC SUSCEPTIBILITIES OF ALUMINIUM RICH TRANSITION METAL INTERMETALLIC COMPOUNDS, by M. A. Taylor. [1960] [11]p. incl. diagrs. tables, refs. (AFOSR-3815) (AF 61(052)50) Unclassified

Also published in Proc. Phys. Soc. (London), v. 78: 1244-1254, 1961.

In aluminum-rich transition-metal intermetallic compounds the behavior of transition-metal atoms in an electron-rich environment can be studied. Electron-density maps, prepared from x-ray data, and considerations of Brillouin zones for these compounds

have not, up to the moment, yielded accurate information on the state of the transition-metal atoms. The results of the measurements of the magnetic susceptibilities of some such compounds are given: from these measurements information on the 3d state of the transition-metal atoms is derived. (Contractor's abstract)

387

[Cambridge U.] Cavendish Lab. (Gt. Brit.).

THE STRUCTURE OF THE INTERMETALLIC PHASE γ(Mo-Al)-Mo_3Al_8, by J. B. Forsyth and G. Gran. [1961] [5]p. incl. diagrs. tables, refs. (AFOSR-3823) (AF 61(052)50) Unclassified

Also published in Acta Cryst., v. 15: 100-104, Feb. 1962.

The molybdenum-aluminum phase diagram has been investigated in the region 12-40 wt % aluminum. The phase Mo_3Al_8 has been isolated and a complete structure determination carried out. The structure is monoclinic with a = 9·208, b = 3·6378, c = 10·065 A and β = 100° 47'. The phase appears to exist over a composition range, the sample analyzed having molybdenum replacing aluminum atoms to the extent of about 5%. The interatomic distances in Mo_3Al_8 are compared with those in other molybdenum-aluminum phases. (Contractor's abstract)

388

Cambridge U. Cavendish Lab. (Gt. Brit.).

EFFECT OF STRAIN-RATE ON THE FLOW-STRESS OF f. c. c. METALS II. PART I. FURTHER OBSERVATIONS OF DEFORMATION TWINNING IN ALLOYS AT LOW TEMPERATURES, by P. B. Hirsch, T. E. Mitchell and P. R. Thornton. Jan. 1961 [23]p. incl. diagrs. refs. (Technical note no. 1) (AFOSR-15) (AF 61(052)98) AD 254922 Unclassified

Observations on low temperature mechanical twinning in copper and copper-zinc alloys are reported. The absence of indications of twinning in the stress strain curves of crystals of 70:30 α-brass is discussed in relation to recent preliminary electron microscopy observations. The twinning data are consistent with the existence of a critical twinning stress which decreases with decreasing stacking fault energy. The data are discussed in terms of recent models for twinning in fcc crystals. Difficulties, both in the theory and in the comparison between theory and experimental data, are critically examined. (Contractor's abstract)

389

Cambridge U. Cavendish Lab. (Gt. Brit.).

DEFORMATION TWINNING IN ALLOYS AT LOW TEMPERATURES, by P. R. Thornton and T. E. Mitchell. [1961] [15]p. incl. diagrs. tables, refs. (AFOSR-3420) (AF 61(052)98) AD 453794 Unclassified

Also published in Philos. Mag., v. 7: 361-375, Mar. 1962.

Observations on low temperature mechanical twinning in Cu and Cu-Zn alloys are reported. The absence of indications of twinning on the stress-strain curves of crystals of 70:30 α-brass is discussed in relation to recent preliminary electron microscopy observations. The twinning data are consistent with the existence of a critical twinning stress which decreases with decreasing stacking-fault energy. The results are discussed in terms of recent models for twinning in fcc crystals. (Contractor's abstract)

390

Cambridge U. Cavendish Lab. (Gt. Brit.).

THE STRAIN-RATE DEPENDENCE OF THE FLOW STRESS OF COPPER SINGLE CRYSTALS, by P. R. Thornton, T. E. Mitchell, and P. B. Hirsch. [1961] [22]p. incl. diagrs. tables, refs. (AFOSR-3421) (AF 61(052)98) AD 613741 Unclassified

Also published in Philos. Mag., v. 7: 337-358, Feb. 1962.

An experimental study is described of the strain-rate sensitivity of the flow stress of Cu single crystals in all stages of deformation and over a wide temperature range. The curves relating the increase $\Delta\tau$ in flow stress on increasing the strain-rate by a fixed amount to the flow stress τ are generally divisible into 3 regions a, b and c. Region a is linear and characteristic of easy glide. At the end of this region the rate of increase of $\Delta\tau$ with strain increases, and a transition region, b, occurs in which $\Delta\tau$ varies with τ much more slowly than in easy glide. Another linear region, c, of $\Delta\tau$ versus τ, of intermediate slope, begins during stage II and is characteristic of the latter part of stage II and of stage III of the work-hardening curves. The lower the test temperature, the greater is the range in stage II in which the linear region c applies. No change occurs in the curves of $\Delta\tau$ versus τ at the onset of stage III. The slope of region c is similar for crystals deforming by single or double slip, and is of the same order of magnitude as that for polycrystals. The results agree with those of previous workers in that the temperature dependence of the flow stress is greater during easy glide than in stages II and III. The 2 linear regions, a and c, are thought to correspond to 2 different arrangements of dislocations, the transition from one type of arrangement to the other taking place in region b. The occurrence of linear regions can be explained on the long range stress, forest, or jog theories of work-hardening. However, while the similarity in the slopes of the curves of $\Delta\tau$ versus τ for single crystals deforming in single or double slip, and for

polycrystals, follows naturally from the forest and jog theories, it does not seem to be so easily explicable in terms of the current long-range stress theory. (Contractor's abstract)

391

Cambridge U. [Dept. of Applied Mathematics and Theoretical Physics] (Gt. Brit.).

UNITARITY AND THE MANDELSTAM REPRESENTATION - II, by R. W. Lardner. [1961] [14]p. incl. diagrs. [AF 61(052)233] Unclassified

Published in Nuovo Cimento, Series X, v. 20: 733-746, May 16, 1961.

An earlier investigation into the analyticity of the 3-particle unitarity contribution to a scattering absorptive part (see item no. 386, Vol. IV) is discussed more completely. The general term is shown to reduce to the same form as the 3-particle term. (Contractor's abstract)

392

Cambridge U. Dept. of Applied Mathematics and Theoretical Physics (Gt. Brit.).

ANALYTICITY AND UNITARITY, by J. C. Polkinghorne. [1961] [8]p. incl. diagrs. refs. [AF 61-(052)233] Unclassified

Published in Nuovo Cimento, Series X, v. 23: 360-367, Jan. 16, 1962.

It is shown that the structure of S-matrix singularities is controlled by unitarity. The minimum consistent set of singularities is that given by perturbation theory, provided a certain condition related to analyticity in external masses is assumed. (Contractor's abstract)

393

Cambridge U. Dept. of Zoology (Gt. Brit.).

DOES THE MALE STIMULATE OESTROGEN SECRETION IN FEMALE CANARIES?, by R. P. Warren and R. A. Hinde. [1960] [2]p. incl. table. (AFOSR-3461) [AF 61(052)97] Unclassified

Also published in Science, v. 133: 1354-1355, Apr. 28, 1961.

Female Border canaries treated with oestrogen during the nonbreeding season may build nests, regardless of winter lighting, temperature, and absence of partner. Incubation may follow completion of the nest although ovulation is suppressed. Reactions obtained in the breeding season suggest that the male does not initiate but accelerates oestrogen production through the stimulation he provides. (Contractor's abstract)

394

Cambridge U. Dept. of Zoology (Gt. Brit.).

SELECTION OF NEST MATERIAL BY FEMALE CANARIES, by R. A. Hinde and E. A. Steel. [1961] [9]p. incl. diagrs. tables, refs. (AFOSR-4200) (AF EOAR-62-44) Unclassified

Also published in Animal Behavior, v. 10: 67-75, Jan.-Apr. 1962.

Domesticated canaries, provided with grass and feathers for nest material, use primarily grass for the outer structure and feathers for lining the cup. The selection of material is governed at least in part by stimuli from the nest cup. Females treated with estrogen, building in large pans and provided with nest material only during occasional watches select mostly grass. The preference for grass is correlated with active building under circumstances in which stimulation of the ventral surfaces is infrequent and/or of low intensity. In normal building the female brings a higher proportion of feathers to the nest as the date of egg laying approaches. This is partly due to the decreasing size of the nest cup, for females bring a higher proportion of feathers when building in a small nest cup than when building in a large one. However, females provided with a small nest but not allowed to build a nest in it show an increasing preference for feathers as egg laying approaches even though the size of the nest cup remains constant. The data indicate that the selection of feathers in normal building is related to (a) the development of the brood patch, and (b) adequate external stimulation from the nest pan.

395

Cambridge U. Psychological Lab. (Gt. Brit.).

THE EFFECT OF TWO "TRANQUILLIZERS" ON AUDITORY DISCRIMINATION AND DELAYED RESPONSE PERFORMANCE OF MONKEYS, by C. G. Gross and L. Weiskrantz. [1961] [6]p. incl. tables, refs. (AFOSR-1724) (AF 61(052)185) AD 611505 Unclassified

Also published in Quart. Jour. Exper. Psychol., v. 13: 34-39, Feb. 1961.

Five rhesus monkeys were tested on performance of an auditory discrimination and a delayed response test with a sliding scale of increasing difficulty after treatment with (a) 0.2 to 0.5 mg/kg reserpine, (b) 150 mg/kg meprobamate, (c) an equivalent saline injection, and (d) no treatment. Both drug treatments resulted in a severe deficit on the auditory discrimination and no change or improvement in delayed response performance. The auditory deficit was not due simply to an increased latency of response. It is suggested that these results support the hypothesis that reserpine and meprobamate reduce the utilization of sensory information. (Contractor's abstract)

396

Cambridge U. Psychological Lab. (Gt. Brit.).

STUDIES OF THE FRONTAL AND STRIATE CORTEX AND BEHAVIOUR IN THE RHESUS MONKEY, by L. Weiskrantz. Final technical rept. Nov. 30, 1961, 51p. incl. refs. (AFOSR-2243) (AF 61(052)185) AD 288195 Unclassified

Visual cortex lesions have been assessed by a perimetry device, the first to be built for animal studies. In addition, visual acuity and visuomotor performance have been quantitatively assessed. The results are discussed in terms of their agreement or otherwise with current conceptions of the visual nervous system. Frontal cortex lesions have been assessed by a number of techniques, among them time estimations, auditory discrimination learning, visual learning set, and tests of recent memory, including the conventional delayed response task. It has been possible to produce reversible frontal defects by electrical stimulation of the cortex. Certain drugs have been shown to have a dramatic effect in alleviating the lesion effect. Various hypotheses are discussed. (Contractor's abstract)

397

Cambridge U. Psychological Lab. (Gt. Brit.).

ROLE OF EXPERIENCE IN MISREACHING PRODUCED BY VISUAL CORTEX LESIONS, by A. Cowey and L. Weiskrantz. [1961] [1]p. (AFOSR-3521) (AF 61(052)185) Unclassified

Also published in Nature, v. 192: 1319, Dec. 30, 1961.

When the macular projection area — that part of the visual striate cortex to which the macular region of the retina projects — is removed in monkeys, the animal frequently misreaches for small pieces of food when they are presented to him on a flat surface. The symptom declines after the first few days of operation, and almost invariably disappears within 10 days, after which the animals are as adept as normal ones at reaching for food. Experiments conducted on monkeys to determine whether practice is necessary for this recovery to occur or whether the recovery process is spontaneous, demonstrated that, although the cause of misreaching is still not clear, recovery depends on experience in the light. Further work is necessary in order to determine whether mere exposure to the light is sufficient, or whether specific practice in reaching for objects is necessary. The latter appears more likely.

398

Cambridge U. Psychological Lab. (Gt. Brit.).

THE LOGIC OF THE LOCALIZATION OF FUNCTION IN THE CENTRAL NERVOUS SYSTEM, by R. L. Gregory. [1961] [3]p. (AFOSR-J58) [AF EOAR-61-13] AD 400094 Unclassified

Also published in Biological Prototypes and Synthetic Systems; Proc. Second Annual Bionics Sympostum, Cornell U., Ithaca, N. Y. (Aug. 30-Sept. 1, 1961), New York, Plenum Press, v. 1: 51-53, 1962.

The use of the technique of ablation by neurologists who hope to discover the function of parts of the nervous system is discussed and compared with the experience of the engineer working with an electronic system. It is suggested that for the neurologist, results from ablation studies should be described with great caution and not interpreted as indicating function except in terms of some explicitly described model. If a component of an electronic system is removed from a circuit, the other components will, in general, function differently. If the bias is changed on a valve this stage may no longer amplify, but may oscillate or produce high-energy harmonics. This, then will become a different circuit with new properties which can be explained only by knowing the parameters and sufficient general principles. If part of the brain is removed and the patient loses his anxieties, or his speech, or the ability to make sensible decisions, what can be inferred as to the function of the part lost. The point is not that ablation is of no theoretical interest, but rather that the results should be interpreted according to what should happen when recognized parts of a similar system are removed.

399

Cambridge U. Sub-Dept. of Veterinary Anatomy (Gt. Brit.).

REGULATION OF OXYGEN TENSION IN THE BRAIN, MAMMARY GLAND AND TESTIS, by B. A. Cross and I. A. Silver. Annual summary rept. no. 1, Oct. 1, 1960-Sept. 30, 1961, 6p. (AFOSR-2508) (AF 61(052)301) AD 288491 Unclassified

The primary aim of this research was to investigate whether changes in the oxygen or carbon dioxide tension of the blood reaching the hypothalamus influences the cerebral circulation through activation of descending sympathetic outflows from the hypothalamus. To this end, study has been made of the resting levels of oxygen tension in various parts of the forebrain and the changes produced by a variety of experimental procedures. Similar phenomena in the mammary gland and testis have also been investigated. Observations confirmed that a major determinant of oxygen tension in these organs is capillary blood flow. This factor made it possible to use mammary and testicular oxygen tension readings as indicators of peripheral vasoconstrictor activity, to obtain evidence that hypoxia and hypercapnia produce a central sympathetico-adrenal discharge.

400

Cambridge U. Sub-Dept. of Veterinary Anatomy (Gt. Brit.).

MAMMARY OXYGEN TENSION AND THE

MILK-EJECTION MECHANISM, by B. A. Cross and I. A. Silver. [1961] [6]p. (AFOSR-2509) (AF 61-(052)301) Unclassified

Presented at Eighty-third general meeting of the Soc. for Endocrinol., London (Gt. Brit.), May 5, 1961.

Abstract published in Jour. Endocrinol., v. 22: XXXIII, July 1961.

Also published in Jour. Endocrinol., v. 23: 375-384, 1962.

Mammary oxygen tension was monitored polarographically with gold-plated needle electrodes using the method of Cater, Silver & Wilson (1959) in 20 lactating rabbits under light urethane anaesthesia. The contractile activity of mammary myoepithelium in response to i.v. injection of standard doses of oxytocin (10-100 mu 'Pitocin', Parke Davis and Co.) was recorded kymographically from cannulated teats by the method of Cross & Harris (1952). Resting pO_2 levels of 15-30 mm Hg were found in the lactating glands. Evacuation of milk from distended glands raised their resting pO_2. Conversely, a rise of intramammary pressure elicited by injection of oxytocin caused a fall in mammary pO_2, the extent and duration of which depended upon the magnitude of the milk-ejection response. Evacuated glands showed a negligible fall of pO_2 following injection of oxytocin. Wide variations in mammary pO_2 (± 80% of the resting level) brought about by inhalation of oxygen or air diluted with nitrogen had no effect on the contractile response of the myoepithelium to i.v. injection of oxytocin. On the other hand, equivalent depressions of mammary pO_2 produced by vascular changes, viz. by i.v. injection of 5-10 µg adrenaline or electrical stimulation of the sympathetic centres of the hypothalamus (Cross, 1955), or by thoracolumbar spinal anaesthesia, were associated with drastically reduced milk-ejection responses. No improvement of the responses followed oxygen breathing, even when the initial pO_2 values were restored thereby. These findings, together with the effects of intramammary pressure reported above, indicate that under normal conditions of respiration the mammary pO_2 serves as an index of capillary blood flow in mammary tissue, and moreover that this capillary flow rather than the absolute oxygen tension determines the response of mammary myoepithelium to circulating oxytocin.

401

Cambridge U. Sub-Dept. of Veterinary Anatomy (Gt. Brit.).

CENTRAL ACTIVATION OF THE SYMPATHETICO-ADRENAL SYSTEM BY HYPOXIA AND HYPERCAPNIA, by B. A. Cross and I. A. Silver. [1961] [13]p. incl. diagrs. tables, refs. (AFOSR-3460) (AF 61(052)301) Unclassified

Also published in Jour. Endocrinol., v. 24: 91-103, Mar. 1962.

In rabbits under urethane anesthesia sympathetico-adrenal vasoconstrictor activity was monitored by the reduction of oxygen tension (measured polarographically with needle electrodes) in the testis and lactating mammary gland, and by the inhibitory effect on milk ejection. Electrical stimulation of the dorsal, lateral and posterior hypothalamus evoked a sympathetic response in these organs, characterized by a rapid nervous effect and secondary humoral effect which outlasted the stimulus, resembled the response to intravenous adrenaline, and was abolished by removal of both adrenal glands. Hypoxia produced by making the animals inhale nitrous oxide or nitrogen for 15-30 sec and hypercapnia induced by inhalation of a mixture of 80% CO_2 and 20% O_2 for 5-15 sec both induced a sympathetic discharge similar to that resulting from hypothalamic stimulation. Hypercapnia was a notably more potent stimulus than hypoxia. The effects were reversibly blocked by thoraco-lumbar spinal anesthesia. Placement of discrete bilateral lesions in the septum, hippocampus and medial thalamus did not impair the sympathetic activation elicited by hypercapnia. Hypothalamic lesions, on the other hand, often reduced and occasionally prevented the central sympathetic discharge. The possible role of the hypothalamus in cardiovascular regulation is discussed in the light of these findings. (Contractor's abstract)

402

Cambridge U. Sub-Dept. of Veterinary Anatomy (Gt. Brit.).

NEUROVASCULAR CONTROL OF OXYGEN TENSION IN THE TESTIS AND EPIDIDYMIS, by B. A. Cross and I. A. Silver. [1961] [21]p. incl. illus. diagrs. refs. (AFOSR-4203) (AF 61(052)301) AD 407595 Unclassified

Also published in Jour. Reprod. Fertil., v. 3: 377-395, June 1962.

Interstitial oxygen tension was recorded polarographically with gold-plated needle electrodes in the testis and cauda epididymidis of the rabbit, sheep and dog. The mean epididymal resting oxygen tension was about twice that of the testis in the rabbit and sheep, and nearly three times testis oxygen tension in the dog. A short period of oxygen breathing doubled testicular oxygen tension while nitrous oxide breathing more than halved it. The latency of the testis response was always much longer than that of the epididymal response in the rabbit and sheep, but only slightly longer in the dog. The discrepancy was accounted for by the arterial arrangement in the 3 species. Occlusion of the internal spermatic artery produced a drastic fall in testis oxygen tension in the rabbit, sheep and dog, and had little effect on epididymal oxygen tension. Vasal artery occlusion reduced oxygen tension in the cauda epididymidis but not the testis, and a large fall occurred only if collateral vessels from the internal spermatic or cremasteric arteries were also clamped. Circulatory hypotension produced by amyl nitrite inhalation reduced oxygen tension in the testis and epididymis of all 3 species. Local cooling of the rabbit, sheep and dog. Conversely, local

warming of the scrotum produced a rise of oxygen tension in the ipsilateral testis. Thoraco-lumbar spinal anesthesia did not block these effects. Electrical stimulation of the sympathetic areas of the hypothalamus in the rabbit elicited a profound depression of testicular oxygen tension characterized by an initial rapid phase, which was abolished by posterior mesenteric ganglionectomy and hypogastric nerve section, and a secondary slower phase, which was abolished by adrenalectomy. The 2 phases could be mimicked by stimulation of the posterior mesenteric ganglion or hypogastric nerves, and by intravenous injection of adrenaline respectively. (Contractor's abstract)

403

Cambridge U. Sub-Dept. of Veterinary Anatomy (Gt. Brit.).

SOME FACTORS AFFECTING OXYGEN TENSION IN THE BRAIN AND OTHER ORGANS, by B. A. Cross and I. A. Silver. [1961] [17]p. incl. diagrs. tables, refs. (AFOSR-4277) (AF 61(052)301) Unclassified

Also published in Proc. Royal Soc. (London), v. 156B: 483-499, Nov. 20, 1962.

Polarographic recording of cerebral oxygen tension was performed by means of gold-plated needle electrodes oriented stereotaxically in the forebrain of rabbits under light urethane anesthesia. The indicated mean resting level of oxygen tension in grey matter was 13 mm Hg. Higher levels were recorded in cerebral ventricles and lower levels in white matter. O_2 breathing doubled the forebrain oxygen tension and N_2 or N_2O reduced it nearly to zero. Inhalation of 80% CO_2 and 20% O_2 produced a threefold increase in oxygen tension. Forebrain oxygen tension was drastically reduced by inhalation of amyl nitrite and by carotid artery occlusion. The oxygen tension recorded in a small coagulated lesion or in dead forebrain was low, and no change resulted when the animal inhaled O_2, N_2 or CO_2. Intravenous injection of 1 to 10 μg adrenaline elicited a rise of up to 20% in forebrain oxygen tension and at the same time a fall in the oxygen tension recorded in the testis, lactating mammary gland or skin. Electrical stimulation (15 s) of the lateral or posterior hypothalamus produced an elevation of forebrain oxygen tension persisting for a minute or more after the stimulus, suggesting a release of adrenomedullary adrenaline. Opposite effects were seen in the oxygen tension measured in testis, mammary gland or skin. Electrical stimulation of the cervical sympathetic nerve evoked an ipsilateral depression of forebrain oxygen tension amounting to nearly 50% in some instances. Cervical sympathetic section did not influence resting forebrain oxygen tension. (Contractor's abstract)

404

Cambridge U. Press, New York.

JOURNAL OF FLUID MECHANICS, ed. by G. K. Batchelor. 1961-1962. (Sponsored jointly by Air Force Office of Scientific Research and Office of Naval Research under Nonr-254800) Unclassified

This journal is an international periodical covering theoretical and experimental research investigations of all aspects of fluid mechanics. The journal compliments Physics of Fluids by making European papers more easily accessible to U. S. scientists.

405

Carnegie Inst. of Tech., Pittsburgh, Pa.

THE HALL EFFECT IN FERROMAGNETICS, by E. M. Pugh. Final rept. June 30, 1961 [41]p. incl. diagrs. tables, refs. (AFOSR-1175) (AF 49(638)257) AD 267112 Unclassified

Results of Hall effect and resistivity measurements on a number of ferromagnetic metals and alloys are presented. These measurements verify some earlier ideas regarding the electronic structure in the region of Ni and its alloys and give new information about this structure in the region of Fe. It is shown that the 4 band model of the ordinary Hall effect in ferromagnetics correctly predicts the results and yields new information regarding the band structure. The measurements of the extraordinary Hall effect are compared with predictions of recent theories. It is found that in their present form none of these theories adequately describe the data. Data are also given for alpha phase Ag-Zn alloys. (Contractor's abstract)

406

Carnegie Inst. of Tech., Pittsburgh, Pa.

CONDUCTION ELECTRONS IN PSEUDONICKEL ALLOYS FROM HALL DATA, by E. R. Sanford, A. C. Ehrlich, and E. M. Pugh. [1961] [5]p. incl. diagrs. table, refs. [AF 49(638)257] Unclassified

Published in Phys. Rev., v. 123: 1947-1951, Sept. 15, 1961.

The 2 Hall coefficients and resistivity of 4 Ni-Cu-Fe alloys having 28 electrons/atom, with Ni content from 97-70 atomic-%, were measured at 20°K, 77°K, and room temperature using fields up to 3.1 webers/m^2. R_0 was found to increase with decreasing temperature for all compositions, and also to increase with decreasing Ni content for each of the 3 temperatures measured. The effective number of conduction electrons calculated from the R_0's measured at low temperatures was found to fall smoothly from the anomalous peak at pure Ni to about 0.3 at 70% Ni, in agreement with the predictions of the 4-band model. A short summary of the considerable evidence supporting this model is given. The extraordinary Hall coefficient, R_e, is negative at all temperatures for the 3 samples richest in Ni, being increasingly negative as the Ni content is lowered. On the other hand, the 70% Ni-20% Cu-10% of Fe alloy has positive extraordinary Hall coefficients at all temperatures. The behavior of R_e obeys none of the variously proposed theoretical relations. (Contractor's abstract)

407

Carnegie Inst. of Tech., Pittsburgh, Pa.

EFFECT OF ORDER ON THE HALL CONSTANTS OF Ni_3Mn, by J. A. Dreesen. [1961] [3]p. incl. diagrs. tables, refs. [AF 49(638)257] Unclassified

Published in Phys. Rev., v. 125: 1215-1217, Feb. 15, 1962.

Hall effect measurements as a function of temperature are reported for ordered and disordered Ni_3Mn. At low temperatures the ordinary Hall coefficient is found to be negative for both the ordered and disordered alloy. It is shown that the apparent positive value of the ordinary Hall coefficient in the disordered alloy at room temperature is due to the near coincidence of the Curie temperature of this alloy with room temperature. This results in a positive contribution to the measured value of the ordinary Hall coefficient from the extraordinary effect, a smaller contribution being present at low temperatures. An approximate correction is made for this contribution, with the result that the true ordinary coefficient in disordered Ni_3Mn is found to be nearly equal to that in the ordered alloy. Furthermore, its absolute magnitude and temperature dependence are much like that of Cu-Ni and pseudo-nickel alloys. Thus, it is concluded that ordering has much less effect on the band structure of this alloy than was previously assumed. (Contractor's abstract)

408

Carnegie Inst. of Tech. [Dept. of Civil Engineering] Pittsburgh, Pa.

DYNAMIC CONSIDERATIONS IN FRACTURE ARREST BY RIVETED STIFFENERS, by P. H. Sanders and J. P. Romualdi. [1961] [12]p. incl. illus. diagrs. tables. (AFOSR-2404) (AF 49(638)237) Unclassified

Also published in Developments in Mechanics, Proc. of the Seventh Midwestern Mechanics Conf., Michigan State U. (Sept. 6-8, 1961), New York, Plenum Press, v. 1: 100-111, 1961.

Energy methods are used to derive relationships between applied tensile stress, crack length, and the rivet force required to arrest the crack. An adjustable rivet force is used to verify certain of these relationships. (Contractor's abstract)

409

Carnegie Inst. of Tech. Dept. of Mathematics, Pittsburgh, Pa.

FUNCTION THEORETIC SOLUTIONS OF CERTAIN BOUNDARY-VALUE PROBLEMS, by V. P. Sreedharan. July 1961, 39p. (Technical rept. no. 34) (AFOSR-1083) (AF 49(638)227) AD 261985 Unclassified

Also published in Jour. Math. and Mech., v. 14: 211-230, 1965.

The domains of analyticity of solutions of the equation $\Delta u \pm k^2 u = 0$ in 2 independent variables are studied with a view to solving boundary-value problems in the large. The boundary value problems are transformed into function theoretic problems. Specifically the Sommerfeld half-plane problem for $\Delta u + k^2 u = 0$ is solved. A related result on integral equations is obtained. Green's functions for a wedge with various boundary conditions are constructed in the case of the equation $\Delta u - k^2 u = 0$. (Contractor's abstract)

409A

Carnegie Inst. of Tech. [Dept. of Mathematics] Pittsburgh, Pa.

ON FINITE GROUPS WITH AN ABELIAN SYLOW GROUP, by R. Brauer and H. S. Leonard, Jr. [1959] 27p. (AFOSR-3610) (AF 49(638)227) AD 428409 Unclassified

Also published in Canad. Jour. Math., v. 14: 436-450, 1962.

Consideration is given finite groups G of order g which satisfy the following condition: There exists a prime p dividing g such that if $p \neq 1$, is an element of a p-Sylow group P of G then the centralizer C(P) of P in G coincides with the centralizer C(P) of P in G. P is abelian.

410

Carnegie Inst. of Tech. [Dept. of Psychology] Pittsburgh, Pa.

EFFECTS OF INSTRUCTIONS ON THE PERCEPTION OF MULTIPLE TARGETS: SUPPLEMENTARY REPORT, by H. W. Karn and L. W. Gregg. [1961] [2]p. incl. diagr. (AFOSR-1097) (AF 49(638)770) Unclassified

Also published in Jour. Exper. Psychol., v. 62: 533-534, 1961.

For abstract see item no. 412, Vol. V.

411

Carnegie Inst. of Tech. [Dept. of Psychology] Pittsburgh, Pa.

RESPONSE TENDENCIES IN THE VISUAL DETECTION OF SINGLE TARGETS, by G. F. Pitz, L. W. Gregg, and H. W. Karn. [1961] [6]p. incl. diagrs. tables. (AFOSR-1424) (AF 49(638)770) AD 450643 Unclassified

Also published in Perceptual and Motor Skills, v. 13: 275-280, Dec. 1961.

An attempt was made to determine the conditions

which gave rise to differing frequencies of the 2 types of error, reporting a dot as present when it was not (errors of commission) and failure to identify a dot which was present (errors of omission). The proportion of occurrence of dots was .5, and the size of the circular area in which the dot appeared, brightness of the dot, and duration of presentation were varied. The results indicated that at conditions of poor visibility, errors of omission predominated. As conditions improved, the proportions of each type of error became more alike. At some conditions of good, but not perfect visibility, errors of commission were more frequent than errors of omission. Possible determinants of response tendencies in experiments of this sort were discussed. (Contractor's abstract)

412

Carnegie Inst. of Tech. [Dept. of Psychology] Pittsburgh, Pa.

THE EFFECTS OF INSTRUCTIONAL SETS ON THE PERCEPTION OF PERIPHERAL VISUAL STIMULI, by H. W. Karn and L. W. Gregg. [1961] [17]p. incl. diagrs. tables. (AFOSR-1919) (AF 49(638)770) AD 271754 Unclassified

The effects of different instructions on a task requiring the detection of a learnable cue under conditions which precluded the possibility of complete observation of three targets in a peripheral visual field were studied. The failure to obtain anticipated insightful shifts in performance does not support the supposition that cognitive sets are critical determinants of the behavior generated by the multiple stimulus task. The experimental conditions apparently lead Ss to acquire information about the stimulus complex but do not enable them to draw inferences that maximize performance. Unspecified nonverbalized perceptual and response sets, biases, and purely peripheral components are suggested as possible explanatory factors governing the observed behavior.

413

Carnegie Inst. of Tech. [Metals Research Lab.] Pittsburgh, Pa.

STUDY OF DISLOCATION ARRAYS BY X-RAY DIFFRACTION MICROSCOPY, by W. H. Robinson and H. J. Levinstein. [1961] [8]p. incl. illus. table. (AFOSR-506) [AF 49(638)551] AD 261656 Unclassified

Also published in Direct Observation of Imperfections in Crystals; Proc. of a Technical Conf., St. Louis, Mo. (Mar. 1-2, 1961), New York, Interscience Publishers, 1962, p. 561-568.

X-ray diffraction micrographs obtained from single crystals of Ag and Cu showed that it is not possible to resolve individual dislocations in these crystals. Cr radiation and high resolution spectroscopic plates were used. The lineage structure in these crystals was very sharply portrayed. The failure to observe individual dislocations is probably due to high absorption of the CrKα leading to only slight penetration and the extension of dislocations in these metals. (Contractor's abstract)

414

Carnegie Inst. of Tech. Metals Research Lab., Pittsburgh, Pa.

THERMAL ETCH PITS AND DISLOCATIONS IN SILVER, by W. L. Winterbottom, W. H. Robinson, and J. P. Hirth. Mar. 15, 1961 [4]p. incl. illus. refs. (AFOSR-731) (AF 49(638)551) AD 261655 Unclassified

Silver single crystals having (100), (110) and (111) orientations were heated to 750°C in a vacuum of about 10^{-5} to 10^{-6} mm of Hg. The density of the thermal etch pits which resulted agreed with the estimate of the dislocation density as obtained with the Lambot x-ray method. The formation of these relatively sharp thermal etch pits is interpreted as being a result of the low undersaturation of Ag vapor and the presence of impurities. (Contractor's abstract)

415

Case Inst. of Tech. Computing Center, Cleveland, Ohio.

A SORTING PROBLEM, by R. C. Bose and R. J. Nelson. Apr. 1961, 22p. incl. tables. (Computing Center publ. no. 1043) (AFOSR-636) (In cooperation with North Carolina U. Inst. of Statistics, Chapel Hill) (AF 49(638)213 and AF 49(638)971) AD 256333 Unclassified

Also published in Jour. Assoc. Comput. Mach., v. 9: 282-296, Apr. 1962.

An important problem in digital computer applications is the problem of sorting a collection of records, documents, numbers or other data into some predesigned arrangement according to a key or field which is associated to each record. Given a set of n real numbers, the problem is to find the least number of comparisons f(n) for arranging the set in ascending order with the condition that the number of permutations (transpositions) be no larger than the number of comparisons, and to provide an algorithm for obtaining this arrangement. The problem as stated is not relevant to radix or merging algorithms since both are fixed schemes in which speed in making comparisons and not in minimizing their number, is the criterion of efficiency. However the new upper bound f(n) is found to be so much better than $\binom{n}{2}$ for large n that it suggests the desirability of a different hardware approach to the problem. An apparent shortcoming of this method is that every n requires a different algorithm; however, a simple meta-algorithm is available for calculating an algorithm for any n.

416

Case Inst. of Tech. Dept. of Chemistry, Cleveland, Ohio.

DICHLORO- AND SILOXYGERMANIUM PHTHALOCYANINES, by R. D. Joyner, R. G. Linck and others. [1961] [4]p. incl. table. (AFOSR-1325) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)773, National Science Foundation, and Research Corporation) Unclassified

Also published in Jour. Inorg. and Nuclear Chem., v. 24: 299-302, Mar. 1962.

Two syntheses of dichlorogermanium phthalocyanine are given. One method depends on the reaction of o-cyanobenzamide with $GeCl_4$ in refluxing 1-chloronaphthalene and the other on the reaction occurring between phthalocyanine and $GeCl_4$ in refluxing quinoline. The second of these 2 methods appears to be especially advantageous in terms of yield, convenience and purity of product. In addition, several siloxy germanium phthalocyanines are described. The properties of one member of this group suggest that it is polymeric.

417

Case Inst. of Tech. [Dept. of Chemistry] Cleveland, Ohio.

PHTHALOCYANINOSILICON COMPOUNDS, by R. D. Joyner and M. E. Kenney. [1961] [3]p. incl. table. [AFOSR-1431] (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)773] and Research Corporation) Unclassified

Presented at 139th Nat'l. meeting of the Amer. Chem. Soc., St. Louis, Mo., Mar. 1961.

Also published in Inorg. Chem., v. 1: 236-238, May 1962. (Title varies)

Four compounds are described: $PcSiCl_2$, $PcSi(OH)_2$, $PcSi[OSi(C_6H_5)_3]_2$, and $PcSi[OSi(OCH_2C_6H_5)_2]_2$. All of the compounds possess Si-N-C links which are stable, and the latter 2 contain both tetracoördinate and hexacoördinate silicon atoms. (Contractor's abstract)

418

Case Inst. of Tech. [Dept. of Chemistry] Cleveland, Ohio.

ALUMINUM AND SILICON HYDROXY AND OXY SYSTEMS OF THE PHTHALOCYANINO TYPE, by J. E. Owen and M. E. Kenney. [1961] [3]p. incl. diagr. table. (AFOSR-1765) [AF 49(638)773] Unclassified

Presented at 139th Nat'l. meeting of the Amer. Chem. Soc., St. Louis, Mo., Mar. 1961.

Also published in Inorg. Chem., v. 1: 334-336, May 1962.

A re-investigation of some oxy- and hydroxy-(phthalocyanino)-aluminum compounds has revealed the existence of unhydrated PcAlOH and confirmed the existence of PcAlOAlPc. Two structurally related substances also have been found which it is concluded have the formulas PcAlOSi(Pc)OAlPc and PcAlOSi(Pc)OSi(Pc)OAlPc. Hydrolysis of the second of these has yielded what appears to be HOSi(Pc)OSi(Pc)OH. (Contractor's abstract)

419

Case Inst. of Tech. [Dept. of Chemistry] Cleveland, Ohio.

A PHTHALOCYANINOSILOXANE, by R. D. Joyner and M. E. Kenney. [1961] [2]p. incl. diagr. table. (AFOSR-4354) [AF 49(638)773] Unclassified

Presented at 139th Nat'l. meeting of the Amer. Chem. Soc., St. Louis, Mo., Mar. 1961.

Also published in Inorg. Chem., v. 1: 717-718, Aug. 1962.

Recently it has been reported that oxy-linked polymers are formed by both phthalocyaninogermanium and phthalocyaninomanganese (IV) systems. Work now has been carried out which shows that a related siloxane, $HO(PcSiO)_xH$, is formed by the dehydration of $PcSi(OH)_2$. The reaction by which it is formed, $xPcSi(OH)_2 \rightarrow HO(PcSiO)_xH + (x - 1)H_2O$, entails the cleavage of Si-O bonds in the presence of Si-N bonds. No observable amounts of gas were evolved below 400° but at 400° water was evolved rapidly for less than 15 min and then the reaction ceased. The amounts of water evolved during the formation of $HO(PcSiO)_xH$ indicate that the minimum value of x is greater than 10, perhaps near 10^2. The polymer withstood 520° in vacuo for 2.5 hr with no detectable gas evolution and no discoloration of itself or the apparatus. At 550° for 1 hr it did produce 3.3 mm of pressure and gave evidence of a more rapid decomposition at 625°.

420

Case Inst. of Tech. [Dept. of Physics] Cleveland, Ohio.

MAGNETORESISTANCE AND HALL EFFECT IN SINGLE CRYSTALS OF ALUMINUM, by R. W. Stark. June 1, 1961, 30p. incl. diagrs. table, refs. (AFOSR-951) (AF 49(638)621) AD 298129 Unclassified

The transverse magnetoresistance and the Hall effect in aluminum have been investigated for several single crystals of high purity. The approx space isotropy of these effects is in qualitative agreement with the models that have been proposed for the Fermi surface of Al. Certain details of the data are consistent with the presence of an infinite chain structure in the third zone of Al as predicted by the model of W. A. Harrison (Phys. Rev., v. 116: 555, 1959). (Contractor's abstract)

421

Case Inst. of Tech. Dept. of Physics, Cleveland, Ohio.

EVIDENCE FOR SPIN-ORBIT SPLITTING IN THE BAND STRUCTURE OF ZINC AND CADMIUM, by A. S. Joseph, W. L. Gordon and others. [1961] [3]p. incl. diagrs. (AFOSR-1487) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)-621] and Atomic Energy Commission) Unclassified

Also published in Phys. Rev. Ltrs., v. 7: 334-336, Nov. 1, 1961.

Detailed de Haas-van Alphen effect measurements on zinc and cadmium were made which cannot be accounted for with any Fermi surface model in which spin-orbit coupling is neglected. The magnetic breakdown of the spin-orbit energy gap is also discussed.

422

Case Inst. of Tech. [Dept. of Physics] Cleveland, Ohio.

THE LOW FIELD DE HAAS-VAN ALPHEN EFFECT IN ZINC, by A. S. Joseph. Nov. 1961 [60]p. incl. diagrs. refs. (Technical rept. no. 3) (AFOSR-1757) (AF 49(638)621) AD 273017 Unclassified

Also published in Phys. Rev., v. 126: 489-497, Apr. 15, 1962.

A study of the low field de Haas-van Alphen effect in Zn employing automatic recording of the variation of the torque as a function of the reciprocal of the applied magnetic field revealed 6 sets of periods. These periods are assigned in a consistent manner to portions of the free-electron model of the Fermi surface (single OPW). Cyclotron masses associated with the 3 larger sets of the observed periods agreed well with the theoretical estimates. Evidence is obtained for the presence of a spin-orbit energy gap across the hexagonal face of the first Brillouin zone near the corners. Thus, the validity of the single Brillouin zone construction is demonstrated for Zn. (Contractor's abstract)

423

Case Inst. of Tech. [Dept. of Physics] Cleveland, Ohio.

THE MEASUREMENT OF THE RESISTIVITIES OF METALS USING AN EDDY CURRENT METHOD, by L. D. Bogan. 1961, 34p. incl. diagrs. (AF 49(638)-621) Unclassified

A method is described which measures the electrical resistivity of metals in cylindrical form by placing the bar in a uniform magnetic field and then rapidly reducing the field to zero. The resistivity of the metal may be calculated from the observed rate of decay of the eddy current induced in the metal bar. No electrical contact to the metal is necessary. Measurements of residual resistivity ratios, P273/P4.2, were made on a sample of triply sublimed magnesium and 2 samples of zone refined beryllium. The ratio found for the magnesium sample was 374 ± 11. The beryllium sample which was 1 pass zone refined had a ratio of only 8.2 ± 0.3 while the 8 pass zone refined sample had a resistivity ratio of 18.1 ± 0.6. (Contractor's abstract)

424

Case Inst. of Tech. [Dept. of Physics] Cleveland, Ohio.

LOW-FIELD DE HAAS-VAN ALPHEN EFFECT IN ZINC, by A. S. Joseph and W. L. Gordon. [1961] [9]p. incl. diagrs. refs. (AFOSR-3119) (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-62-222], Atomic Energy Commission, and National Carbon Company) Unclassified

Also published in Phys. Rev., v. 126: 489-497, Apr. 15, 1962.

For abstract see item no. 422, Vol. V.

425

Case Inst. of Tech. [Statistical Lab.] Cleveland, Ohio.

THE FOLDED NORMAL DISTRIBUTION, by F. C. Leone, L. S. Nelson, and R. B. Nottingham. Jan. 1961, 22p. incl. illus. tables. (Case Statistical Lab. publ. no. 1041) (AFOSR-180) (AF 49(638)361) AD 251168; PB 154731 Unclassified

Also published in Technometrics, v. 3: 543-550, Nov. 1961.

The folded normal probability density function is considered, as it relates to the original normal population from which it came. Some maximum likelihood estimates are presented, followed by other estimating procedures which are simpler to handle. A table is given for the estimation of μ and σ (the mean and standard deviation of the original normal) given an estimate of the ratio of μ_f and σ_f (of the folded normal). A second table gives the areas of the folded normal for the values of T_f from 0.0 to 7.0 for 18 different ratios of μ_f to σ_f. An example of real camber data is presented with the appropriate estimation of the theoretical distributions. (Contractor's abstract)

426

Case Inst. of Tech. Statistical Lab., Cleveland, Ohio.

FOLDED NORMAL II: COMPARISON OF TWO METHODS OF ESTIMATING PARAMETERS FROM MOMENTS, by R. C. Elandt. Feb. 1961, 20p. incl. diagrs. tables. (Case Statistical Lab. publ. no. 1042) (AFOSR-393) (AF 49(638)361) AD 253245 Unclassified

Also published in Technometrics, v. 3: 551-562, Nov. 1961. (Title varies)

The general formula for the r^{th} to the n^{th} power moment of the folded normal distribution is obtained, and formulae for the first four non-central and central moments are calculated explicitly. To illustrate the mode of convergence of the folded normal to the normal distribution, as $\mu/\sigma = \theta$ increases, the shape factors β_{11} and β_{12} were calculated and the relationship between them represented graphically. Two methods, one using first and second moments and the other using second and fourth moments of estimating the parameters μ and σ of the parent normal distribution are presented and their standard errors calculated. The accuracy of both methods, for various methods of θ are discussed. (Contractor's abstract)

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Case Inst. of Tech. Statistical Lab., Cleveland, Ohio.

ASYMPTOTIC RELATIVE EFFICIENCY OF MOOD'S AND MASSEY'S TWO SAMPLE TESTS AGAINST SOME PARAMETRIC ALTERNATIVES, by I. M. Chakravarti, F. C. Leone, and J. D. Alanen. May 1961, 19p. incl. table. (Case Statistical Lab. publ. no. 1046) (AFOSR-846) (AF 49(638)361) AD 259004 Unclassified

Presented at Eastern Regional meeting of the Inst. Math. Stat., Ithaca, N. Y., Apr. 20-22, 1961.

Abstract published in Ann. Math. Stat., v. 32: 623, June 1961.

Also published in Ann. Math. Stat., v. 33: 1375-1383, Dec. 1962.

The asymptotic relative efficiency of Mood's test against the likelihood ratio test for the change in location of exponential distribution, is derived. Further, this is carried out for all 3 alternatives for Massey's test. The asymptotic powers are compared with the exact powers to find out how large a sample size is needed before one could use the expressions for the asymptot'c power. (Contractor's abstract)

428

Case Inst. of Tech. Statistical Lab., Cleveland, Ohio.

THE FOLDED NORMAL DISTRIBUTION, III: ACCURACY OF ESTIMATION BY MAXIMUM LIKELIHOOD, by N. L. Johnson. Apr. 1961, 14p. incl. diagr. tables. (Case Statistical Lab. publ. no. 1044) (AFOSR-849) (AF 49(638)361) AD 259005 Unclassified

Also published in Technometrics, v. 4: 249-256, May 1961.

Formulae for the asymptotic variances and covariance of the maximum likelihood estimators of the parameters of the folded normal distribution are obtained. Numerical comparisons with the asymptotic variances of moments estimators are made. (Contractor's abstract)

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Case Inst. of Tech. Statistical Lab., Cleveland, Ohio.

EXACT POWER OF SOME TESTS BASED ON MOOD'S AND MASSEY'S STATISTICS, by I. M. Chakravarti, F. C. Leone, and J. D. Alanen. Apr. 1961, 59p. incl. tables. (AFOSR-1049) (AF 49(638)361) AD 260730 Unclassified

Presented at Eastern Regional meeting of the Inst. Math. Stat., Ithaca, N. Y., Apr. 20-22, 1961.

Abstract published in Ann. Math. Stat., v. 32: 629, June 1961.

When sample observations are originally recorded in order of their magnitude, Mood's test, based on the median of the combined samples, and Massey's extension of Mood's test based on fractiles, have much to commend themselves as quick tests. In Mood's test one need record observations only up to the median of the combined samples, and in Massey's test, up to the highest fractile included in the test. It is known (Mood, (1954) and Andrews, (1954)) that the asymptotic relative efficiency of Mood's test against normal and rectangular alternatives is low. However, it was felt that there was enough gain in Massey's extension to justify this investigation. The objects of the present investigation are: (1) to derive the exact power functions of Mood's and Massey's tests for two samples against parametric alternatives of exponential and rectangular populations; (2) to tabulate them for comparable sample sizes in order to get an idea about their respective performances and also to evaluate if there is any resultant gain in the use of Massey's test (which uses more than one fractile and hence is more elaborate) over Mood's tests.

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Case Inst. of Tech. [Statistical Lab.] Cleveland, Ohio.

EXACT POWER OF SOME QUICK TESTS BASED ON MOOD'S AND MASSEY'S STATISTICS, by F. C. Leone, I. M. Chakravarti, and J. D. Alanen. [1961] [11]p. incl. tables. (AFOSR-65-2602) (AF 49(638)-361) Unclassified

Also published in Bull. Inst. Internat'l. Stat. (Paris), [v. 38: 1-11, 1961].

The objects of the present investigation were (1) to derive the exact power functions of Mood's and Massey's tests for 2 samples against parametric alternatives of exponential and rectangular populations, and (2) to tabulate them for comparable sample sizes in order to get an idea about their respective performances as well as to evaluate the possibility of any resultant gain in the use of Massey's test (which uses more than 1 fractile and hence is more elaborate) over Mood's test. It was found that Massey's test for comparable size does not show sufficient gain over Mood's test when the selected value a is small. But as a increases, the power function of Massey's test increases at a much faster rate than Mood's test.

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Case Inst. of Tech. [Statistical Lab.] Cleveland, Ohio.

TABLES OF MINIMUM FUNCTIONS FOR GENERATING GALOIS FIELDS GF (p^n) (Abstract), by J. D. Alanen. [1961] [1]p. [AF 49(638)361]
Unclassified

Presented at Eastern Regional meeting of the Inst. Math. Stat., Ithaca, N. Y., Apr. 20-22, 1961.

Published in Ann. Math. Stat., v. 32: 621, June 1961.

A polynomial f(x) of degree n irreducible in the field GF(p) where p is a prime number, is called a minimum function, if a root ω of the equation f(x) = 0, serves as a primitive element of GF (p^n), that is, $\omega^0 = 1$, ω, ω^2, ···, ω^{p^n-2} are the p^n - 1 non-zero elements of GF(p^n). It is known that for the GF(p^n), there are $\varphi(p^n - 1/n$ minimum functions, where φ is the Euler function, p a prime, and n an integer. Minimum functions were very successfully used in the past in constructing sets of mutually orthogonal Latin squares, balanced incomplete block designs, confounded and fractorial designs. Recently these have found a new application in the construction of error-correcting codes. While searching for a minimum function of GF (13^3), a lack of comprehensive tables of minimum functions in the published literature was noticed. A program has been written and all minimum functions generated for a fairly comprehensive set of values of p and n.

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Catholic U. of America [Dept. of Chemistry] Washington, D. C.

EXCITED ELECTRONIC STATES OF LINEAR SYMMETRIC H_3 (Abstract), by H. L. Morrison and V. Griffing. [1960] [1]p. [AF 18(600)1537]
Unclassified

Presented at meeting of the Amer. Phys. Soc., Montreal (Canada), June 15-17, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 339, June 15, 1960.

The Roothaan self-consistent field procedure has been applied to the problem of calculating the excited states of H_3 in the linear symmetric configuration. The excited states considered have an electron pair in a nodeless molecular orbital that consists of a linear combination of 1s wave functions from the respective centers. The first excited wave function—containing 1 electron and having 1 central node-is constructed from 2s atomic functions; a second excited orbital contains 2p functions instead. A third molecular orbital is a linear combination of all three 2s functions. The molecular orbitals of the singly occupied states are orthogonal to the doubly occupied state by virtue of symmetry. One then obtains separate Hartree-Fock equations for the open and closed shell orbitals. This type of calculation was performed for the ungerade orbitals of the 2s and 2p functions at seven values of the internuclear distance ranging from 1.4 a.u. to 2.6 a.u. Curves for both state functions exhibit minima at 1.8 a.u., when one plots total energy versus internuclear distance. The third excited state was calculated only approximately.

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Catholic U. of America [Dept. of Chemistry] Washington, D. C.

INTERACTION OF TWO Be ATOMS (Abstract), by R. Hampson and J. S. Dooling. [1960] [1]p. [AF 18(600)-1537]
Unclassified

Presented at meeting of the Amer. Phys. Soc., Montreal (Canada), June 15-17, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 339, June 15, 1960.

Calculations of the interaction of 2 Be atoms have been carried out using the LCAO MO SCF approximation for 6 distances ranging from 3.58A to infinity. Two ground-state calculations were performed: one using as the basis set 1s, and 2s Slater orbitals for each atom; the other using 1s, 2s, and 2pσ orbitals. A single determinant SCF calculation for the excited state, $(\sigma_g 1s)^2(\sigma_u 1s)^2(\sigma_g 2s)^2\, X(\sigma_g 2p\sigma)^2$, approx, also was made. Curves for these states, and one including configuration interaction are presented. An excited state, $^3\Sigma_u$, represented by $(\sigma_g 1s)^2\, X(\sigma_u 1s)^2 (\sigma_g 2s)^2 (\sigma_u 2s\alpha) (\sigma_g 2p\sigma\alpha)$ has been calculated and is is discussed.

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Catholic U. of America. [Dept. of Chemistry] Washington, D. C.

INTERACTION OF TWO HELIUM ATOMS (Abstract), by J. S. Dooling and P. Piper. [1960] [1]p. [AF 18-(600)1537]
Unclassified

Presented at meeting of the Amer. Phys. Soc., Montreal (Canada), June 15-17, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 339, June 15, 1960.

Calculations using the LCAO MO SCF approximation were carried out for the ground state of 2 He atoms for distances ranging from 2.51 to 3.76A. The atomic functions used as the basis set were Slater orbitals with ζ = 1.6875 on all atomic orbitals. In the first calculation the MO's were constructed from 1s and 2pσ on each atom; the second calculation used as the basis set, 1s, 2s, and 2pσ atomic orbitals. Curves for the interaction potential for each of these calculations show a minimum in the van der Waal's region. The inclusion of the 2s atomic functions in the basis set lowers the minimum and shifts it

toward smaller internuclear distances. The degree to which the wave functions lead to the fulfillment of the virial theorem was tested, and the results are shown.

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Catholic U. of America. [Dept. of Chemistry] Washington, D. C.

[STRUCTURE, SPECTRA AND KINETICS OF MOLECULES], by V. Griffing. Interim final rept. [1961] 8p. incl. tables. (AFOSR-1113) (AF 18(600)1537) Unclassified

This research has been concerned with determining methods of calculating the energy and configuration of molecules and molecular systems. Potential energy curves have been calculated for (1) H_3, symmetric and asymmetric; (2) H_4, symmetric and a few asymmetric; (3) C_2; (4) Be_2; and NO. Results of the calculations for H_3 and H_4 are tabulated. It is expected that the results of this research will enable prediction of unobserved spectra and the identification of unknown but observed spectra.

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Catholic U. of America [Dept. of Mathematics] Washington, D. C.

ON TUBE STATISTICS AND CHARACTERIZATION PROBLEMS, by E. Lukacs. [1961] [10]p. (AFOSR-4389) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-32 and National Science Foundation under G-9968) Unclassified

Also published in Zeitschr. Wahrscheinlichkeitstheorie und Verwandte Gebiete, v. 1: 116-125, 1962.

Let $X_1, X_2, \ldots, X_n$ be a sample from a population with distribution function $F(x)$. A single-valued and measurable function $S = S(X_1, X_2 \ldots, X_n)$ of the observations is usually called a statistic. It is customary to represent the observations $(X_1, X_2, \ldots, X_n)$ as a point in an n-dimensional Euclidean space E_n, the sample space. The equation $S(X_1, X_2, \ldots, X_n) = c$ (c a real parameter) determines then a family of hypersurfaces in E_n which partitions the sample space. A statistic S can therefore also be defined as a family of hypersurfaces (or as a partition) in the sample space. In this paper these surfaces are referred to as the level surfaces of the statistic. In section 2 certain notations are introduced and tube statistics, defined. In section 3 it is assumed that a tube statistic is independent of the sample mean. Section 4 discusses characterizations of the normal and of the gamma distribution.

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Catholic U. of America. Dept. of Physics, Washington, D. C.

COMPLEX CLUSTER INTEGRALS FOR AN AUGMENTED GAUSSIAN GAS, by T. Tanaka, P. H. E. Meijer, and J. N. Fox. [1961] [6]p. incl. diagrs. table, refs. (AFOSR-2636) [AF 49(638)452] AD 612338 Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 245, Apr. 24, 1961.

Also published in Jour. Chem. Phys., v. 36: 731-736, Feb. 1, 1962.

It has been shown by Montroll, Berlin, and Hart that complex cluster integrals can be evaluated very easily if the actual Ursell-Mayer f function is replaced by a Gaussian. The possibility of using a more realistic function was suggested by the same authors. We have carried out the actual calculation of the cluster integrals for 4 particles and determined the dependence of the parameters on the temperature. It is shown that the integration problem is reduced to the evaluation of higher derivatives of the so called graph determinant. The method can also be used to calculate the effective interaction between 2 articulation points of a complicated cluster. The importance of the nonring diagrams is stressed by some numerical estimates of discrepancy between actual condensation and the divergence of the ring series.

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Catholic U. of America. Dept. of Physics, Washington, D. C.

RELAXATION PHENOMENA IN AN ISING SPIN SYSTEM, by T. Tanaka and P. H. E. Meijer. [1961] [3]p. (AFOSR-J91) (Sponsored jointly by Air Force [Office of Scientific Research under AF 49(638)452] and Office of Naval Research) AD 400133 Unclassified

Presented at Internat'l. Conf. on Magnetism and Crystallography, Kyoto (Japan), Sept. 25-30, 1961.

Also published in Jour. Phys. Soc. Japan, v. 17: Suppl. B-I: 78-80, Mar. 1962.

The kinetics of an Ising model is formulated by the method of thermodynamics of irreversible processes. From the expression for the entropy production, generalized forces and fluxes are determined. By introducing kinetic coefficients which satisfy the Onsager relation, the kinetic equations are obtained. By solving these equations a set of relaxation times is obtained. In terms of these relaxation times 2 initial value problems are solved. A set of N identical Ising spins of magnitude 1/2 is considered. In thermodynamic equilibrium these spins behave similarly, and one can dismiss the long range or the short range

order. In a time dependent phenomenon, this is not the case and all spins behave differently at a given instant of time. There is a certain phase relation between motions of neighboring spins. The following form is assumed for the total distribution function: $f_N = \prod f_n(\sigma_n)$, $\sigma_n = \pm 1$, and $\sum_{\sigma_n} f_n(\sigma_n) = 1$. The fluctuations in the neighborhood of the equilibrium conditions are discussed.

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Catholic U. of America. Dept. of Physics, Washington, D. C.

DYNAMIC BEHAVIOR OF A SET OF WEAKLY COUPLED ISING SPINS, by P. H. E. Meijer, T. Tanaka, and J. Barry. [1961] [5]p. (AFOSR-J92) [AF 49(638)452] AD 400099 Unclassified

Also published in Jour. Math. Phys., v. 3: 793-797, July-Aug. 1962.

The master equation of a set of independent spins contains only 1 undetermined constant, the rate constant. If one assumes the local field to be altered by the field produced by the 2 neighboring spins, one can formulate a set of equations for the average of 1, 2, 3, etc., spins. On assuming an Ising interaction between the spins, weak compared to the coupling with the heat bath, we can terminate the hierarchy and solve the problem of a linear chain with periodic boundary conditions by Fourier-transformation. The resulting secular equation determines 2 sets of relaxation times and 2 sets of eigensolutions. An explicit solution for the spin averages is given for the initial condition describing a localized excitation. Similarities with, and differences between, this and the random walk problem is pointed out. (Contractor's abstract)

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Catholic U. of America. [Dept. of Physics] Washington, D. C.

THEORY OF RELAXATION PHENOMENA NEAR THE SECOND-ORDER PHASE-TRANSITION POINT, by T. Tanaka, P. H. E. Meijer, and J. G. Barry. [1961] [6]p. (AFOSR-J93) (AF 49(638)452) AD 400097 Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 55, Feb. 1, 1961.

Also published in Jour. Chem. Phys., v. 37: 1397-1402, Oct. 1962.

It is expected that the observables connected with nonequilibrium processes will show abrupt changes if a substance undergoes a second-order phase-transition, since the equilibrium thermodynamic quantities appear to do so. In order to study these phenomena in a connected way the assumption is made that the long-range order parameter and the short-range order parameter can be treated as fluxes and forces in the sense of Onsager's theory of irreversible thermodynamics. Actual calculations are performed for two cases: an order-disorder system with short- and long-range and a system with 2 modes of long-range order (antiferromagnet). The absorption of sound is calculated and its behavior near the critical temperature is analyzed. The function is continuous with a discontinuity in the slope provided the phenomenological constants are smooth functions of the temperature. (Contractor's abstract)

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Catholic U. of America. [Dept. of Physics] Washington, D. C.

MASTER EQUATION OF A SET OF WEAKLY COUPLED ISING SPINS (Abstract), by P. H. E. Meijer, T. Tanaka, and J. H. Barry. [1961] [1]p. [AF 49-(638)452] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 55, Feb. 1, 1961.

The master equation of a set of independent equivalent Ising spins contains only 1 undetermined constant, the rate constant. Assuming the local field to be altered by the field produced by the 2 neighboring spins, one can formulate a hierarchy of equations for the time dependence of the average spin $\langle \sigma_k \rangle$, the average of 2 neighboring spins $\langle \sigma_k \sigma_{k\pm1} \rangle$, the average of 3 neighboring spins, etc. This set of simultaneous linear first-order differential equations can be solved if 1 makes a cutoff by assuming that the local field is smaller than the external field. The 2 sets of equations are solved by a Fourier transform. The resulting secular equation determined 2 sets of relaxation times. The initial conditions are taken in the form of a delta function in order to obtain the Green's function of the problem. The initial conditions have to be replaced by 2 proper linear combinations of initial conditions in order to determine the time-dependent solution. The solution has the general characteristic of a Gaussian with a variance that increases in time, but the area under the curve diminishes approximately exponentially.

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Catholic U. of America. Dept. of Physics, Washington, D. C.

QUANTUM MECHANICAL STUDY OF THE HYDROGEN BIMOLECULAR EXCHANGE REACTION, by A. R. Ruffa and V. Griffing. [1961] [6]p. incl. diagrs. tables, refs. (AFOSR-4227) [AF 49(638)906] Unclassified

Also published in Jour. Chem. Phys., v. 36: 1389-1394, Mar. 1, 1962.

A theoretical calculation of the potential-energy curves of several linear 4-atom hydrogen complexes has been made in order to study the interaction governing the kinetics of the bimolecular exchange reaction. In particular, an attempt was made to determine for what distance of approach the 2 diatomic molecules make a transition into the 4-atom complex. Hence, the linear H_4 complex H—r—H—R—H—r—H was chosen for study as function of r and R. The partial potential energy surface constructed in this manner indicates that 2 hydrogen molecules approaching on a line experience an increase in interatomic separation with the inner 2 atoms forming a hydrogen molecule at small separations while the outer 2 atoms are repelled outward from the center of the system. The minimum occurs for r = R = 1.8 and gives an activation energy of 65 kcal for the bimolecular exchange reaction, if one assumes a linear transition state. An additional calculation was performed on a linear chain of 6 hydrogen atoms with interatomic separation of 2 atomic units in order to get additional information regarding the relative stability of the linear hydrogen chain in comparison with other possible configurations. Computation of the total energies in the LCAO MO SCF approximation with 1s functions indicates that the energies of the chains of 4 or 6 hydrogen atoms generally lie between the energies of the separated hydrogen molecules and the separated hydrogen atoms. (Contractor's abstract)

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Catholic U. of Chile. [Lab. of Physiology] Santiago.

[THE EFFECTS OF ANGIOTENSIN II ON WATER, SODIUM AND POTASSIUM EXCRETION IN RATS] Effectos de la Angiotensina II, sobre la excrecion de agua sodio y potasio en ratas, by L. Barnafi, S. Vial and others. [1961] [4]p. incl. diagrs. table, refs. (AFOSR-842) (AF 49(638)584) Unclassified

Also published in Rev. Med. y Alimentacion, v. 10: 23-26, 1962.

The effect of Val5-Angiotensin II on sodium, potassium and water excretion of overloaded rats was studied. Irregular effects were observed with 0.01-10 mcg Angiotensin (per 100 g body weight). Natriuresis, with slight changes in potassium and water excretion followed 20 and 50 mcg injections. The possible role of Angiotensin II in renin-induced natriuresis and diuresis is discussed. The present results do not support the hypothesis that Angiotensin II is responsible for the augmented sodium and water excretion obtained with renin. (Contractor's abstract)

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Catholic U. of Chile. [Lab. of Physiology] Santiago.

EFFECT OF OXYTOCIN STRUCTURAL CHANGES ON RAT RENAL EXCRETION OF Na, K, AND WATER, by R. Rosas, L. Barnafi, and others. [1961] [4]p. incl. diagrs. refs. (AFOSR-843) (AF 49-(638)584) Unclassified

Also published in Amer. Jour. Physiol., v. 202: 901-904, May 1962.

The common action of oxytocin on the smooth musculature of the uterus and on the renal excretion of sodium, potassium, and water suggests a relationship between the 2 effects. In order to investigate this possibility, the action of oxytocin treated with chymotrypsin and with sodium thioglycollate on sodium, potassium, and water excretion was studied. These agents greatly reduce the uterotonic activity of the hormone as well as its effect on electrolyte and water excretion in rats. Equivalent uterotonic doses of oxytocin, Val_3-oxytocin, and Phe2-Tyr_3-oxytocin were assayed on the excretion of electrolytes and water. Excretion of sodium and potassium produced by Val_3-oxytocin was less than that produced by oxytocin. Phe2-Tyr_3-oxytocin was approximately one-ninth as active as oxytocin in this respect. In studies with low doses of oxytocin it was established that 0.25 mu (0.005 μg) was necessary to increase sodium excretion while 0.5 mu had to be administered in order to increase potassium as well.

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Catholic U. of Chile. Lab. of Physiology, Santiago.

EFFECT OF VASOPRESSIN STRUCTURAL MODIFICATIONS ON RAT RENAL EXCRETION OF Na, K, AND WATER, by L. Barnafi, R. Rosas and others. [1961] [4]p. incl. diagr. table, refs. (AFOSR-3183) (AF 49(638)584) AD 612339 Unclassified

Also published in Amer. Jour. Physiol., v. 202: 593-596, Mar. 1962.

Lys8-vasopressin was incubated with trypsin, chymotrypsin, and sodium thioglycollate, and the resultant modification of the effect of the hormone on sodium, potassium, and water excretion was studied. These agents, which destroy the antidiuretic-pressor activity of the hormone, also bring about a loss of its natriuretic and kaliuretic effects. The action of Arg8-vasopressin, Phe2-Lys8-vasopressin, and His2-Lys8-vasopressin on sodium, potassium, and water excretion was studied; comparisons were made with the effects of equivalent pressor doses of Lys8-vasopressin. No significant differences between Arg8- and Lys8-vasopressin were obtained. Phe2-Lys8-vasopressin had nearly 10 times the antidiuretic effect and 4 times the natriuretic and kaliuretic effect. Even though His2-Lys8-vasopressin has an antidiuretic effect, it lacks activity with regard to blood pressure or electrolyte excretion. (Contractor's abstract)

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[Centre National de la Recherche Scientifique, Paris (France)]

SLOW WAVES AND ASSOCIATED SPIKING IN NERVE CELLS OF APLYSIA, by A. Arvanitaki and N. Chalazonitis. [1961] 15p. incl. illus. refs. (AFOSR-3415) (AF EOAR-61-30) Unclassified

Also published in Bull. Inst. Oceanog. (Monaco), No. 1224: 1-15, Dec. 14, 1961.

The purpose of this work was to investigate patterns of activity of the giant nerve cells of the isolated Aplysia's visceral ganglia (especially Br-type nerve cells). The spontaneous activity of the giant A cell (on the surface of the parieto-branchial ganglion near the origin of the pleuro-branchial connective was characterized by constant low frequency of the order of 1/sec, rapid (8-10 msec duration), full-sized spikes (~ 90 mv) preceded by a prepotential and followed by a hyperpolarizing afterpotential. In contrast the giant ganglion cells visible on the parieto-visceral ganglion at the origin of the genital and the anal nerves were characterized by an arrhythmic type of spontaneous activity. The Br soma repeated spontaneously, at regular intervals, a slow signoidal wave of depolarization. If the maximum rate of rise did not exceed 20 mv/sec and the maximum amplitude remained below 20 mv, no firing of spikes was observed. The slow depolarizing wave was then subliminal. If the depolarization developed with a threshold rate, a train of spikes was elicited and reached a maximum frequency of 3/sec to 20/sec according to the preparation. Any increase in the membrane potential reduced the rate of the depolarizing slow wave, decreased the frequency of the patterns, and later on, the spontaneous activity ceased. Any decrease in the membrane potential increased the frequency patterns by inhibiting the repolarizing wave to the point that emission of spikes became continuous.

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Centre National de la Recherche Scientifique, Paris (France).

SLOW CHANGES DURING AND FOLLOWING REPETITIVE SYNAPTIC ACTIVATION IN GANGLION NERVE CELLS, by N. Chalazonitis and A. Arvanitaki. [1961] 23p. incl. illus. refs. (AF EOAR-61-30) Unclassified

Published in Bull. Inst. Oceanog. (Monaco), No. 1225: 1-23, Dec. 27, 1961.

The visceral branchio-genital ganglion of Aplysia fasciata, depilans, or californica were submitted to excitatory or inhibitory synaptic actions at various frequencies. In certain cells, by repetitive activation at low frequencies it was possible to record the development of the excitatory postsynaptic potential (EPSP) from its classical transient "cuneiform" shape to a "rectangular" shape whose plateau was ~ 15mv amplitude. It was found that the responsiveness (or excitability) of the cells increases to a maximum during the initial of the plateau and declines as the latter subsides. When the level of the subsiding plateau attains a threshold value, a rapid repolarization is initiated. When the nerve cell was subjected to a series of afferent volleys of subliminal synaptic efficiency at frequencies of 10/sec to 20/sec, a cumulative membrane depolarization was built up, soon reaching the threshold membrane potential for spike discharge. Following cessation of the EPSP bombardment 2 main modalities were observed: (1) the membrane remained for many seconds at a depolarized level, to the extent that the cell continued to fire at a high frequency, and (2) a rapid repolarization and a transient rebound, hyperpolarizing the membrane to a level 5 to 10 mv more positive than the peak of the spike positive afterpotential, developed. Successive inhibitory postsynaptic potentials (IPSP's) at high frequency resulted in a cumulative hyperpolarization which increased as a function of the frequency of the IPSP's. After cessation of the IPSP bombardment the membrane was observed to undergo (1) post-inhibitory long-lasting hyperpolarization and inhibition, and (2) post-inhibitory depolarizing rebound and spiking.

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Century Geophysical Corp., Tulsa, Okla.

STUDY OF A THREE-DIMENSIONAL SEISMIC DETECTION SYSTEM, by J. E. Woodburn. Dec. 20, 1961, 15p. incl. diagrs. (Rept. no. P-5-61-4) (AF 49(638)-1084) AD 290385 Unclassified

A study of a 3-dimensional seismic detection system is described. The study had the following objectives: (1) the acquisition of 5 suitably spaced, deep (3900 ft or more) bore holes to be used in the construction of a 5-spot, 3-level, 3-dimensional seismic array; and (2) by means of quarry blasts or other types of chemical explosions, evaluate the following: (a) the ratio of background noise with depth; (b) signal-to-noise improvement in vertical arrays and the effect of compositing vertical or horizontal arrays as a means of increasing the signal-to-noise ratio; and (c) suitability of 3-dimensional arrays in determining direction and velocity of recorded pulses. (Contractor's abstract)

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Chicago U. Committee on Mathematical Biology, Ill.

A MODEL FOR CONDITIONING AND THE EFFECT OF SPACED TRIALS IN LEARNING, by H. D. Landahl. [1961] [5]p. (AFOSR-154) (AF 49(638)414) AD 260512 Unclassified

Also published in Bull. Math. Biophys., v. 23: 159-163, June 1961.

A mechanism is suggested in which a postulated substance can enter a synaptic region only during the simultaneous action of a conditioned and an unconditioned stimulus. If this substance remains and produces a physico-chemical change, then a consequence is that the degree of learning will depend on the spacing of conditioning trials and the time constant of the process will be related to the rate of diffusion or transport of the substance along the axon. (Contractor's abstract)

450

Chicago U. [Committee on Mathematical Biology] Ill.

MATHEMATICAL MODELS OF NEURONE INTERACTION, by H. D. Landahl. [1961] [7]p. (AFOSR-1131) (AF 49(638)414) Unclassified

Also published in Proc. Symposium on Switching Circuit Theory and Logical Design, Detroit, Mich., Oct. 17-20, 1961, p. 70-76.

With other than weak conditions of the parameters a neural element may have a behavior very different from its behavior as a logical element when the stimuli are weak. When the stimuli are strong its behavior can be approximated by a continuous model taking into account the average output rate and the author devises a mathematical expression for the average output frequency under such conditions. He then applies his model to a number of psychological properties such as the mechanism in response to curvature in movement, enhancement effects, flicker phenomena, discrimination and detection or real and apparent movement. Insight into certain types of psychological phenomena can be obtained by the study of neural nets made up of both logical and continuous elements.

451

Chicago U. Committee on Mathematical Biology, Ill.

A CANONICAL FORM FOR NERVE NETS WITHOUT CIRCLES, by J. Towber. [1961] [9]p. (AFOSR-1390) (AF 49(638)414) Unclassified

Also published in Bull. Math. Biophys., v. 24: 335-353, Sept. 1962.

By "neural net" will be meant "neural net without circles." Every neural net effects a transformation from inputs (i.e., firing patterns of the input neurons) to outputs (firing patterns of the output neurons). Two neural nets will be called equivalent if they effect the same transformation from inputs to outputs. A canonical form is found for neural nets with respect to equivalence, i.e., a class of neural nets is defined, no 2 of which are equivalent and which contains a neural net equivalent to any given neural net. (Contractor's abstract)

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Chicago U. Committe ... Mathematical Biology, Ill.

A RELATIONAL THEORY OF THE STRUCTURAL CHANGES INDUCED IN BIOLOGICAL SYSTEMS BY ALTERATIONS IN ENVIRONMENT, by R. Rosen. [1961] [7]p. (AFOSR-381) (AF 49(638)917) AD 260094 Unclassified

Also published in Bull. Math. Biophys., v. 23: 165-171, June 1961.

It is shown that a wide variety of structural alterations in both the metabolic and genetic apparatus of (M,R)-systems can result from specific changes in the environment of such systems. A number of specific examples are investigated in order to demonstrate the scope of these alterations. Certain biological applications of this discussion are suggested, including a suggestion for a possible interpretation of the mitotic cycle.

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Chicago U. Committee on Mathematical Biology, Ill.

AN HYPOTHESIS OF FREESE AND THE DNA-PROTEIN CODING PROBLEM, by R. Rosen. May 15, 1961, 14p. incl. refs. (AFOSR-976) (AF 49(638)917) AD 264447 Unclassified

Also published in Bull. Math. Biophys., v. 23: 305-318, Sept. 1961.

Freese's Hypothesis states that a single specific alteration in the sequence of nucleotides of an information-bearing DNA molecule results in a specific mutational effect. Within the framework of the DNA-protein coding problem developed elsewhere, and assuming the quasi-ergodicity of the general coding process, it is shown that Freese's Hypothesis allows us to derive expressions for the length of the smallest mutable DNA molecule and to obtain a bound for the maximal number of allelic molecules of fixed length. To illustrate these ideas, calculations are carried out on appropriate data from bacteriophage and man, and the results are shown to differ by a factor of 10 (modulo the rather crude approximations used). The implications of this result for the spontaneous aggregation of a sufficient number of information-bearing words to characterize an organism are discussed. (Contractor's abstract)

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Chicago U. Committee on Mathematical Biology, Ill.

ON THE ROLE OF CHEMICAL SYSTEMS IN THE MICROPHYSICAL ASPECTS OF PRIMARY GENETIC MECHANISMS, by R. Rosen. [1961] [11]p. (AFOSR-977) (AF 49(638)917) Unclassified

Also published in Bull. Math. Biophys., v. 23: 393-403, Dec. 1961.

It is pointed out that 2 fundamentally different views of primary genetic processes occur in the literature which are frequently confused. The first is a true communication-theoretic view, which regards the genetic apparatus as containing a real information-source and a transducer which converts that information to useful form. The second view is generally expressed as a template scheme based on the Watson-Crick model; it is shown that in this model there is actually no such thing as genetic information in a communication-theoretic sense. Both views are then discussed on the basis of microphysical principles developed in previous work (Bull. Math. Biophys.,

v. 22: 227-255, 1960) in an attempt to find which approach is in closer accord with the biological facts. It is shown that, if the communication-theoretic view is correct, then the information-bearing object must act as a "catalyst," but it is pointed out that the type of catalysis involved must be of a fundamentally different nature than that occurring in familiar enzyme-catalyzed reactions. On the basis of general considerations of irreversible changes in microphysical measuring systems, it is shown that any type of template must suffer a gradual and irreversible denaturation, which seems to make it unlikely that a template could play a primary role in fundamental genetic processes. (Contractor's abstract)

455

Chicago U. Committee on Mathematical Biology, Ill.

A NOTE ON ABSTRACT RELATIONAL BIOLOGIES, by R. Rosen. [1961] [8]p. (AFOSR-1943) (AF 49-(638)917) Unclassified

Also published in Bull. Math. Biophys., v. 24: 31-38, Mar. 1962.

It is shown that the class of abstract block diagrams of $(\mathfrak{M},\mathfrak{R})$-systems which can be constructed out of the objects and mappings of a particular subcategory $\mathcal{S}_0$ of the category $\mathcal{S}$ of all sets depends heavily on the structure of $\mathcal{S}_0$, and in particular on the number of sets of mappings H(A, B) which are empty in $\mathcal{S}_0$. In the context of $(\mathfrak{M},\mathfrak{R})$-systems, therefore, each particular category $\mathcal{S}_0$ gives rise to a different "abstract biology" in the sense of Rashevsky. A number of theorems illustrating the relation between the structure of a categroy $\mathcal{S}_0$ and the embeddability of an arbitrary mapping $\alpha \in \mathcal{S}_0$ into an $(\mathfrak{M},\mathfrak{R})$-system are proved, and their biological implication is discussed. (Contractor's abstract)

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Chicago U. Dept. of Mathematics, Ill.

NORMAL p-COMPLEMENTS FOR FINITE GROUPS, by J. G. Thompson. [1959] [23]p. incl. diagrs. [AF 18(600)1383] Unclassified

Published in Math. Zeitschr., v. 72: 332-354, 1960.

Proof is offered of the following theorem: Let G be a finite group with a p-Sylow subgroup P, p an odd prime, and let $\mathfrak{A}$ be a group of automorphisms of G which leaves P invariant. Suppose for every $\mathfrak{A}$-invariant normal subgroup Q of P, elements of order prime to p which normalize Q also centralize Q. Then G possesses a normal p-complement.

457

Chicago U. Dept. of Mathematics, Ill.

INTRODUCTION TO TOPOLOGY OF FUNCTIONAL SPACES, by A. Granas. May 1961 [94]p. (AFOSR-680) (AF 18(600)1383) AD 257981 Unclassified

A series of lectures are presented which constitute a concise introduction to the study of topological phenomena in functional spaces. The following topics are discussed: compact and finite dimensional mappings, compact vector fields and the homotopy extension theorem, Borsuk's antipodensatz, essential and inessential compact fields, theorem on antipodes, continuous continuation method and fixed-point theorem, Birkhoff-Kellogg theorem, theorems on epsilon domains, invariance of domain, transformations of Banach space onto itself, intersection theorem for Banach spaces, and theorem on disconnection of Banach spaces.

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Chicago U. Dept. of Mathematics, Ill.

AN ALGEBRA OF ADDITIVE RELATIONS, by S. MacLane. May 1961, 15p. (AFOSR-905) (AF 18-(600)1383) AD 261076 Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 47: 1043-1051, July 1961.

Additive relations are regarded as being basic, and suitable formal axioms valid in the category of all additive relations are set up. The construction of submodules in an abelian category is quite indirect, in that the submodules must be described as equivalence classes of monomorphisms. In the category of additive relations the lattice order properties are present from the start, along with the composition properties. (Contractor's abstract)

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Chicago U. Dept. of Mathematics, Ill.

THE ALGEBRAIC MECHANISM OF FIBER SPACES, by S. MacLane. Final rept. Oct. 1, 1955-May 31, 1961. June 1961, 12p. (AFOSR-1005) (AF 18(600)-1383) AD 261852 Unclassified

This research has been concerned with a variety of topics in algebra and in topology related to its main objectives. The present summary of the various investigations is classified by subject matter. The achievements of the project have included publications in group theory, algebraic topology, twisted simplicial products, topology, homological algebra, lie groups, categorical theory of algebras, and cohomotopy multiplication in functional spaces. Two outstanding achievements which have had a major influence on the course of mathematical research are J. F. Adams on Hopf Invariant one and John Thompson on the Frobenius problem.

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Chicago U. Dept. of Mathematics, Ill.

THE HOMOLOGY OF TWISTED CARTESIAN PRODUCTS, by R. H. Szczarba. [1961] [20]p. incl. refs. [AF 18(600)1383] Unclassified

Published in Trans. Amer. Math. Soc., v. 100: 197-216, Aug. 1961.

Let X and F be simplicial sets and let $X \times_\tau F$ be their twisted cartesian product with respect to a simplicial group G acting on F and a twisting function τ: X → G. In Guggenheim's paper (Illinois Jour. Math., v. 4: 292-311, 1960) it is shown by means of acyclic models that there is a twisting cochain φ : C(X) → C(G) (C denotes the associated chain complex) so that $C(X \times_\tau F)$ and the twisted tensor product $(C X)_\varphi \otimes C(F)$ (Ann. Math., v. 69: 223-246, 1959) are chain equivalent. In this paper an explicit construction is given by means of which φ may be obtained from τ. This construction is used to obtain some partial results concerning the ring structure of the cohomology groups of a fibre space over a sphere. (Math. Rev. abstract)

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Chicago U. [Dept. of Mathematics] Ill.

A GENERALIZATION OF A CONTINUOUS CHOICE FUNCTION THEOREM, by J. W. Jaworowski. [1961] [3]p. incl. diagr. (AFOSR-2813) [AF 49(638)568] AD 261257 Unclassified

Also published in Michigan Math. Jour., v. 9: 29-31, Feb. 1962.

Let H_m^n be the set of all m-dimensional linear subspaces of the Euclidean n-space $E^n (m < n)$. The Vietoris mapping theorem is applied for the proof of the following result. Let F be a multivalued upper semi-continuous function which assigns to each $x \in H_m^n$ an acyclic (modulo 2) set $F(x) \subset E^n$. Then there exists a subspace $x_0 \in H_m^n$ such that $F(x_0)$ intersects the orthogonal complement of x_0. (Math. Rev. abstract)

462

[Chicago U. Dept. of Mathematics, Ill.]

FOUNDATIONS OF THE THEORY OF DYNAMICAL SYSTEMS OF INFINITELY MANY DEGREES OF FREEDOM, II, by I. E. Segal. [1959] [18]p. incl. refs. (AFOSR-3668) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)666] and National Science Foundation) Unclassified

Also published in Canad. Jour. Math., v. 13: 1-18, 1961.

It is shown that a regular state of a linear field can be characterized by a functional on the corresponding classical wave functions. That is, any regular state of the quantized hermitian Klein-Gordon field satisfying the equation $\Box \varphi = m^2 \varphi$ is determined by a functional defined on the manifold of all classical real-valued normalizable solutions of this equation.

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Chicago U. Dept. of Mathematics, Ill.

ON TRANSITIVE SIMPLE GROUPS OF DEGREE 2p, IN WHICH THE NORMALIZER OF A SYLOW p-SUBGROUP HAS ORDER 2p, by N. Ito. June 1961, 21p. incl. refs. (AFOSR-911) (AF 49(638)858) AD 261075 Unclassified

Also published in Math. Zeitschr., v. 78: 453-468, Mar. 1962. (Title varies)

Two theorems are proven concerning G, a transitive permutation group, on omega, a set of symbols 1, . . . , 2p, where p is an odd prime number. In G, which is a simple group, the normalizer of a Sylow p-subgroup has order 2p. Theorem I: If G is doubly transitive on omega, then G is isomorphic to the linear fractional group LF(2, q) with q + 1 equal to 2p. Theorem II: If G is not doubly transitive on omega, then p equals 5 and G is isomorphic to the icosahedral group.

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Chicago U. [Dept. of Mathematics] Ill.

ON A CLASS OF DOUBLY TRANSITIVE PERMUTATION GROUPS, by N. Ito. [June 1961] [16]p. (AFOSR-936) [AF 49(638)858] AD 261074 Unclassified

Also published in Illinois Jour. Math., v. 6: 341-352, June 1962.

Let G be a doubly transitive permutation group on m + 1 in which no non-trivial permutation leaves three symbols fixed. Such a group is called a Zassenhaus group. It is known that $m = p^e$ for some prime p, and furthermore, if G is not isomorphic to a known group, then the Sylow p-group of G is non-abelian and satisfies certain conditions. Theorem: If G is a Zassenhaus group, and if $p \neq 2$, then the Sylow p-group of G is abelian. This theorem, together with the above mentioned result and a recent result of Suzaki yields a complete classification of Zassenhaus groups. The proof is very ingenious and uses some detailed information about the character of G. At one point it is necessary to use the fact that a p-block of defect d contains at most p^{2d-2} ordinary irreducible characters. If p^{2d-2} could be replaced by the conjectured bound p^d, then the proof of the above mentioned theorem could be considerably simplified. (Math. Rev. abstract)

465

Chicago U. Dept. of Mathematics, Ill.

ON A CLASS OF DOUBLY TRANSITIVE GROUPS, by M. Suzuki. June 1961, 53p. incl. refs. (AFOSR-1013) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)858 and National Science Foundation under G-9654) Unclassified

Also published in Ann. Math., v. 75: 105-145, Jan. 1962.

This study considers a class of doubly transitive groups satisfying the condition that the identity is the only element leaving 3 distinct letters fixed. The main object of the investigation is to classify the groups which do not contain a regular normal subgroup of order 1 + N in case N is even. (Contractor's abstract)

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[Chicago U.] Dept. of Mathematics, Ill.

ON A FINITE GROUP WITH A PARTITION, by M. Suzuki. [1961] [14]p. incl. refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)858 and National Science Foundation) Unclassified

Published in Arch. Math., v. 12: 241-254, 1961.

A non-trivial partition of a group G is a collection $\{U_i\}$ of proper subgroups U_i of G such that every element ≠ 1 in G is contained in one and only one subgroups U_i. The group U_i are called the components of the partition. A partition is normal if conjugation by any element of G permutes the components. A partition is nilpotent if every component is nilpotent. Theorem: A finite non-solvable group G has a non-trivial partition if and only if G is isomorphic to one of PGL(2, q), PSL(2, q) with q ≥ 4 or G(q). Here G(q) denotes the family of simple groups discovered by the author previously. By using a result of Kegel it is quickly shown that a finite non-solvable group G with a non-trivial partition has a normal nilpotent partition. Let G be a finite non-solvable group with a normal nilpotent partition. The case that G has odd order is eliminated by using a modification of an unpublished argument of the reviewer (W. Feit) and J. G. Thompson in conjunction with the fact that some non-identity element of G has a non-nilpotent centralizer. The case that G has even order is dealt with by appealing to several structure theorems. (Math. Rev. abstract)

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Chicago U. Dept. of Physics, Ill.

RESONANCE TRANSFER MODEL OF ELECTRON AND HOLE CONDUCTION IN ANTHRACENE, by D. [R.] Kearns. [1961] [2]p. incl. table, refs. (AFOSR-1136) [AF 49(638)923] AD 450829 Unclassified

Also published in Jour. Chem. Phys., v. 35: 2269-2270, Dec. 1961.

A resonance transfer model is applied to the experimental results of Kepler. The model predicts that both electron and hole mobilities will vary approximately inversely with temperature, in agreement with experiment. However, both electron and hole mobilities are predicted to have the same temperature dependence, and this is not observed. Anisotropy of hole mobility in the model shows good agreement with experiment but differences occur in the case of electron mobility.

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Chicago U. Dept. of Physics, Ill.

THE DETERMINATION OF THE ASSIGNMENT OF TRIPLET STATES IN CATACONDENSED AROMATIC HYDROCARBONS, by D. R. Kearns. [1961] [47]p. incl. diagrs. tables, refs. (AFOSR-1233) (AF 49-(638)923) AD 450831 Unclassified

Also published in Jour. Chem. Phys., v. 36: 1608-1621, Mar. 1962.

The assignment of the triplet states in benzene plays a central role in the determination of the assignment of triplet states of all catacondensed aromatic hydrocarbons. In this paper 2 tests of the assignment of triplet states, based on (1) the prediction of triplet state energies in catacondensed aromatic hydrocarbons calculated using a perimeter model developed by Moffitt, and (2) the prediction of the lowest singlet-triplet transitions in substituted benzenes calculated using perturbation theory, are developed and applied to existing data. The above tests are in agreement with the generally accepted assignment in which the lowest triplet state in benzene as well as the linear catacondensed aromatic hydrocarbons is assigned to ^3L_a. The first test virtually rules out all alternative assignments. The second test is consistent with the favored assignment and provides fairly strong evidence against the assignment which, on theoretical grounds, is considered the next most likely assignment (lowest triplet state in benzene assigned ^3L_b). More crucial experiments are proposed which should lead to an even more definitive selection of the correct assignment of the triplet states in the catacondensed aromated hydrocarbons. (Contractor's abstract)

469

Chicago U. Dept. of Physics, Ill.

LCAO MO THEORY OF AN ORGANIC BIRADICAL WITH A PROBABLE TRIPLET GROUND STATE, by D. [R.] Kearns and S. Ehrenson. [1961] [4]p. incl. diagrs. refs. (AFOSR-1234) (AF 49(638)923) AD 450825 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 84: 739-742, Mar. 5, 1962.

The triphenylmethyl derivative biradical recently prepared by Yang and Castro is predicted by LCAO MO calculations to have a triplet ground state. Preliminary measurements of the paramagnetic susceptibility (3.1×10^{-3} cm^3/mol) and the observation, following the theoretical prediction, of a long wave length absorption peak (beyond 1 μ) seem to support this conclusion. (Contractor's abstract)

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Chicago U. Dept. of Physics, Ill.

ELECTRONIC PROPERTIES OF ORGANIC MOLECULES, by D. R. Kearns. Final rept. Sept. 1961, 2p. (AFOSR-1475) (AF 49(638)923) AD 607744
Unclassified

The work was concerned with the application of quantum mechanics to the interpretation of certain electronic properties of aromatic organic molecules. The results of this work appear in 3 articles (item nos. 467, 468, and 469) which are briefly reviewed. (Contractor's abstract)

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Chicago U. [Dept. of Psychology] Ill.

LEARNED RESPONSES ELICITED BY ELECTRICAL STIMULATION OF AUDITORY PATHWAYS (Abstract), by W. D. Neff, P. C. Nieder, and R. E. Oesterreich. [1959] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)99] and Office of Naval Research) Unclassified

Presented at Eighty-second meeting of the Amer. Physiol. Soc., Atlantic City, N. J., Apr. 13-17, 1959.

Published in Fed. Proc., v. 18: 112, Mar. 1959.

Bipolar electrodes have been implanted at medullar, tectal, and cortical levels of the auditory pathways of the cat. In some animals conditioned avoidance responses were established to a series of clicks (100 per sec) presented over a loudspeaker. Test trials were then conducted in which auditory pathways were directly stimulated by short pulses at a similar frequency. In a number of cases the response conditioned to sound was elicited immediately by the direct stimulation of the auditory neural pathways. The converse procedure, conditioning to electrical stimulation of auditory pathways and testing for response to sound stimuli, has also produced positive results.

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Chicago U. [Dept. of Psychology] Ill.

SENSORY DISCRIMINATION, by W. D. Neff. [1960] [24]p. incl. refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)925] and Office of Naval Research) Unclassified

Published in Handbook of Physiology: Neurophysiology, Washington, D. C., Amer. Physiol. Soc. and Baltimore, Williams and Wilkins Co., v. 3(Section 1): 1447-1470, 1960.

A review is made of the available data on neurophysiological explanations of sensory discrimination (covering all of the sensory systems). The topics discussed include: a historical summary of research in this field from the beginning of scientific inquiry up to the modern period; the primary sense modalities (vision, hearing, touch, taste, and smell); discriminable dimensions of sensation including intensity discrimination, quality discrimination, space discrimination, and pattern discrimination; and the relation of the primary sensory systems to other systems.

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Chicago U. [Dept. of Psychology] Ill.

AUDITORY INFORMATION FROM SUBCORTICAL ELECTRICAL STIMULATION IN CATS, by P. C. Nieder and W. D. Neff. [1960] [2]p. (AF 49(638)925)
Unclassified

Published in Science, v. 133: 1010-1011, Mar. 31, 1961.

Animals trained to respond to sound stimuli were found to perform the learned response when they were electrically stimulated through electrodes chronically implanted in subcortical structures of the auditory pathway. Other animals trained to respond to electrical stimulation of subcortical auditory structures showed differential transfer effects depending on the positions of the stimulating electrodes. (Contractor's abstract)

474

Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

ELECTRONS IN THE PRIMARY COSMIC RADIATION, by P. Meyer and R. Vogt. [1961] [11]p. incl. diagrs. table. (Rept. no. EFINS 61-7) (AFOSR-310) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)666, National Science Foundation, and Office of Naval Research) AD 254691
Unclassified

Also published in Phys. Rev. Ltrs., v. 6: 193-196, Feb. 15, 1961.

The flux of minimizing ionizing particles with ranges less than 120 g cm^{-2} Pb, was measured at atmospheric depths of 3-5 to 300 g cm^{-2}. It is shown that the major part of this flux at the top of the atmosphere cannot be due to protons, mesons or secondary electrons, and must be due to electrons in the primary radiation. The flux of vertically incident electrons (cm^{-2} sec^{-1} sr^{-1}) is calculated to lie between the following limits: $25 < E < 100$ mev: $28-31 \times 10^{-3}$; $100 < E < 1300$ mev: $3.5 - 11 \times 10^{-3}$; 1300 mev < E: $0 - 8 \times 10^{-3}$.

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill

THE DISTRIBUTION OF TRAPPED PARTICLES IN A CHANGING MAGNETIC FIELD, by E. N. Parker. Feb. 1961 [37]p. incl. diagrs. refs. (Rept. no. EFINS-61-9) (AFOSR-402) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)-666 and National Aeronautics and Space Administration under NsG-96-60) AD 261088 Unclassified

Also published in Jour. Geophys. Research, v. 66: 2641-2652, Sept. 1961.

The redistribution of charged particles in the mirror field $B(s,t) = B_0 T(t) [1 + [s/a(t)]^{\nu(t)}]$ is worked out for slow changes in T(t), a(t), and $\nu(t)$. It is found that increasing T(t) gives a relatively greater particle density increase in the center of the field than deep in the mirrors $s >> a(t)$. The mirror distance retracts like $1/T^{1/(\nu+2)}$. Decreasing a(t) has the opposite effect. Field variations constrained to preserve $T(t)a^2(t)$ and $\nu(t)$ leave the form of the particle distribution unchanged, increasing the density everywhere by the same factor. Comparing the theoretical results with the analysis by Fan, Meyer, and Simpson (Jour. Geophys. Research, v. 66: 1961) of the large changes in the outer Van Allen radiation zone during the magnetic activity of Aug. 1960 shows that the changes in the particle density can be explained by a small increase of T(t) with a(t) fixed, and later by a decrease of a(t) so that $T(t)a^2(t)$ approximates to its initial value. No irreversible particle injection or acceleration appears necessary to explain the changes in the radiation zone. (Contractor's abstract)

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

THE STELLAR WIND REGIONS, by E. N. Parker. Nov. 1960 [53]p. incl. diagrs. refs. (AFOSR-403) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)666 and National Aeronautics and Space Administration under NsG-96-60) AD 261089 Unclassified

Also published in Astrophys. Jour., v. 134: 20-27, July 1961.

From the observations of the solar wind and of the M-giant α-Herculis the gross dynamical features of the stellar wind regions associated with class G main sequence and M-giant stars are given for various interstellar environments. The supersonic wind from a class G star undergoes a shock transition to subsonic flow at a radial distance of 10^2-10^3 a.u. and may extend many times farther as a subsonic flow. This subsonic flow will be subject to turbulence and other instabilities in many cases. The wind from an M-giant may extend many parsecs if the M-giant phase of evolution lasts long enough for its wind to approach equilibrium; the resultant interstellar contamination and heating is important for a distance of many parsecs. A rough calculation of the cavity formed by a stellar wind in a large-scale interstellar field is carried out, and it is found that the cavity shape and dimensions for stationary flow depend upon the back pressure at infinity. As the pressure increases, the cavity changes from a circular cylinder of infinite radius, through an increasingly bulbous shape of finite radius, to a sphere of infinite radius with one finite cylindrical channel from each pole. (Contractor's abstract)

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

HYDROSTATIC PROPERTIES OF AN IONIZED ATMOSPHERE, by E. N. Parker. Feb. 1961 [16]p. incl. diagrs. (Rept. no. EFINS-61-14) (AFOSR-404) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)666 and National Aeronautics and Space Administration under NsG-96-60) AD 261090 Unclassified

It is shown that the electrostatic field in an ionized atmosphere causes ions of different charge and mass to concentrate at different levels. Thus, for instance, if the solar corona is sufficiently quiet as to permit an approach to equilibrium, its composition is stratified and not at all typical of the true solar composition. On the other hand, in the presence of sufficient stirring to maintain chemical homogeneity it is shown that the settling of helium ions through the hydrogen corona toward their lower equilibrium level is a powerful heating mechanism. It is shown that the ionized atmosphere of a hypothetical helium star will eject protons into space with a velocity of the order of the gravitational escape velocity (energies of the order of kv) (Contractor's abstract)

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

COSMIC-RAY PRODUCTION OF LOW-ENERGY GAMMA RAYS, by F. C. Jones. Jan. 1961 [63]p. incl. diagrs. refs. (Rept. no. EFINS-61-3) (AFOSR-405) (AF 18(600)666) AD 261091 Unclassified

Also published in Jour. Geophys. Research, v. 66: 2029-2042, July 1961.

An attempt was made to detect and measure any vertically incident flux of low-energy (0.25 - 10 mev) γ-rays that might be present at high altitudes. A series of balloon flights were made carrying a phoswitch gamma spectrometer with pulse height recording to altitudes of approx 5.5 g/cm^2 atmosphere depth. Directional sensitivity was obtained by placing a lead collimating shield around the detector and by periodically opening and closing a lead shutter above the opening of the shield. At altitudes between 5.4 and 6.0 g/cm^2 atmospheric depth the experiment yielded a value of 0.000 ± 0.034 photons sec^{-1} cm^{-2} sterad^{-1} for the vertical flux of γ-rays in the vicinity

of 0.5 mev energy. This is a null result; however, it places a new upper limit on the vertical γ-ray flux which is lower than any previously reported for this energy region. At lower altitudes it was observed that γ-rays are generated by cosmic rays in the atmosphere and in the collimating lead shield. At an atmospheric depth of 300 g/cm^2 the flux of γ-rays from the atmosphere was about 0.3 photons sec^{-1} cm^{-2} sterad^{-1}. Convincing evidence was found that the γ-rays of atmospheric origin were generated by the secondary nucleonic component and that they are not genetically related to the electromagnetic or "soft" component of the secondary cosmic rays. (Contractor's abstract)

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

THE OBSERVED OUTER BELT ELECTRON DISTRIBUTION AND THE NEUTRON DECAY HYPOTHESIS, by W. N. Hess, J. Killeen and others. May 1961 [7]p. incl. diagr. (Rept. no. EFINS-61-26) (AFOSR-866) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)366, Atomic Energy Commission, and National Aeronautics and Space Administration) Unclassified

Also published in Jour. Geophys. Research, v. 66: 2313-2314, Aug. 1961.

Measurements of electron flux along a line of force in the outer radiation belt are compared with calculations which assume that all electrons are injected by neutron decay. The comparison shows that the 2 distributions are entirely different at intermediate and low latitudes where corrections are unimportant. It is concluded that other processes in addition to electron injection by neutron decay are necessary to explain the experimentally observed flux distribution along a line of force. (Contractor's abstract)

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

DYNAMICS AND STRUCTURE OF THE OUTER RADIATION BELT, by C. Y. Fan, P. Meyer, and J. A. Simpson. June 1961 [98]p. incl. diagrs. tables, refs. (Rept. no. EFINS-61-34) (AFOSR-1133) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)666 and National Aeronautics and Space Administration under NASw-24) Unclassified

Also published in Jour. Geophys. Research, v. 66: 2606-2640, Sept. 1961.

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: Supp. A-II: 154-161, Jan. 1962. (Title varies)

From an analysis of electron measurements in the Explorer VI satellite (Aug. 7-Oct. 6, 1959) four time-dependent parameters have been investigated which characterize the outer electron belt. They are: (1) the equatorial electron intensity I_c, (2) the equatorial range from the earth R_0 of the peak intensity, (3) the electron density distribution along a line of force through the intensity peak, and (4) a measure of the change in electron spectrum with time. These parameters along with measurements of magnetic field intensity make it possible to study the origin of the changes in electron intensity and distribution which are known to occur in the outer belt. Several magnetic storms occurred during the observation on Explorer VI. Within the sequence of changes in the outer belt induced by these geomagnetic storms, there are some changes of the parameters which are accounted for only by invoking an irreversible energy gain or loss within the outer belt. The energy gain process appears to be through irreversible local acceleration of electrons. The energy loss process leads to a stable mirror point distribution characteristic of the periods between geomagnetic storms. The time intervals are identified within which each of these processes is operative. Reversible processes are possibly the cause for other changes. The foregoing analysis rests upon the proof given in this paper that the outer belt peak intensity coincides over a wide range of geomagnetic latitudes with magnetic field lines of force in the centered dipole approximation. Consequently, the measured electron intensity maximum is used as a tracer of the geomagnetic field lines of force for analyzing changes in the outer belt with time. It is shown that even during geomagnetic storms the trace of the electron intensity maximum followed a centered dipole line of force. This indicates that at all times the particle energy density of the radiation belt is much less than the energy density of the magnetic field in the region. The electron fluxes, high energy proton fluxes and possible electron spectra are investigated. Two distinct peaks of electron intensity are identified to persist in the outer belt for about two months, and it is shown that these peak distributions undergo radial motion during geomagnetic disturbances. (Contractor's abstract)

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

PRIMARY COSMIC-RAY AND SOLAR PROTONS, by R. Vogt. [1961] [48]p. incl. diagrs. tables, refs. (Rept. no. EFINS-61-43) (AFOSR-1662) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)666, National Science Foundation under G7629 and G14669, and Office of Naval Research under Nonr-(G)-00010-60) Unclassified

Also published in Phys. Rev., v. 125: 366-377, Jan. 1, 1962.

A study of the low-energy portion of the primary cosmic-ray proton spectrum was made in Aug. and Sept. 1960. A significant flux of primary protons with energies below 500 mev were detected, which previously had been considered absent. This result is of importance to astrophysical considerations as it imposes restraints upon possible modulation mechanisms should these particles be of galactic origin. The alternate possibility, namely of solar origin of

these particles is also discussed. The observations were made in three high altitude balloon flights at geomagnetic latitudes $\lambda \geq 73°$ N. The results show that the low energy proton spectrum observed on quiet days may be represented by $dJ/dE = 2.3 \times 10^4 \times E^{-2}$ protons/m^2 sec-sr mev for $78 \leq E \leq 200$ mev and flattens between 200 and 350 mev. On Sept. 8, 1960, the observed proton flux between 70 and 350 mev was several times larger than on quiet days. These protons are believed to have been produced by a class 3 flare on Sept. 3, 1960. Their energy spectrum has been measured. (Contractor's abstract)

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

THE PRIMARY COSMIC-RAY ELECTRON FLUX DURING A FORBUSH-TYPE DECREASE, by P. Meyer and R. Vogt. [1961] [9]p. incl. diagrs. (Rept. no. EFINS-61-50) (AFOSR-1663) (Sponsored jointly by Air Force Office of Scientific Research under AF 18-(600)666, National Science Foundation, and Office of Naval Research) Unclassified

Also published in Jour. Geophys. Research, v. 66: 3950-3952, Nov. 1961.

Observations are described which indicate that if, during the Sept. 3, 1960 flare, electrons were produced on the sun, they were not stored in space like protons of similar rigidity. Since this does not appear plausible, the observation indicates that the flare did not lead to the emission of electrons. Also a Forbush decrease, which began about Sept. 4, 1960 and amounted to about 4% at high-latitude neutron monitor stations, and to about 9% for primary protons with energy greater than 350 mev, affected the primary electron component and reduced the electron flux by more than 40% in the rigidity range from 100 to 1000 mev. This suggests that the electrons observed at the earth have a history similar to the galactic protons and, therefore, a galactic origin. The possibility of solar emission with subsequent, temporary storage in space at other times is not excluded by these measurements.

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

[NUCLEAR INTERACTIONS IN COSMIC RADIATION], by J. A. Simpson. Final technical rept. June 18-Sept. 30, 1961 [11]p. incl. refs. (AFOSR-3712) (AF 18(600)666) Unclassified

The most important discoveries and advances made under this contract over a period of approx 8 yr include: (1) establishment of the nucleonic component of the cosmic radiation as a new tool to investigate the cosmic ray primary spectrum and its changes with time; (2) experiments proving the solar modulation phenomenon in interplanetary space is a heliocentric phenomenon, i.e., the 11-yr intensity variation and the Forbush decreases; (3) proof that the energy spectrum of the galactic cosmic radiation changes over an 11-yr cycle; (4) establishment of theories for the modulation of cosmic radiation through the ejection of plasma and the persistence of a solar wind in interplanetary space; (5) providing the first proof that interplanetary magnetic fields exist in space; (6) first measurement of a solar flare high energy particle spectrum; (7) discovering electrons in the primary cosmic radiation, and their likely origin as a galactic flux, also electrons of solar origin; (8) identification of a low energy proton spectrum different from the assumed cosmic ray spectrum, thus extending the cosmic ray spectrum to energies below 70 mev; (9) evidence that the outer belt electrons are locally accelerated and cannot be due entirely to neutron albedo; (10) evidence for the dynamics and structure of the outer radiation belt showing their changes during geomagnetic storms; and (11) first measurements of the proton flux within the inner Van Allen belt exclusive of the inner belt electrons.

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

THE EQUATORIAL PITCH ANGLE DISTRIBUTIONS OF ELECTRONS IN THE OUTER RADIATION BELT, by C. Y. Fan, P. Meyer, and J. A. Simpson. [1961] [9]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)666 and National Aeronautics and Space Administration under NASw-24) Unclassified

Published in Space Research II; Proc. Second Internat'l. Space Science Symposium, Florence (Italy) (Apr. 10-14, 1961), Amsterdam, North-Holland Publishing Co., 1961, p. 867-875.

It is shown that the Explorer VI satellite (Aug. 7 - Oct. 6, 1959) passes, for some orbital periods, along sections of a dipole line of force. This makes it possible to determine the electron intensity as a function of geomagnetic latitude along lines of force in the E_3 region of the outer Van Allen radiation belt. The electron pitch angle distributions are derived from these results. The analysis shows that (1) the equatorial pitch angle distribution for electrons moving in a tube of force with velocity v is peaked about an angle of ~35°, (2) a great increase of intensity observed by bremsstrahlung sensitive detectors is accompanied by a change in pitch angle distribution, (3) after the disturbed phase of a geomagnetic storm the pitch angle distribution returns to the prestorm distribution even though the number of electrons of velocity v has changed by a large factor. (Contractor's abstract)

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

THE COSMIC RAY INTENSITY GRADIENT IN SPACE DURING SOLAR MODULATION, by J. A. Simpson, C. Y. Fan, and P. Meyer. [1961] [3]p. incl. diagr. (Sponsored jointly by Air Force Office of Scientific

Research under AF 18(600)666, Air Force Cambridge Research Center, and National Aeronautics and Space Administration) Unclassified

Presented at Internat'l. Conf. on Cosmic Rays and the Earth Storm, Kyoto (Japan), Sept. 4-15, 1961.

Published in Jour. Phys. Soc. Japan, v. 17: Suppl. A-II: 505-507, Jan. 1962.

Measurements of cosmic radiation intensity have been made to ~0.1 a.u. from the earth in Pioneer V for investigating the heliocentric properties of the 11 year and Forbush decrease modulations of cosmic ray intensity by magnetic fields in interplanetary space. It is shown that during a Forbush decrease at 0.03 a.u. the cosmic ray spectrum undergoes a sudden change wherein approx 10% of the total flux (mostly low energy particles) is removed from the spectrum. A second decrease at 0.1 a.u. (30 days later) shows that this low energy component does not return to the vicinity of Pioneer V. It is shown that this change in spectrum is important for determining the gradient of cosmic ray intensity in space at the time of solar maximum. The gradient for the 11 year intensity variation (0.0 ± 2.0) %/0.1 a.u. This result shows that if the cosmic ray flux at solar minimum approximates the galactic flux of cosmic rays, then the main heliocentric gradient in space lies beyond the orbit of the earth. (Contractor's abstract)

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

ELECTRONS AND γ-RAYS IN THE PRIMARY COSMIC RADIATION, by P. Meyer. [1961] [3]p. [AF 18(600)666] Unclassified

Presented at Internat'l. Conf. on Cosmic Rays and the Earth Storm, Kyoto (Japan), Sept. 4-15, 1961.

Published in Jour. Phys. Soc. Japan, v. 17: Suppl. A-III: 60-62, Jan. 1962.

A brief summary of the recent experimental work concerned with the gamma and electron components of the primary cosmic radiation is given.

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

FLUX AND ENERGY SPECTRA OF PRIMARY COSMIC-RAY PROTONS FROM 70 TO 400 MEV, by R. Vogt. [1961] [5]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)666, National Science Foundation, and Office of Naval Research) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Presented at Internat'l. Conf. on Cosmic Rays and the Earth Storm, Kyoto (Japan), Sept. 4-15, 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 263, Apr. 24, 1961.

Published in Jour. Phys. Soc. Japan, v. 17, Suppl. A-II: 436-440, Jan. 1962.

A study of the low energy portion of the primary cosmic ray proton spectrum was made in Aug. and Sept. 1960. The observations took place in 3 high altitude balloon flights at geomagnetic latitudes $\lambda \geq 73°N$. A significant flux of primary protons was detected with energies below 500 mev, which previously had been considered absent. Fluxes and energy spectra of these particles are given and their possible origins are discussed. (Contractor's abstract)

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

SOME PROPERTIES OF THE PRIMARY COSMIC RAY ELECTRONS, by P. Meyer and R. Vogt. [1961] [4]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)666, National Science Foundation, and Office of Naval Research) Unclassified

Presented at Internat'l. Conf. on Cosmic Rays and the Earth Storm, Kyoto (Japan), Sept. 4-15, 1961.

Published in Jour. Phys. Soc. Japan, v. 17, Suppl. A-III: 5-8, Jan. 1962.

If, during the Sept. 3, 1960 solar flare, electrons were produced on the sun, they were not stored in interplanetary space like protons of similar rigidity. Since this does not appear plausible, the measurement indicates that the flare did not lead to an emission of electrons. A Forbush decrease which began on Sept. 4, 1960, and amounted to about 9% for primary protons with E > 350 mev, affected the primary electron component and reduced the electron flux by more than 40% in the rigidity range from 100 to 1000 mev. This strongly suggests that the electrons observed at the earth have a history which is similar to the galactic protons. The evidence, therefore, points to a galactic origin of the primary electrons. However, it does not exclude the possibility of solar emission with subsequent, temporary storage in interplanetary space at other times.

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Chicago U. [Enrico Fermi Inst. for Nuclear Studies] Ill.

IDENTIFICATION OF HYPERNUCLEI $_{\Lambda}^{7}$Li BY K^- ABSORPTION ANALYSIS IN NUCLEAR EMULSION, (Abstract), by P. E. Schlein and W. E. Slater. [1960] [1]p. [AF 49(638)209] Unclassified

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

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 12, Jan. 27, 1960.

Analysis of the production reactions, (K^-,Σ^-) + emulsion nucleus → hypernucleus + residual particles, will often provide additional information for the identification of the heavier hypernuclei. In the work reported here the EFINS events from EFINS-NU collaboration were studied in order to investigate the extent to which production analysis would be generally useful in resolving certain hypernucleus-identification ambiguities. To be reported are (1) 3 examples of mesic $_{\Lambda}C^{12,13}$. One of these is a unique example of $_{\Lambda}C^{13}$ which probably decays into $N^{13} + \pi^-$ with $B_{\Lambda} = 10.8 \pm 0.6$ mev. (2) One new example of mesic $_{\Lambda}B^{12}$ with $B_{\Lambda} = 9.9 \pm 0.6$ mev, production analysis of a $_{\Lambda}B^{11}$ event and an example of nonmesic $_{\Lambda}B^{12}$. (3) One example of $_{\Lambda}Be^{8,9}$ whose Λ^0 is produced in a 2-nucleon primary reaction $K^- + 2H^1 \rightarrow \Lambda^0 + H^1 + 317$ mev. This hypernucleus is most probably produced in C^{12}. (4) Production analyses of other heavy hypernuclei some of which have a bearing on the existence of Be^{10}. All heavy hypernuclei thus far analyzed have been produced in C^{12} or O^{16}.

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

IDENTIFICATION OF HEAVY HYPERNUCLEI FROM K^- CAPTURE BY PRIMARY STAR ANALYSIS, by P. E. Schlein and W. E. Slater. [1961] [24]p. incl. illus. diagrs. tables, refs. (AFOSR-775) (AF 49-(638)209) Unclassified

Also published in Nuovo Cimento, Series X, v. 21: 213-234, July 16, 1961.

Several hypernuclei of $A \geq 7$ have been unic ely identified from an analysis of the parent K^- capture reactions. This method has proved of great value in the choice of the correct identity when the decay process offered various alternative interpretations. An example of the decay $C^{13}_{\Lambda} \rightarrow \pi^- + N^{13}$, $B_{\Lambda} = (10.8 \pm 0.5)$ mev has been thus identified for the first time. A second example of the decay $B^{12}_{\Lambda} \rightarrow \pi^- + 3\,He^4$, $B_{\Lambda} = (9.9 \pm 0.6)$ mev is reported here, confirming the previous observation of this hypernuclide. Some progress is made in resolving the composition of a group of heavy two-body decays. None of the events studied here is inconsistent with K^- capture on light nuclei (C, N, O); two events require a two-nucleon capture process. (Contractor's abstract)

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

MESIC DECAYS OF HYPERNUCLEI FROM K^- CAPTURE. III. C[H]ARACTERISTICS OF THE PARENT STARS, by D. Abeledo, L. Choy and others. [1961] [26]p. incl. diagrs. tables, refs. (AFOSR-1174) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)209, Atomic Energy Commission, and National Science Foundation) AD 295873 Unclassified

Also published in Nuovo Cimento, Series X, v. 22: 1171-1196, Dec. 16, 1961.

A study has been made of K^- and Σ^- capture stars emitting mesic hyperfragments (MHF) in an attempt to understand the mechanism of hyperfragment production. K^- stars emitting Li^8 fragments were also considered. The experimental results are presented. Particular emphasis is placed on a determination of the fractions of MHF produced in light (C, N, O) and heavy elements (Ag, Br) of the emulsion and on a comparison of the characteristics of MHF emission with those of ordinary nuclear fragments, such as He and Li^8. The data are examined with reference to several mechanisms which may play a role in the emission of hyperfragments.

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Chicago U. [Enrico Fermi Inst. for Nuclear Studies] Ill.

PRODUCTION OF HYPERFRAGMENTS FROM K^- CAPTURE IN NUCLEAR EMULSION (Abstract), by O. Skjeggestad, R. G. Ammar and others. [1961] [1]p. [AF 49(638)209] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 291, Apr. 24, 1961.

K^- capture stars emitting mesic hyperfragments (HF) were studied in an attempt to understand the mechanism of their production. Out of a total of 436, 390 were found in a stack of standard K5 and L4 emulsion (EFINS-NU collaboration), and 46 were in a stack of K5 2X diluted emulsion. In addition, about 120 K^- stars yielding Li^8 fragments were considered. A separation between captures in light and heavy elements has been achieved making use of the prong-range cutoff arising from the Coulomb barrier of Ag and Br. Lower limits for HF emission from light elements are 50, 70, 80, and 80% for $_{\Lambda}H$, $_{\Lambda}He$, $_{\Lambda}Li$, and Li^8. The range distributions on $\sim 60_{\Lambda}$ Li and ~ 100 Li^8 tracks are indistinguishable. Analogous results are obtained for the range distribution of $\sim 150_{\Lambda}$ He and of ~ 500 stable prongs of range < 150 μ (mostly α particles). The HF momentum was found to point preferentially opposite to that of the associated π or fast proton. Various hypotheses for the HF production mechanism are discussed.

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

A SUMMARY OF BINDING ENERGY DATA FROM

HYPERNUCLEI DECAYING BY π^- EMISSION, by N. Crayton, R. Levi Setti and others. [1961] [2]p. incl. table. (In cooperation with Northwestern U., Evanston, Ill.) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)209], Atomic Energy Comission, and National Science Foundation) Unclassified

Published in Proc. Rutherford Jubilee Internat'l. Conf., Manchester (Gt. Brit.) (Sept. 4-8, 1961), New York, Academic Press, 1961, p. 205-206.

The statistics on Λ-binding energies collected by the EFINS-NU collaboration have been recently improved with the addition of several events, in particular π^--mesic decays of hypernuclei with A > 5. A table is presented summarizing the final results. Events from the literature have been surveyed and the average binding energies obtained are compared with the EFINS-NU data. All binding energies have been calculated for Q_Λ = (37.58 ± 0.15) mev.

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Chicago U. Inst. for the Study of Metals, Ill.

SELF-DIFFUSION OF LEAD, THALLIUM AND BISMUTH IN THE SOLID LEAD-THALLIUM SYSTEM, by H. A. Resing and N. H. Nachtrieb. [1960] [17]p. incl. diagrs. tables, refs. (AFOSR-3425) (AF 18-(600)1489) AD 615193 Unclassified

Also published in Jour. Phys. and Chem. Solids, v. 21: 40-56, 1961.

Results are reported for the self-diffusion of both lead and thallium over the whole range of solid solution for these elements (0-87 at-% Tl) for the temperature interval 206-323°C. Data for the trace impurity diffusion of bismuth over the same concentration range are also given for a more limited temperature range. All 3 elements show the same qualitative dependence of their diffusion coefficient upon alloy composition: namely, a slight max at about 35 at-% thallium and a deep min at about 75% at-% thallium at all temperatures. The results are compared with the predictions of the corresponding states principle and with theories based upon the Johnson vacancy-solute complex mechanism. A correction applied to the corresponding states principle, based upon lattice parameter deviations from Vegard's law, leads to agreement with observation. Some evidence for the existence of a superlattice at alloy compositions in the neighborhood of $PbTl_7$ is inferred from trends in the ratios D_{Tl}/D_{Pb} and D_{Bi}/D_{Pb} with thallium concentration. (Contractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill.

CHAIN MODEL FOR POLYELECTROLYTES. VII. POTENTIOMETRIC TITRATION AND ION BINDING IN SOLUTIONS OF LINEAR POLYELECTROLYTES, by L. Kotin and M. Nagasawa. [1961] [7]p. incl. diagrs. refs. (AFOSR-2731) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49-(638)694] and National Institutes of Health) Unclassified

Also published in Jour. Chem. Phys., v. 36: 873-879, Feb. 15, 1962.

The electrostatic potential about a rodlike polyion in an aqueous solution containing added simple electrolyte is calculated by numerical integration of the Poisson-Boltzmann equation. The results are applied to the calculation of the ionic distributions about the polyion and the potentiometric titration curves of polyweak acids. The nature of ion binding is discussed in terms of a molecular model and it is found that the degree of ion binding f^* may be expressed as $f^* = 1 - (2Ne^2/DkTL)^{-1}$. (Contractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill.

EFFECT OF UNIAXIAL COMPRESSION ON IMPURITY CONDUCTION IN n-TYPE GERMANIUM, by H. Fritzsche. Oct. 17, 1961 [36]p. incl. diagrs. tables, refs. (AFOSR-1621) (AF 49(638)802) Unclassified

Also published in Phys. Rev., v. 125: 1552-1560, Mar. 1, 1962.

Shear strains, which change the donor wave functions, greatly affect impurity conduction, which depends sensitively on the wave function overlap of neighboring impurity states. Using uniaxial compression along [111] investigation was made as a function of stress of the critical impurity separation d_c for the transition from non-metallic to metallic conduction and impurity conduction in the intermediate concentration range $7 \times 10^6 < N < 3 \times 10^7$ cm^{-3}. The largest stress applied was 2×10^9 dyne cm^{-2}. The main effect of stress is a change of the activation energy ε_2 of impurity conduction. In arsenic and phosphorus-doped germanium [111] compression decreases ε_2 and increases d_c. In antimony-doped germanium the opposite is observed. At 1.2°K [111] compression can increase the resistivity of antimony-doped germanium by a factor of 10^7. Using the same orientation and temperature, a decrease of the resistivity of arsenic-doped germanium by a factor of 5×10^{-4} is observed. These results suggest that the activation energy ε_2 depends strongly on the wave function overlap and shear strains change the donor wave functions originating from the individual valleys by an amount which is proportional to the valley-orbit splitting of the donor element. (Contractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill.

EFFECT OF STRESS ON THE DONOR WAVE FUNCTIONS IN GERMANIUM, by H. Fritzsche. Oct. 17, 1961 [32]p. incl. diagrs. table, refs. (AFOSR-1622) (AF 49(638)802) Unclassified

Also published in Phys. Rev., v. 125: 1560-1567, Mar. 1, 1962.

The effect of the corrections to the effective mass approximations on the stress dependence of the donor wave functions has been reexamined. It is found that not only the relative valley contributions to the ground state wave function are changed by the stress but also the individual envelope functions $F_j(r)$ which originate from the j conduction band valleys. The stress dependence of the $F_j(r)$ depends strongly on the value of the valley-orbit splitting of the donor. This can explain qualitatively the different behavior of the piezo-resistance effect in the impurity conduction range of germanium doped antimony, arsenic, or phosphorus. The stress dependence of the hyperfine splitting of the electron spin resonance is shown to be very insensitive to the stress-induced changes in $F_j(r)$ except in the limit of very large stresses. (Contractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill.

THE THEORY OF IMPURITY CONDUCTION, by N. F. Mott and W. D. Twose. [1961] [57]p. incl. diagrs. tables, refs. (AFOSR-3359) [AF 49(638)802] AD 613743 Unclassified

Also published in Philos. Mag., Suppl., v. 10: 107-163, Apr. 1961.

Also published in Advances in Phys., v. 10: 107-163, Apr. 1961.

A theoretical study is made of one of the ways in which electricity can flow in a semiconductor containing impurities. The following topics are discussed: the model and a general discussion of impurity conduction, impurity wave functions, observations of impurity conduction, methods of calculating the electrical conductivity at low concentrations, the properties of a 1-dimensional disordered lattice, the interaction of localized carriers with lattice vibrations, calculations of impurity conduction, dependence of the transition concentration on degree of compensation, concentration at which transition occurs, and resistivity in the region of metallic conduction.

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Chicago U. [Inst. for the Study of Metals] Ill.

IMPURITY CONDUCTION IN STRAINED n-TYPE GERMANIUM (Abstract), by H. Fritzsche. [1961] [1]p. [AF 49(638)802] Unclassified

Presented at meeting of the Amer. Phys. Soc., Monterey, Calif., Mar. 20-23, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 136, Mar. 20, 1961.

Impurity conduction of germanium doped with antimony or with arsenic has been measured as a function of uniaxial compression along [111]. Using Sb as donors the resistivity measured along [111] rises rapidly with increasing compression by more than a factor of 10^7 at low temperatures. Saturation is reached when the strain-induced shift of the conduction band valleys becomes larger than the valley-orbit splitting. The resistivity measured perpendicular to the stress direction remains almost unchanged. The resistivity anisotropies and resistivity changes are several orders of magnitude smaller in arsenic-doped Ge at comparable stresses. This is due to the larger valley-orbit splitting of As donors. These effects can be explained in terms of the strain-induced change of the impurity ground state wave function and of the low-temperature activation energy of impurity conduction.

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Chicago U. Inst. for the Study of Metals, Ill.

USE OF GERMANIUM AS A SECOND SOUND RECEIVER, by H. A. Snyder. [1961] [3]p. incl. diagr. refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)802 and National Science Foundation under NSFG-15538) Unclassified

Published in Rev. Scient. Instr., v. 33: 467-469, Apr. 1962.

It is shown that doped germanium crystals can be used as second sound receivers. Their frequency response, sensitivity, and noise level have been measured for samples of several thicknesses. By comparing the results with the corresponding values found in other types of second sound receivers, it is concluded that germanium receivers are superior to the other types in common use for applications below 10 kc.

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Chicago U. Inst. for the Study of Metals, Ill.

KINETIC THEORY OF IDEAL IONIC MELTS, by S. A. Rice. [1961] [12]p. incl. refs. (AFOSR-1776) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-52 and Petroleum Research Fund) Unclassified

Also published in Trans. Faraday Soc., v. 58: 499-510, Mar. 1962.

The kinetic theory of molten salts is considered from the point of view of the model fluids proposed by Rice and Allnatt, and Rice and Kirkwood. An ideal ionic melt is defined as a useful reference system with the

definition chosen to make the melt equivalent to a one component system. In an ideal ionic melt the interionic pair potential is defined as the sum of 3 terms: a coulomb attraction (repulsion), a Van der Waals interaction, and a rigid core repulsion. All rigid cores are taken to be the same, as are all polarizabilities. The effect of polarization appears in a dielectric constant. It is shown that the coulomb potential causes only slow dissipation of energy and therefore that the transport properties of the melt are largely determined by short-range forces. A comparison is then possible of, say, the properties of liquid argon and molten KCl. The self-diffusion constant, viscosity and thermal conductivity of an ideal ionic melt, approximately representative of KCl, are computed and shown to be in good agreement with experiment. (Contractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill.

ON THE KINETIC THEORY OF DENSE FLUIDS. IX. THE FLUID OF RIGID SPHERES WITH A SQUARE-WELL ATTRACTION, by H. T. Davis, S. A. Rice, and J. V. Sengers. [1961] [24]p. incl. refs. (AFOSR-1779) (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-61-52] and Petroleum Research Fund) Unclassified

Also published in Jour. Chem. Phys., v. 35: 2210-2233, Dec. 1961.

Using methods previously introduced, the statistical theory of a dense fluid of molecules interacting with a square-well potential is discussed. The argument proceeds via the derivation and solution of a modified Boltzmann equation. The theory is used in 2 ways: (a) to provide a test of the theory proposed by Rice and Allnatt; and (b) to estimate the attractive force contribution to the transport of momentum and energy in a real fluid. The approach of Rice and Allnatt is shown to give a friction coefficient in agreement with experiment for liquid argon. The presence of the attraction has a marked effect on the transport of momentum and energy, and the square-well-model fluid gives a surprisingly accurate representation of the properties of liquid argon. The computed thermal conductance and self-diffusion coefficient are in agreement with experiment. (Contractor's abstract, in part)

503

Chicago U. Inst. for the Study of Metals, Ill.

A CONJECTURE CONCERNING THE ELECTRICAL CONDUCTANCE OF METAL-MOLTEN SALT MIXTURES, by S. A. Rice. [1961] [6]p. incl. refs. (AFOSR-1780) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-52, National Science Foundation, and Petroleum Research Fund) Unclassified

Also published in Faraday Soc. Discussions, No. 32: 181-187, 1961.

It is proposed that the excess electrical conductance in an atomically dispersed solution of metal atoms in a molten parent metal halide arises from a random walk of the electron between atom and metal ions. The resonant charge transfer is considered for the cases when the anion does and does not act as a mediating bridge. The order of magnitude of the computed electron mobility is in accord with experiment, as is the qualitative nature of the concentration dependence of the excess conductance. The computations do not permit a definite decision as to whether or not the anion plays a role in the conductance. (Contractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill.

AN ACOUSTIC CONTINUUM MODEL OF MOLECULAR FRICTION IN SIMPLE DENSE FLUIDS, by S. A. Rice. [1961] [6]p. incl. refs. (AFOSR-1781) (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-61-52] and Petroleum Research Fund) Unclassified

Also published in Molec. Phys., v. 4: 305-310, July 1961.

An acoustic model is presented with the aim of calculating an upper bound for the molecular friction constant. Problems arising from the use of macroscopic boundary conditions at molecular surfaces are circumvented by treating the molecule in a continuum as a distributed force center modifying the propagation of acoustic waves. The computed friction constant is a factor of 2 larger than experiment. Physical arguments are given for the validity of the relation, $\zeta_0 < \zeta$ (real system) $< \zeta$ (acoustic). Other acoustic models are briefly discussed. (Contractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill.

KINETIC THEORY OF DENSE FLUIDS. X. MEASUREMENT AND INTERPRETATION OF SELF-DIFFUSION IN LIQUID Ar, Kr, Xe, AND CH_4, by J. Naghizadeh and S. A. Rice. [1961] [11]p. incl. diagrs. tables, refs. (AFOSR-1873) (AF AFOSR-61-52) Unclassified

Also published in Jour. Chem. Phys., v. 36: 2710-2720, May 15, 1962.

The self-diffusion coefficients of Ar, Kr, Xe, and CH_4 have been measured as functions of temperature and pressure and the data used to examine critically the current theories of diffusion. It is found that: (1) The self-diffusion coefficients of Ar, Kr, and Xe fit one corresponding states relationship, and this relationship differs from that needed to fit the observed diffusion coefficients of CH_4. For Ar, Kr, and Xe:

$\log\tilde{D} = 0.05 + 0.07\tilde{p} - (1/\tilde{T})(1.04 + 0.1\tilde{p})$, with $\tilde{D}$, $\tilde{T}$,

$\tilde{p}$ the reduced diffusion coefficient, temperature and pressure. (2) The free volume theory of diffusion is inadequate to describe the observations. (3) The volume of activation for CH_4 is 1/3 of the molar volume, while for Ar, Kr, and Xe it is 1 molar volume or larger. This observation is related to the steepness of the intermolecular repulsion, as is the deviation of CH_4 from the corresponding states curve determined by Ar, Kr, and Xe. (4) The dominant temperature dependence of D arises from the correlation between successive increments in momentum. In describing molecular motion it is necessary to include negative portions of the momentum autocorrelation function. A simple fluid continuum model appears to be accurate in describing momentum correlations. Calculations of D and (d lnD/dT) are in good agreement with experiment. (5) The dense square-well fluid provides a zeroth-order approximation to real fluids. The computed temperature dependence of D is in quantitative agreement with experiment, but the computed values of D are in error by about 30%. (Contractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill

CONCENTRATION DEPENDENCE OF THE FRICTIONAL COEFFICIENT OF POLYMERS IN SOLUTION, by H. Yamakawa. [1961] [7]p. incl. diagr. tables, refs. (AFOSR-1882) (AF AFOSR-61-52) Unclassified

Also published in Jour. Chem. Phys., v. 2995-3001, June 1, 1962.

The frictional coefficient of chain polymers at finite concentrations is calculated on the basis of the Kirkwood-Riseman approach taking into account the intramolecular and intermolecular hydrodynamic interactions. The intermolecular potential energy of Flory and Krigbaum is employed for the calculation of the perturbation velocity produced in the neighborhood of one molecule by the presence of another. Difficulties arising from an improper integral encountered in the intermolecular treatment of the viscosity to the Stokes approximation do not occur in the present problem. Evaluation is carried out up to the term linear in concentration, and the final expression is rewritten in terms of the molecular parameters familiar in the recent dilute polymer solution theories. The results show that the frictional coefficient is initially independent of concentration at the theta temperature, and that the ratio of the coefficient of the linear term to the intrinsic viscosity takes a value of about 1.7 for good solvent systems. These conclusions are in agreement with the experimental observations. A detailed comparison with experiment is made for several systems. (Contractor's abstract)

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Chicago U. Lab. of Molecular Structure and Spectra, Ill.

STUDIES IN MOLECULAR STRUCTURE. III. POPULATIONS ANALYSES FOR SELECTED FIRST-ROW DIATOMIC MOLECULES, by S. Fraga and B. J. Ransil. [1960] [16]p. incl. tables. (Sponsored jointly by [Air Force Office of Scientific Research under AF 49(638)699], National Science Foundation, and Office of Ordnance Research) Unclassified

Published in Jour. Chem. Phys., v. 34: 727-742, Mar. 1961.

Electronic population analyses for selected diatomic molecules of the first row of the periodic table are tabulated. The tentative value of population analyses in relation to accuracy of approximation is discussed briefly. (Contractor's abstract)

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Chicago U. Lab. of Molecular Structure and Spectra, Ill.

STUDIES IN MOLECULAR STRUCTURE. IV. POTENTIAL CURVE FOR THE INTERACTION OF TWO HELIUM ATOMS IN SINGLE-CONFIGURATION LCAO MO SCF APPROXIMATION, by B. J. Ransil. [1960] [10]p. incl. diagrs. tables. (Sponsored jointly by [Air Force Office of Scientific Research under AF 49-(638)699], National Science Foundation, and Office of Ordnance Research) Unclassified

Published in Jour. Chem. Phys., v. 34: 2109-2118, June 1961.

Single configuration LCAO-MO-SCF wave functions and corresponding total energies were calculated for 2 ground state He atoms interacting over an extensive range (0.4A to 12.0A). Comparison with available experimental data shows good agreement for distances greater than 1.5A. For the first time, it is believed, an a priori account is given of both the Van der Waals minimum and the repulsion region with a wave function of sufficient flexibility to deal with both. The details of repulsion and of bonding in the Van der Waals region are analyzed in terms of atomic and overlap populations. (Contractor's abstract)

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Chicago U. Lab. of Molecular Structure and Spectra, Ill.

STUDIES IN MOLECULAR STRUCTURE. V. COMPUTED SPECTROSCOPIC CONSTANTS FOR SELECTED DIATOMIC MOLECULES OF THE FIRST ROW, by S. Fraga and B. J. Ransil. [1960] [10]p. incl. diagrs. tables. (Sponsored jointly by [Air Force Office of Scientific Research under AF 49(638)699], National Science Foundation, and Office of Ordnance Research) Unclassified

Published in Jour. Chem. Phys., v. 35: 669-678, Aug. 1961.

Limited LCAO MO functions were computed for several diatomic molecules at 4 different values of the internuclear distance near R_e, and the corresponding total energies fitted to a third degree polynomial in R.

Spectroscopic constants ω_e, $\omega_e x_e$, B_e, α_e, R_e, k_e were derived from the resulting potential curve and compared to observed values. The good agreement obtained in most cases suggests a valuable application of the self consistent field function. In addition, calculations were made for a few more values of the internuclear distance providing a potential curve over a reasonably broad range around R_e. (Contractor's abstract)

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Chicago U. [Lab. of Molecular Structure and Spectra] Ill.

INTERIM FINAL REPORT FOR CONTRACT NO. AF 49(638)699, by C. C. J. Roothaan. Jan. 19, 1961 [8]p. (AFOSR-305) (AF 49(638)699) Unclassified

Techniques for performing quantum mechanical calculations on atoms and molecules have been developed. The most notable of these calculations are: atomic self-consistent field calculations, accurate functions for 2- 3-, and 4-electron systems, a program for linear 3- and 4-center molecules, and computations involving selected closed shell diatomic molecules.

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Chicago U. Lab. of Molecular Structure and Spectra, Ill.

[QUANTUM MECHANICAL CALCULATIONS ON ATOMS AND MOLECULES]. Technical rept. 1959-1960 [1961] 395p. incl. illus. diagrs. tables, refs. (AFOSR-1015) (Sponsored jointly by [Air Force Office of Scientific Research] under AF 49(638)699, Air Force Systems Command under AF 19(604)6662, Army Research Office under DA 11-022-ORD-3119, and Office of Naval Research under Nonr-212101) AD 259126 Unclassified

Research performed by this project during the period June 1, 1959 to Jan. 31, 1961 is reported. Thirty-five papers resulting from the work performed during this period, and devoted largely to spectroscopy and related studies, and theoretical computations on electronic structures are included.

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Chicago U. [Lab. of Molecular Structure and Spectra] Ill.

ANALYSIS OF THE ω TECHNIQUE OF CHARGE REDISTRIBUTION OF SIMPLE ORGANIC MOLECULAR SYSTEMS (Abstract), by S. Ehrenson. [1961] [1]p. [AF 49(638)699] Unclassified

Presented at meeting of the Amer. Phys. Soc., Monterey, Calif., Mar. 20-23, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 164, Mar. 20, 1961.

The empirical LCAO-MO method of Coulomb integral adjustment with charge density, first used by Wheland and Mann and subsequently by others, has been examined in terms of the dependence of convergence upon initial parameter choices. Closed form solutions of the iterative method (to obtain self-consistent eigenvalues and vectors) for some simple molecular cases provide information on the general validity of this technique. Comparisons may be drawn with other SCF methods such as Pople's.

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Chicago U. [Lab. of Molecular Structure and Spectra] Ill.

ATOMIC SCF CALCULATIONS IN ANALYTICAL FORM (Abstract), by C. C. J. Roothaan and M. Yoshimine. [1961] [1]p. [AF 49(638)699] Unclassified

Presented at meeting of the Amer. Phys. Soc., Monterey, Calif., Mar. 20-23, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 165, Mar. 20, 1961.

Hartree-Fock calculations were performed by the expansion method for a number of elements and ions of the first row of the periodic table, using the open shell treatment developed recently by one of us. Considerable experimentation with the basis set was carried out. This demonstrated the need for optimizing the basis set in order to obtain actual Hartree-Fock functions by this method with a reasonably short set of basis functions. Results for a variety of cases will be presented.

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Chicago U. [Lab. of Molecular Structure and Spectra] Ill.

CONFIGURATION INTERACTION IN SIMPLE ATOMIC SYSTEMS (Abstract), by A. W. Weiss. [1961] [1]p. [AF 49(638)699] Unclassified

Presented at meeting of the Amer. Phys. Soc., Monterey, Calif., Mar. 20-23, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 165, Mar. 20, 1961.

The ground-state wave functions of the helium, lithium, and beryllium atoms were approximated by a superposition of configurations with expansion lengths ranging from 35 for helium to 55 for beryllium. The discrepancies in the total energy are 0.014 ev for helium, 0.026 ev for lithium, and 0.17 ev for beryllium. A 19 configuration function was also applied to the lowest ^3S state of helium, with a resulting accuracy of 0.0005 ev. The calculations were also made on all the isoelectronic series of ions through $Z = 8$, the discrepancy remaining of the same order of magnitude but increasing with increasing Z. Upper and lower bounds to the electron affinity of lithium are set at 0.4773 ev and 0.6547 ev, respectively, with the most probable value as 0.6158 ev.

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Chicago U. [Lab. of Molecular Structure and Spectra] Ill.

CONFIGURATION INTERACTION TREATMENT OF He_2 (Abstract), by P. E. Phillipson. [1961] [1]p. [AF 49(638)699] Unclassified

Presented at meeting of the Amer. Phys. Soc., Monterey, Calif., Mar. 20-23, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 165, Mar. 20, 1961.

The repulsion energy between two normal helium atoms ($^1\Sigma_g$ of He_2) has been investigated by the method of configuration interaction. The wave function is expressed as a linear combination of determinantal configurations of the form $|\varphi_i\alpha(1)\,\varphi_i\beta(2)\,\varphi_j\alpha(3)\,\varphi_k\beta(4)| + |\varphi_i\alpha(1)\,\varphi_i\beta(2)\,\varphi_k\alpha(3)\,\varphi_j\beta(4)|$ where the φ's are symmetry orbitals constructed from Slater-type atomic orbitals (1s, 1s', $2p\sigma$, $2p\pi$). At several internuclear distances R between 0.5 A and ∞, the orbital exponents were independently varied to minimize the energy for a chosen set of configurations. Various types of wave functions were tried varying from one to 64 configurations. It was found that between 0.5 A and ∞ the repulsion energy (the difference between the energy at a given R and the separated atom energy) is quite constant at a given R over a range of optimized wave functions of various degrees of goodness. It appears that any improvement in the energy at a given R is compensated for by a quantitatively similar improvement in the separation energy so that the repulsion energy remains essentially the same. At 0.5 A, a repulsion energy of 27.71 ev was calculated using a 64-configuration wave function, and all wave functions tried gave an energy within 0.9 ev of this figure.

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Chicago U. [Lab. of Molecular Structure and Spectra] Ill.

LCAO-MO-SCF WAVE FUNCTIONS FOR LINEAR MOLECULES (Abstract), by E. Clementi and A. D. McLean. [1961] [1]p. [AF 49(638)699] Unclassified

Presented at meeting of the Amer. Phys. Soc., Monterey, Calif., Mar. 20-23, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 165, Mar. 20, 1961.

Results of a systematic investigation on the ground state LCAO-MO-SCF wave function for the molecules CO_2, HCN, C_3, N_2O, N_3^-, HF_2^-, NO_2^+, OCN^-, SCO, C_4, C_2N_2, and H_2C_2 are presented. All the needed integrals are accurately computed. The basis functions used are Slater-type orbitals. Both minimum and extended basis sets up to 16 basis functions are used. Inclusion of $3d\pi$ and $3d\sigma$ orbitals has been proved to be important to obtain valency and Coulomb polarization. These wave functions are the most accurate attempt yet made to approximate the Hartree-Fock functions for polyatomic molecules. Results obtained with electron population analysis calculations will be presented.

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Chicago U. [Lab. of Molecular Structure and Spectra] Ill.

AN LCSTO SCF CALCULATION OF O_2 (Abstract), by S. Huzinaga. [1961] [1]p. [AF 49(638)699] Unclassified

Presented at meeting of the Amer. Phys. Soc., Monterey, Calif., Mar. 20-23, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 165, Mar. 20, 1961.

The energies of the ground state $^3\Sigma_g^-$ of O_2 were computed at several interatomic distances by Roothaan's open-shell SCF method. Computations were made automatically by use of the McLean-Weiss Molecular SCF Program written for the Univac 1103-A computor. The basis functions used were 1s, 2s, $2p\sigma$, $2p\pi$ and $3d\pi$ STO's (Slater-type orbitals). Our main interest was in the polarization effect of $2p\pi$ due to $3d\pi$. The additional flexibility imparted to the π_u and π_g molecular orbitals yielded improvements of about 2 ev in the total energy and in the binding energy over the case of the so-called minimum set: 1s, 2s, $2p\sigma$ and $2p\pi$. Similar calculations were also made for F_2.

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Chicago U. Lab. of Molecular Structure and Spectra, Ill.

STUDIES IN MOLECULAR STRUCTURE. VI. POTENTIAL CURVE FOR THE INTERACTION OF TWO HYDROGEN ATOMS IN THE LCAO MO SCF APPROXIMATION, by S. Fraga and B. J. Ransil. [1961] [11]p. incl. diagrs. tables, refs. (Sponsored jointly by [Air Force Office of Scientific Research under AF 49-(638)699], National Science Foundation, and Office of Ordnance Research) Unclassified

Published in Jour. Chem. Phys., v. 35: 1967-1977, Dec. 1961.

The LCAO MO SCF method, both in the single-configuration and a limited configuration interaction approximation, has been utilized to evaluate the potential curve of the ground state of H_2; wave functions and total molecular energies are presented for a wide range of the internuclear distance (1.0 au $\leq$ R $\leq$ 18.0 au). These solutions were then used to construct potential curves for the ground states of the molecular ions H_2^+ and H_2^- and for the lower-lying excited states of the neutral molecule. Results of vibration-rotation analyses for the stable states are presented.

The results for a population analysis of the single-configuration ground-state function over the whole range of R are given and compared to similar results for He_2. (Contractor's abstract)

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Chicago U. Lab. of Molecular Structure and Spectra, Ill.

REPULSIVE INTERACTION BETWEEN TWO GROUND-STATE HELIUM ATOMS, by P. E. Phillipson. [1961] [12]p. incl. diagrs. tables, refs. (AFOSR-4031) (Sponsored jointly by [Air Force Office of Scientific Research under AF 49(638)1068], Atomic Energy Commission, and Office of Naval Research) Unclassified

Also published in Phys. Rev., v. 125: 1981-1992, Mar. 15, 1962.

The repulsion energy between two ground-state helium atoms ($^1\Sigma_g^+$ state of He_2) has been investigated in the single-configuration MO (molecular orbital) approximation and then further refined to include the effects of electron correlation by the inclusion of superposition of configurations. In the former case, the wave function is expressed as a single antisymmetrized spin-orbital product (ASOP) of the form $|\sigma_g 1s(1)\alpha(1)\sigma_g 1s(2)\beta(2)\sigma_u 1s'(3)\alpha(3)\sigma_u 1s'(4)\beta(4)|$, where the MO's $\sigma_g 1s$ and $\sigma_u 1s'$ are approximated as the sum and difference of Slater-type orbitals (STO's) 1s and 1s', respectively, and the energy minimized with respect to the orbital exponents. In addition to the repulsion energy at small internuclear distances the slight polarization of the $\sigma_u 1s'$ MO effected by the ζ variation, permitted the single ASOP wave function to give indications of the Van der Waals energy minimum at large distances. The superposition of configurations treatment employed a linear combination of configurations constructed out of a 1s, 1s', $2p\sigma$, $2p\pi$ STO basis set, and at five internuclear distances R between 0.5 and 2.0 A, the STO orbital exponents were varied to minimize the energy. Various wave functions including from 10 to 64 electron configurations were tried, which were so chosen that the wave functions would go properly as $R \to 0$ into the ^1S ground-state function of beryllium and as $R \to \infty$ go into a product of two ^1S helium atom functions. The computed repulsion energies in the region $0.5 A \leq R \leq 1.0 A$ are 2.8 to 1.2 times higher than values deduced from experimental scattering data obtained previously, and since the difference between the lowest computed (64-configuration) energy and the estimated exact energy is much smaller than this, a reinvestigation of the scattering analysis is emphasized. (Contractor's abstract)

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Chicago U. Lab. of Molecular Structure and Spectra, Ill.

STUDIES IN MOLECULAR STRUCTURE. VII. LIMITED CONFIGURATION INTERACTION FOR SELECTED FIRST-ROW DIATOMICS, by S. Fraga and B. J. Ransil. [1961] [16]p. incl. tables, refs. (AFOSR-4032) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)1068], National Science Foundation and Office of Ordnance Research) Unclassified

Also published in Jour. Chem. Phys., v. 36: 1127-1142, Mar. 1, 1962.

Calculations on selected first-row diatomic molecules using a limited configuration interaction with minimal LCAO MO SCF wave functions are described. Molecular energies, dipole moments and population analyses are tabulated and discussed. These results provide an extensive foundation for a tentative evaluation of the value of limited configuration interaction for LiH, BH, NH ($d^1\Sigma^+$), HF, Li_2, C_2, N_2, F_2 LiF, CO, and BF within the limits of the approximations used.

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Chicago U. Lab. of Molecular Structure and Spectra, Ill.

STUDIES IN MOLECULAR STRUCTURE. VIII. He_2^{++} IN THE SINGLE- AND MANY-CONFIGURATION LCAO MO SCF APPROXIMATION, by S. Fraga and B. J. Ransil. [1961] [8]p. incl. diagrs. tables, refs. (AFOSR-4033) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)1068], National Science Foundation, and Office of Ordnance Research) Unclassified

Also published in Jour. Chem. Phys., v. 37: 1112-1119, Sept. 1, 1962.

Single- and many-configuration wave functions and their corresponding molecular energies are reported for the diatomic molecular ion He_2^{++} in the LCAO MO SCF approximation for a wide range of internuclear distances. A potential curve displaying a min at 0.71 A and a max at about 1.11 A is obtained with $\omega_e = 3295\ cm^{-1}$ and $D_e = 1.21$ ev. Comparison with potential curves and correlation energies computed by the more accurate methods of Kolos, Roothaan, Weiss, Yoshimine, and McLean are made. The results are discussed with reference to stability and occurrence of the ion. Correlation energy is computed as a function of internuclear distance and compared with the isoelectronic analog H_2.

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Chicago U. Lab. of Molecular Structure and Spectra, Ill.

SCF-LCAO-MO WAVE FUNCTION FOR THE $^1\Sigma_g^+$ GROUND STATE OF C_3, by E. Clementi and A. D. McLean. [1961] [3]p. incl. tables. (AFOSR-4034) (Sponsored jointly by [Air Force Office of Scientific Research under AF 49(638)1068] and National Science Foundation) Unclassified

Also published in Jour. Chem. Phys., v. 36: 45-47, Jan. 1, 1962.

The $^1\Sigma_g^+$ grcund state wave function for the C_3 molecule is computed in the SCF-LCAO-MO approximation. Four wave functions derived from different basis sets of Slater type orbitals (STO's) are compared. Subject to the limitations of the available computer program investigation has been made of the effects of expanding a minimal basis set by adding extra functions which should allow for polarization effects, and changes in optimum orbital exponents of atomic orbitals in the molecular environment.

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Chicago U. [Lab. of Molecular Structure and Spectra] Ill.

SCF-LCAO-MO WAVE FUNCTIONS FOR THE BIFLUORIDE ION, by E. Clementi and A. D. McLean. [1961] [5]p. incl. tables, refs. (AFOSR-4035) (Sponsored jointly by [Air Force Office of Scientific Research under AF 49(638)1068], National Science Foundation, and Office of Ordnance Research) Unclassified

Also published in Jour. Chem. Phys., v. 36: 745-749, Feb. 1, 1962.

Several SCF-LCAO-MO wave functions for the ground state of HF_2^- are reported. The best one has a total energy ~4 ev higher than the estimated Hartree-Fock energy for HF_2^-, and it is about 30 ev lower than the energy corresponding to an SCF-LCAO-MO wave function with minimal basis set. These wave functions give indications as to what, in the SCF-LCAO-MO framework, is the smallest basis set which would give a wave function with total energy very near the Hartree-Fock energy. The importance of inclusion of a 2pπ Slater type orbital (STO) on the hydrogen atom is discussed. (Contractor's abstract)

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Chicago U. Lab. of Molecular Structure and Spectra, Ill.

GROUND STATE SCF-LCAO-MO WAVE FUNCTION FOR THE CARBONYL SULFIDE MOLECULE, by E. Clementi. [1961] [3]p. incl. tables, refs. (AFOSR-4036) (Sponsored jointly by [Air Force Office of Scientific Research under AF 49(638)1068], National Science Foundation, and Office of Ordnance Research) Unclassified

Also published in Jour. Chem. Phys., v. 36: 750-752, Feb. 1, 1962.

The ground state SCF-LCAO-MO wave function for the carbonyl sulfide molecule is presented and analyzed. All the 30 electrons are included in the computation and all the integrals are accurately computed with McLean's automatic program. A brief discussion of some of the excited states is given at the end of the paper. (Contractor's abstract)

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Chicago U. Lab. of Molecular Structure and Spectra, Ill.

A COMPUTATION ON THE GROUND STATE WAVE FUNCTION FOR THE C_2N_2 MOLECULE, by E. Clementi and A. D. McLean. [1961] [2]p. incl. tables. (AFOSR-4037) (Sponsored jointly by [Air Force Office of Scientific Research under AF 49(638)1068] and National Science Foundation) Unclassified

Also published in Jour. Chem. Phys., v. 36: 563-564, Jan. 15, 1962.

A self-consistent field wave function is presented for the ground state of C_2N_2. The orbital energies and coefficients are obtained in an SCF-LCAO-MO calculation using an unoptimized minimal basis set of 16 Slater type orbitals. The usual chemical picture of the molecule is confirmed, with a very strong double bond between N and C.

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Chicago U. Lab. of Molecular Structure and Spectra, Ill.

SCF-MO WAVE FUNCTIONS FOR THE HYDROGEN FLUORIDE MOLECULE, by E. Clementi. [1961] [12]p. incl. diagrs. tables, refs. (AFOSR-4038) (Sponsored jointly by [Air Force Office of Scientific Research under AF 49(638)1068] and National Science Foundation) Unclassified

Also published in Jour. Chem. Phys., v. 36: 33-44, Jan. 1, 1962.

An SCF-LCAO-MO ground-state wave function is reported for the HF molecule at several internuclear distances. The basis set of Slater-type orbitals (STO's) was chosen so as to obey the following 4 criteria: (a) be a balanced basis set, i.e., each atom should have a set of STO's equally extended relative to the number and kinds of occupied AO's in the free atom; (b) include in the set STO's for a balanced polarization; (c) optimize the orbital exponents; (d) avoid redundancy in the set. The computed total energy at the internuclear distances of 1.7328 au is -100.05804 au. This should be about 0.004 au above the Hartree-Fock energy of the HF molecule. The significance of the STO's in the basis set adopted is illustrated by several parallel computations. The computed equilibrium distance is 1.74 au and the experimental is 1.733 au. The dipole moment is computed for several wave functions and the value corresponding to the best wave function is 1.984 D (experimental is 1.74 D), whereas the best computed moment for another wave function is 1.970 D. The significance of this variation is discussed. The $d\mu/dr$ is estimated at 1.7 D/au at the equilibrium distance (experimental is 0.954). The overlap population and gross charge Q are computed for several internuclear distances. The significance of the Q_H is discussed; the best value of Q_H at the internuclear distance is 0.479. The ground-state $^2\pi$ and the excited state $^2\Sigma^+$ for HF are investigated. An SCF computation is made

for the $^2\Pi^+$ excited state at several internuclear distances. Gross charges and overlap populations are given for different internuclear distances for the 2 ionic states. The reorganization effect due to the removal of one electron is discussed in relation to the total energy, population analysis, and gross charge Q_H for the ion. A discussion of the computed ionization potential I(3σ) is given at the end of the paper. (Contractor's abstract)

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Chicago U. Lab. of Molecular Structure and Spectra, Ill.

[QUANTUM MECHANICAL CALCULATIONS ON ATOMS AND MOLECULES]. Technical rept. 1961, 350p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)1068, Air Force Systems Command under AF 19-(604)6662, Army Research Office under DA 11-022-ORD-3119, and Office of Naval Research under Nonr-212101) AD 274801 Unclassified

This report presents a collection of 27 papers on the subjects of molecular spectroscopy and related studies, and theoretical computations on electronic structures. Many of the papers are reproduced from published reprints.

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Cincinnati U. Dept. of Chemistry, Ohio.

THE RATE OF REACTION OF HEXYNE-1 WITH SUBSTITUTED PHENYLMAGNESIUM BROMIDES, by R. E. Dessy and R. M. Salinger. [1960] [2]p. incl. table, refs. (AFOSR-1326) [AF 49(638)824] Unclassified

Also published in Jour. Org. Chem., v. 26: 3519-3520, Sept. 1961.

The rates of reaction of a series of substituted phenylmagnesium bromides with hexyne-1 in ether have been determined by following the rate of change of the dielectric constant of the reaction mixture with time. The reactions were run under pseudo-first order conditions in ether with a 20-fold excess of hexyne-1 and obeyed the first order rate law for at least 3 half-lives. A determination of reaction rate of a solution 0.2M in both phenylmagnesium bromide and hexyne-1 obeyed the second order equation past 70% completion, indicating that this reaction is first order in Grignard reagent and in hexyne-1, and is second order overall. The rate constant for the second order reaction was 28% above that for the first order determinations, which is probably due to solvent effects from the excess of hexyne-1 used. The relative reactivities and rate constants of the compounds investigated are given.

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Cincinnati U. Dept. of Chemistry, Ohio.

THE FORMATION OF CARBON-METAL BONDS, by R. E. Dessy, W. L. Budde, and C. Woodruff. [1961] [7]p. incl. diagr. tables, refs. (AFOSR-3431) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)824], Diamond Alkali Co., National Science Foundation, and Petroleum Research Fund of the Amer. Chem. Soc.) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 84: 1172-1178, Apr. 1962.

The reaction of monosubstituted acetylenes, R'C≡CH, with M_2HgX_4 and RHgX, leading to $(R'C{\equiv}C)_2Hg$ and RHgC≡CR' has been investigated kinetically, and a 4-center transition stage postulated for all reactions involved. This confirms earlier suggestions made concerning the transition state for cleavage of R_2Hg compounds with HX, and suggests that the stereochemical consequences of SE2 reactions in organomercury systems are as yet unknown.

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City of Hope Medical Center, Duarte, Calif.

INHIBITION IN THE NERVOUS SYSTEM AND GAMMA-AMINOBUTYRIC ACID: PROCEEDINGS OF AN INTERNATIONAL SYMPOSIUM, Duarte, Calif., May 22-24, 1959, ed. by E. Roberts, C. F. Baxter and others. London, Pergamon Press, 1960, 591p. incl. illus. diagrs. tables, refs. (AFOSR-TR-60-145) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)546], Merck, Sharp, and Dohme, West Point, Pa., Riker Labs., Inc., Northridge, Calif., Smith, Kline, and French Labs., Philadelphia, Pa., and Upjohn Co., Kalamazoo, Mich.) Unclassified

The physiological activities of the single cell and its parts, and the chemistry and physiology of nervous tissue are considered. The application of this information to the clinical and normal behavior patterns of the intact nervous system is then discussed. Finally, the relationship between these 3 approaches to the study of the nervous tissue is explored.

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Colorado U., Boulder.

SPIKED BLUNT BODIES IN SUPERSONIC FLOW, by H. H. Album. June 1961 [138]p. incl. illus. diagrs. tables, refs. (AFOSR-307) AD 257055 Unclassified

The force and moment characteristics of spiked bodies with hemispherical, hemispherical-flat, and flat noses were determined in a supersonic wind tunnel at angles of attack from zero to 10°. The afterbodies were right circular cylinders. A fineness ratio of 3 was maintained for all of the basic bodies. The

spikes were of 5 different configurations and ranged in length from 0.75 to 2.0 body diam. Free-stream conditions included Mach numbers from 2.0 to 3.0 and Reynolds numbers from 300,000 to 900,000 (based on body diam). It was found that the spikes greatly reduced the zero-angle drag, made the drag extremely sensitive to angle of attack variations, substantially increased the lift, and also increased the normal force. The body nose shape proved to be a critical factor in determining the magnitude of these characteristics and whether or not the spikes would have a stabilizing effect on the body pitching moment characteristics. (Contractor's abstract)

532

Colorado U., Boulder.

SECOND INTERNATIONAL CONFERENCE ON THE PHYSICS OF ELECTRONIC AND ATOMIC COLLISIONS; ABSTRACTS OF PAPERS, Colorado U., Boulder, June 12-15, 1961, New York, W. A. Benjamin, 1961, 181p. incl. diagrs. tables, refs. (AFOSR-1327) (MIPR-61-10) Unclassified

Reviewed in Phys. Today, v. 15: 30-34, Feb. 1962.

This conference was the second in a series of conferences organized largely to emphasize (1) the need for experimental work in support of the effort to extract from quantum mechanics useful results for low-energy scattering phenomena, and (2) the shortage of experimental low-energy collision parameters for use in astrophysics, ionospheric physics, and other fields of application of plasma physics. The conference committee was largely successful in limiting experimental papers to those giving results of measurements of collision parameters. The program of contributed papers dealt with collision physics, and not with experimental techniques. The conference attracted well over 300 participants.

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Colorado U. Dept. of Chemistry, Boulder.

11,12-DIMETHYLENE-9,10-DIHYDRO-9,10-ETHANOANTHRACENE, by J. S. Meek and R. D. Stacy. [1959] [3]p. incl. refs. (AF 18(600)648) Unclassified

Published in Jour. Org. Chem., v. 26: 300-302, Feb. 1961.

11,12-Dimethylene-9,10-dihydro-9,10-ethanoanthracene was synthesized and found to undergo the Diels-Alder reaction as well as free radical polymerization. A trans reduction of a carbon-carbon double bond by lithium aluminum hydride was discovered in the reduction of methyl 9,10-dihydro-9,10-ethanoanthracene-11,12-dicarboxylate to dl-2,3-[9,10-anthryiene]-1,4-butanediol. (Contractor's abstract)

534

Colorado U. Dept. of Chemistry, Boulder.

BIREFRINGENCE IN A STRAINED VISCOELASTIC FLUID UNDER STEADY STATE ROTARY CONDITIONS, by S. J. Gill and F. R. Dintzis. Feb. 1961 [15]p. incl. diagrs. (AFOSR-399) (Also bound with its AFOSR-2301) (AF 49(638)310) AD 254242 Unclassified

The theory and apparatus involved in a study of the birefringence of a strained viscoelastic fluid are discussed. Consideration was given to a material in a state of continuous rotary strain. Methods of mathematical analyses of the strain within the fluid subjected to a rotated elliptical boundary, and its birefringence were reviewed. The experimental apparatus was composed of a thin walled Teflon tube rotating inside of a stationary brass tube squeezed to form an elliptical cross section. Optical windows and other mechanical devices were at either end. Birefringence and axes orientation measurements may be made with the Soleil-Babinet compensator. Results are presented for carboxymethyl cellulose and polystyrene solutions. Accuracy depended on factors such as solution concentration, temperature, and speed of rotation. Theoretical expectations were realized; steady state retardation increased with rotation speed; and the angular orientation of the principal optic axes was found to depend on rotation speed.

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Colorado U. Dept. of Chemistry, Boulder.

A DETERMINATION OF MOLECULAR ENTANGLEMENTS IN POLYMER SOLUTIONS BY STRAIN BIREFRINGENCE MEASUREMENTS, by S. J. Gill and R. Toggenburger. [1961] [4]p. (AFOSR-1819) (Also bound with its AFOSR-2301) [AF 49(638)310] AD 295865 Unclassified

Also published in Jour. Polymer Sci., v. 60: S69-S70, 1962.

The birefringence Δn for a deformed network is given as $\Delta n = \frac{2N\pi}{45} \frac{(\bar{n}^2 + 2)^2}{\bar{n}} (\alpha_1 - \alpha_2)(\lambda_1^2 - \lambda_2^2)$ where N is the number of junctions (entanglements in solutions) per cc, $\bar{n}$ is the refractive index of the solutions, $\alpha_1 - \alpha_2$ is the difference of the statistical link polarizabilities along and perpendicular to the link direction, and λ_1, λ_2 are the extension ratios of the imposed macroscopic strain. The above equation is used in conjunction with direct experimental measurements of Δn, $\bar{n}$, λ_1, and λ_2, and a value of -184×10^{-25} cc for $\alpha_1 - \alpha_2$, to determine the number of entanglements per cc of several polystyrene solutions in benzene.

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Colorado U. [Dept. of Mathematics] Boulder.

ON PERIODIC INFINITE RADICALS, by G. Schuske and W. J. Thron. [1961] 8p. (AFOSR-546) (AF 49-(638)100) AD 256245 Unclassified

Also published in Ann. Acad. Scient. Fennicae, Series A.I., No. 307, 1962, 8p.

In an earlier paper (see item no. 478, Vol. IV) investigation was made of the convergence problem of the infinite radical $\{u_n\}$, $u_n = \sqrt{(a_1 + \sqrt{(a_2 + \ldots + \sqrt{(a_n)})})}$, where the elements a_n's are complex numbers, with the help of some properties of function theory. In this paper the periodic infinite radicals of period one are considered with the complex elements. Following an elementary method, in which no functional theory is needed, it is shown that such an infinite radical is always convergent and converges to $(1 + \sqrt{(1 + 4a)})/2$, where a is the element of the infinite radical and $\sqrt{(1 + 4a)}$ is taken in accordance with the authors' definition. (Math. Rev. abstract)

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Colorado U. [Dept. of Mathematics] Boulder.

CERTAIN CONTINUED FRACTIONS ASSOCIATED WITH THE PADÉ TABLE, by A. Magnus. [1961] [14]p. (AFOSR-2799) (AF 49(638)100) Unclassified

Also published in Math. Zeitschr., v. 78: 361-374, Mar. 1962.

The author defines a P-fraction to be a continued fraction, terminating or not, of the form $b_0 + K_1^{\infty}(1/b_n)$, where the b_n are polynomials in $1/z$. It is shown that there is a unique, one-to-one correspondence between P-fractions and formal Laurent series, $L_0 = \Sigma_{-N}^{\infty} a_n z^n$. The algorithm for the P-fraction of L_0 is generated by the formal power series identity $(L_n - b_n) L_{n+1} = 1$, where b_n is the principal part plus constant term of L_n, and terminates at the nth stage if $L_n - b_n = 0$. The terminating case arises if and only if L_0 is the Laurent expansion of a rational function. In the computation of the b_n the inversion of power series can be avoided by using a method similar to that of Frank [Amer. Jour. Math., v. 68: 89-108: 1946] for C-fractions. In case L_0 is a power series it is shown that z^{-s} times any approximant of the P-fraction expansion of $z^s L_0$ lies in the diagonal $[n, n-s]$ of the Padé table for L_0 $(s = 0, \pm 1, \pm 2, \cdots)$. (Math. Rev. abstract)

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Colorado U. Dept. of Physics, Boulder.

THE INTERACTION OF PARAMAGNETIC IONS AND ALUMINUM NUCLEI IN RUBY, by C. M. Verber. July 1961, 69p. incl. diagrs. tables, refs. (AFOSR-1333) (AF 49(638)611) AD 267071 Unclassified

The techniques of continuous and pulsed nuclear magnetic resonance were used to study the aluminum nuclei in ruby crystals. Four commercially prepared samples having nominal chromium ion concentrations of 0.01, 0.1, 1.5, and 4% were investigated at 300, 78, 4, and 1.7°K. The line widths were found to be due to 2 major contributions. The mutual interaction of the aluminum nuclei contributed a constant broadening of about 7 gauss. The paramagnetic ions contributed a broadening which ranged from 0 to 42 gauss as a function of temperature, concentration and static magnetic field. This dependence can be calculated by assuming that the chromium ions have an effective magnetic moment which is determined by the Boltzman average of the 4 spin states of the ion at each temperature considered. This indicates that the chromium ions are in good thermal contact with the lattice down to 1.7°K. The relaxation times were found to be a strong function of the chromium ion concentration. An effort was made to predict these times, using known values of the chromium relaxation times and existing theories in which the nuclear relaxation times are given in terms of the paramagnetic relaxation times. No agreement was found between theoretical and experimental values, and a revision of existing theories is indicated. (Contractor's abstract)

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Colorado U. [Dept. of Physics] Boulder.

NUCLEAR RESONANCE OF ALUMINUM IN SYNTHETIC RUBY, by C. M. Verber, H. P. Mahon, and W. H. Tanttila. [1961] [9]p. incl. diagrs. tables, refs. (AFOSR-3077) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)611] and National Science Foundation) Unclassified

Also published in Phys. Rev., v. 125: 1149-1157, Feb. 15, 1962.

The linewidth, line shape, and spin-lattice relaxation time T_1 have been measured as a function of temperature in single crystals of $(Al^{27})_2O_3$ having nominal Cr_2O_3 concentrations of 0% and 0.01, 0.1, 1.5, and 4% by weight. Of the two important contributions to the linewidth, the nuclear spin-spin interaction is 7 gauss and temperature-independent. The contribution from the paramagnetic ions increased from zero at 300°K to as much as 42 gauss, depending upon concentration, temperature, and static magnetic field. An anomalous structure in the aluminum resonance was evident in both the steady-state and pulsed nuclear induction data. The $\frac{1}{2}$ to $-\frac{1}{2}$ transition has a splitting of 2.84 gauss with a $3\cos^2\theta - 1$ dependence on the angle between the c axis and H_0. The splitting is

independent of the observation frequency and chromium ion concentration. T_1 was observed to vary from 150 sec to 1.5 msec as a function of ion concentration and temperature, and to vary in a manner not correctly given by existing theory. Many of the samples were observed to have a nonunique T_1. (Contractor's abstract)

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Columbia U. [Columbia Radiation Lab.] New York.

COHERENT AMPLIFICATION OF ELECTROMAGNETIC WAVES BY ATOMIC AND MOLECULAR PHENOMENA, by C. H. Townes. [1958] [19]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-73279]) Unclassified

Published in Physikertagung Essen 1958: 110-128, 1959.

Coherent amplification of electromagnet waves by atomic and molecular phenomena is discussed. Amplifiers which work on this basis are called molecular amplifiers, quantum mechanical amplifiers or masers (an abridgement of Microwave Amplification by Stimulated Emission of Radiation). The workings of a NH_3 beam-type maser are discussed. In the case of a maser amplifier the noise temperature (power per unit bandwidth which can also be expressed in terms of black body radiation at a certain temperature) is the ratio of the number of systems in the upper states to those in the lower states or $n_2/n_1 = \exp(-h\nu/kt)$. $n_1 - n_2 \geq Vh\Delta\nu/16\pi^2\mu^2Q$ shows the number of excited atoms and molecules required for oscillation or amplification increases as the line width increases. No present maser delivers much power, but solid state masers using paramagnetic materials have power outputs as high as a few mw, whereas the beam-type systems are limited to about 10^{-8} w. The 2-level solid state maser is based on an isolated electron spin having 2 levels separated by an energy 2 μH. The 3 level system is based on a quanta of energy $h\nu$, producing a non-equilibrium condition so that there is a larger population in level 1 than in level 2, or in level 2 than level 3, allowing amplification at 1 of the 2 lower frequencies. The most popular of which is an amplifier using the paramagnetic centers of ruby. Another type uses the proton resonance in water and oscillates at frequencies in the mc region or lower. The Raman effect can also provide amplification. Schematic illustrations and descriptions are given for some masers and the possibilities offered by them suggested.

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Columbia U. Columbia Radiation Lab., New York.

BEAM MASER SPECTROSCOPY ON HDO, by P. Thaddeus and J. Loubser. [1959] [5]p. incl. illus. table. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-73279]) Unclassified

Published in Nuovo Cimento, Series X, v. 13: 1060-1064, Sept. 1, 1959.

A beam maser of the type originally used by Gordon, Zeiger, and Townes (Phys. Rev., v. 95: 282, 1954) to investigate the magnetic hyperfine structure of the NH_3 inversion lines has been used to resolve the hyperfine structure of the 2_{20}-2_{21} rotational transition in HDO which lies at 10 278.245 mc/s. The quadrupole satellites reported by Posener (Austral. Jour. Phys., v. 10: 276, 1957) have been fully resolved and substantial effects due to magnetic interactions confirmed.

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Columbia U. [Columbia Radiation Lab.] New York.

HYPERFINE STRUCTURE MEASUREMENTS IN THE METASTABLE 2S STATE OF HYDROGENIC ATOMS, by P. Kusch. [1959] [13]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-73279]) Unclassified

Published in Recent Research in Molecular Beams, New York, Academic Press, 1959, p. 93-105.

Atomic beam spectroscopic experiments on the metastable 2S state of H, D, and He^{3+} yielded the following values for the zero field hfs splittings: $\Delta\nu$ (2S;H) = 177, 556.86 ± 0.05 kc/sec; $\Delta\nu$ (2S;D) = 40,924.439 ± 0.020 kc/sec; and $\Delta\nu$ (2S, He^{3+}) = 1083.35499 ± 0.00020 mc/sec. Comparison of the latter experimental value with the predicted value of $\Delta\nu$(2S, He^{3+}) = 1083.557 ± 0.010 mc/sec shows a discrepancy of 182 ± 22 parts/million. The discrepancy presumably arises from nuclear structure effects such as those that lead to the hyperfine structure anomaly of H and D.

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Columbia U. Columbia Radiation Lab., New York.

CONCENTRATION-MODULATION ELECTRON-BEAM DEVICES, by H. Lashinsky. [1960] [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-73279]) Unclassified

Published in I. R. E. Trans. on Electron Devices, v. ED-8: 185-191, May 1961.

Electron-beam devices are considered in which a form of concentration modulation, as defined by Gabor is utilized. In the devices described a scalloped electron beam is produced by a combination of crossed electric fields and a magnetic field, and strikes a collector after passing through a fixed aperture. The points of minimum width of the scalloped beam are "images" of the cathode which are reproduced along the longitudinal axis of the system by virtue of the

cyclotron motion of the electrons. The application of an additional alternating electric field, parallel to the fixed electric field causes a periodic variation in the longitudinal position of the cathode images, giving rise to an alternating component in the current which reaches the collector. Concentration modulation is compared with other modulation methods. Transit-time limitations are evaluated and possible applications are considered, including frequency multiplication at microwave frequencies. The use of the concentration-modulation technique in modulating a high-density electron beam at audio frequencies in an experimental system is described. (Contractor's abstract)

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Columbia U. Columbia Radiation Lab., New York.

SIZE-DEPENDENT RELAXATION TIMES AT LIQUID HELIUM TEMPERATURES, by F. R. Nash. [1961] [3]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-73279])
Unclassified

Published in Phys. Rev. Ltrs., v. 7: 59-61, July 15, 1961.

The salt used was $Cu(NH_4)_2(SO_4)_2 \cdot 6H_2O$ and crystals 37-1000 μ were prepared in 2 ways, by slow growth over 24 hr and by rapid growth from a supersaturated solution (~1 min). For the quickly grown crystals, τ was proportional to the size for crystal sizes less than 200 μ. For sizes greater than 500 μ, τ was independent of size. For the slowly grown crystals, $\tau \alpha$ (size) up to 900 μ. A tentative explanation is given in terms of phonon imprisonment. (Phys. Rev., v. 114: 1002-1005, May 15, 1959.

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Columbia U. [Columbia Radiation Lab.] New York.

A BEAM MASER SPECTROMETER, by P. Thaddeus and L. C. Krisher. [1961] [7]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-73279])
Unclassified

Published in Rev. Scient. Instr., v. 32: 1083-1089, Oct. 1961.

The construction and operation of a molecular beam maser spectrometer, similar to the ammonia maser, is described. The observed linewidths are of the order of 5 kc at microwave frequencies, thereby allowing high resolution hyperfine spectroscopy on a number of molecules. The major factors affecting the resolution and sensitivity are examined. A brief survey of possible experiments is given. (Contractor's abstract)

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Columbia U. Columbia Radiation Lab., New York.

CERENKOV RADIATION AT MICROWAVE FREQUENCIES, by H. Lashinsky. [1961] [33]p. incl. diagrs. refs. (Sponsored jointly by [Air Force Office of Scientific Research], Office of Naval Research, and Signal Corps under [DA 36-039-sc-73279])
Unclassified

Published in Advances in Electron. and Electron Phys., v. 14: 265-297, 1961.

Cerenkov radiation is considered as the electromagnetic analog of the acoustic shock wave which is produced when a projectile moves through a medium at a velocity which exceeds the velocity of wave propagation in the medium. The present review summarizes the general theory of the Cerenkov effect and investigates the theoretical considerations and design factors which pertain to the generation of microwaves by Cerenkov radiation.

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Columbia U. Columbia Radiation Lab., New York.

THE OBSERVATION OF THREE CENTIMETER RADIATION FROM ASTRONOMICAL OBJECTS WITH A RUBY MASER, by R. Novick. Special technical rept. June 1, 1961 [96]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-78330) AD 263565
Unclassified

Radiation at 3 cm wavelength associated with the planets Venus, Mars, and Jupiter has been measured with the use of a maser type radiometer in conjunction with the U. S. Naval Research Lab. 50 ft reflector. The fluxes of radiation correspond to apparent planetary temperatures of 575°K, 211°K, and 177°K, respectively. The apparent temperature is defined as the temperature of a black body subtending the same solid angle as the planetary disk, which produces the observed flux. The measurement of radiation intensities from 5 radio sources observed for the first time at 3 cm wavelength and a search for radiation from planetary nebulae are also reported.

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Columbia U. Columbia Radiation Lab., New York.

THERMAL TUNING OF RUBY OPTICAL MASER, by I. D. Abella and H. Z. Cummins. [1961] 2p. incl. illus. diagrs. (Rept. no. CU-2-62 AF 507) (AFOSR-619) (AF 49(638)507)
Unclassified

Also published in Jour. Appl. Phys., v. 32: 1177-1178, June 1961.

For this experiment a 0.05% Cr^{3+} ruby rod of dimensions 1/4 x 1/4 x 1 3/4 in. was cut with the optic axis

perpendicular to the length of the rod, and the ends were polished and silvered. The maser output was coupled through the partially transmitting end, and directed into a Jarrell Ash 3.4m grating spectrometer set at high order. The light was found to be essentially 100% plane polarized, with the plane of vibration of the E vector perpendicular to the plane containing the optic axis, and the normal to the end face of the rod. The light was incident on the grating with the plane of vibration parallel to the rulings, and the lines were photographed in the exit plane, where the dispersion in the eighth order, 6940A, is 0.677A/mm. A sample of ruby lines and comparisons spectra show that the intensity of successive lines decreases since the threshold increases with temperature. It was also observed that in a number of cases, the ruby R_1 line consisted of 2 or 3 closely spaced components, with widths about 0.07A; the total width of the group was about 0.2A. The slope is found to be 0.065A/deg and, because the spectral width is of this order, good temperature control is necessary for frequency stability; indeed, some degree of line broadening may occur as a result of temperature variation within a single pulse. A number of runs were made with the ruby cooled in liquid nitrogen and then mounted into the flashlamp. The results show that the variation of oscillation wavelength is due to the shift of the fluorescent R_1 line.

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Columbia U. Columbia Radiation Lab., New York.

ALKALI-METAL OPTICAL MASERS, by I. D. Abella and H. Z. Cummins. Nov. 1, 1961, 12p. incl. diagrs. (AFOSR-1465) (Rept. no. CU-1-61) (AF 49(638)507) AD 265988 Unclassified

Presented at Western Electronic Show and Convention, San Francisco, Calif., Aug. 1961.

An optical maser device is described by which a pressure broadened mercury lamp provides the outside light source. The mercury line was observed at high resolution and was found to be self-reversed. An adsorption cell containing potassium-absorbed energy was found to be about half as intense as mercury. The apparatus was assembled such that the mercury lamp was focussed by means of an elliptical cylinder onto a closed cell containing vaporized potassium.

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Columbia U. [Columbia Radiation Lab.] New York.

ALKALI VAPOR INFRARED MASERS, by H. Z. Cummins, I. [D.] Abella and others. [1961] [6]p. incl. diagrs. (AFOSR-3251) [AF 49(638)507] Unclassified

Presented at Second Internat'l. Conf. on Quantum Electronics, Berkeley, Calif., Mar. 23-25, 1961.

Also published in Advances in Quantum Electronics, New York, Columbia U. Press, 1961, p. 12-17.

Experiments using optically pumped cesium for maser action are reported. Six spectral lines were examined in fluorescence under varying conditions of temperature and gas pressure. These were: the 2 resonance lines at 8943 and 8521A; the 2 transitions $8S_{1/2}$ - $6P_{1/2,3/2}$ at 7609 and 7944A; the $6D_{3/2}$ - $6P_{1/2}$ transition at 8761A; and the unresolved 4F - $5D_{3/2,5/2}$ doublet at 10,100A. The measurements were made in order to study the relative intensities of the lines under different operating conditions and to provide some quantitative estimate of populations as an indication of the feasibility of maser action. It was found that at a cesium vapor pressure of 0.01 mm Hg and a foreign gas pressure less than 2×10^{-5}, the first 5 lines occurred with relative intensities close to predicted calculations. The 10,100A line did not appear under these conditions. As the cesium pressure was increased to 0.1 mm, the apparent intensities of the resonance lines increased by about 30X, the intensities of the 8S-6P and the 6D-6P transitions remained roughly constant, while the 4F-6P line increased from 0 to about the same intensity as the 3 nonresonance lines. Introduction of Xe produced a decrease in line intensity by a factor of 100. It was apparent that Cs-Cs collisons of the second kind cause transitions from the 8S to the 4F state even in the absence of foreign gas. Addition of the foreign gas enhanced this effect while quenching some of the other excited states.

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Columbia U. [Columbia Radiation Lab.] New York.

MODE CHARACTERISTICS AND COHERENCE IN OPTICAL RUBY MASERS, by I. D. Abella and C. H. Townes. [1961] [3]p. incl. illus. (In cooperation with Massachusetts Inst. of Tech., Cambridge) [AF 49-(638)507] Unclassified

Also published in Nature, v. 192: 957-959, Dec. 1961.

Mode characteristics and coherence in optical ruby masers are investigated. The ring structure in light emitted from the ruby maser is photographed and the series of rings observed correspond within the accuracy of measurement with the pattern of a Fabry-Perot interferometer. Three patterns are analyzed: (1) ring pattern formed by a light beam at the focal plane of a lens; (2) interference pattern produced by light from 2 small apertures transmitting beams from different parts of the ring pattern of (1); (3) rings produced by a beam after passage through a Fabry-Perot interferometer.

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Columbia U. Columbia Radiation Lab., New York.

HYPERFINE STRUCTURE OF THE $(5p)^5(6s)\ ^3P_2$ STATE OF $_{54}Xe^{129}$ AND $_{54}Xe^{131}$, by W. L. Faust and M. N. McDermott. [1961] [7]p. incl. diagrs.

tables, refs. (AFOSR-280) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [AF 49(638)557]) Unclassified

Also published in Phys. Rev., v. 123: 198-204, July 1, 1961.

The hyperfine structure of the metastable $(5p)^5(6s)\ ^3P_2$ state of $_{54}Xe^{129}$ and $_{54}Xe^{131}$ has been measured by the atomic beam magnetic resonance method. The zero magnetic field intervals $f(F \leftrightarrow F')$ are: for Xe^{129}, $f(3/2 \leftrightarrow 5/2) = 5961.2577(9)$ mc/sec; and for Xe^{131}, $f(5/2 \leftrightarrow 7/2) = 2693.6234(7)$ mc/sec, $f(3/2 \leftrightarrow 5/2) = 1608.3475(8)$ mc/sec, and $f(\frac{1}{2} \leftrightarrow 3/2) = 838.7636(4)$ mc/sec. The values of the quadrupole and octupole moments of Xe^{131}, without polarization corrections and without corrections for any effects of configuration mixing, are $Q = -0.120(12)$ b and $\Omega = +0.048(12)$ nmb. The hyperfine-structure anomaly for the 2 isotopes due to the $s\frac{1}{2}$ electron alone is $\Delta(s\frac{1}{2}) = +0.0440(44)\%$, in disagreement with the prediction of the single-particle model. (Contractor's abstract)

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Columbia U. [Columbia Radiation Lab.] New York.

HYPERFINE STRUCTURE OF $_{36}Kr^{83}$ IN THE METASTABLE $^3P_2$ STATE (Abstract), by W. L. Faust, C. L. Summers, and L. Y. Chow Chiu. [1961] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)557] Office of Naval Research, and Signal Corps) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 74, Feb. 1, 1961.

Eleven weak field Zeeman components of the $F = 9/2 \leftrightarrow F = 11/2$ lines of the metastable $(4p)^5(5s)^3P_2$ state of $_{36}Kr^{83}$, $I = 9/2$, have been observed by the atomic beam magnetic resonance method. The metastable state is populated in a beam by electron bombardment and detected by Auger ejection of electrons from a Cs surface. The preliminary result of 1342 mc/sec for the zero field splitting agrees with the optical measurements of Bayer-Helms.

554

Columbia U. Columbia Radiation Lab., New York.

HEAVY ABSORPTION BY A DOPPLER-BROADENED SPECTRAL LINE, by R. H. Kohler. [1961] [10]p. (AFOSR-214) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)936], Office of Naval Research and Signal Corps) AD 289481 Unclassified

Closed form expressions for the absorption of light by a gas with a Doppler-broadened resonance are derived for the limiting case of large absorption coefficient in the center of the absorbing line. Calculations are made for a Doppler-broadened source of different temperature and wave number from the absorber. Calculations are made too for a white or continuous source. (Contractor's abstract)

555

Columbia U. Columbia Radiation Lab., New York.

LARGE-APERTURE POLARIZERS AND RETARDATION PLATES FOR USE IN THE FAR ULTRAVIOLET, by M. N. McDermott and R. Novick. [1960] [3]p. incl. diagrs. refs. (AFOSR-579) (AF 49(638)936) Unclassified

Also published in Jour. Opt. Soc. Amer., v. 51: 1008-1010, Sept. 1961.

The ultraviolet properties of films having useful polarizing properties at wavelengths as short as 215 mμ are reported. Large-diam films may be obtained, and the material is not bleached by intense ultraviolet radiation. The use of stretched polyvinyl alcohol and cleaved mica sheets as retardation plates is reviewed. (Contractor's abstract)

556

Columbia U. Columbia Radiation Lab., New York.

SECOND-ORDER HYPERFINE AND ZEEMAN CORRECTIONS FOR AN (sl) CONFIGURATION, by A. Lurio, M. Mandel, and R. Novick. [1961] [25]p. incl. tables, refs. (AFOSR-1796) (AF 49(638)936) Unclassified

Also published in Phys. Rev., v. 126: 1758-1767, June 1, 1962.

The complete Zeeman and hyperfine (dipole, quadrupole and octupole) matrices are given for an (sl) configuration in intermediate coupling. From these are derived the second-order corrections to the zero-field hyperfine intervals for an (sp) configuration. In addition corrections are obtained which are appropriate to the crossing of certain of the hyperfine Zeeman levels of an (sp) $^3P_1$ state for atoms with spin-$\frac{1}{2}$ and spin-3/2 nuclei. (Contractor's abstract)

557

Columbia U. [Columbia Radiation Lab.] New York.

PRECISE MEASUREMENT OF LEVEL CROSSING FIELDS FOR $Cd^{111,113}$ (Abstract), by P. Thaddeus and R. Novick. [1961] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49-(638)936] Office of Naval Research, and Signal Corps) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 74, Feb. 1, 1961.

The crossing point of the (1/2, - 1/2) and (3/2, 3/2) hyperfine levels of the $5s5p\,^3P_1$ state has been determined to lie at 1964.48 ± 0.07 gauss for Cd^{111} and 2054.99 ± 0.07 gauss for Cd^{113}. A linewidth for the crossing of 0.17 gauss, about 3 times that expected from the known lifetime of the $5s5p\,^3P_1$ state, has been obtained by improving the magnetic field homogeneity. Using field modulation and phase sensitive detection of 30 cps, a signal-to-noise ratio of about 50:1 has been attained with a detector time constant of 10 sec.

558

Columbia U. [Columbia Radiation Lab.] New York.

SPIN AND MOMENT DETERMINATION OF Cd^{109} BY OPTICAL DOUBLE RESONANCE (Abstract), by M. N. McDermott and R. Novick. [1961] [1]p. [AF 49(638)-936] Unclassified

Presented at meeting of the Amer. Phys. Soc., Monterey, Calif., Mar. 20-23, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 142, Mar. 20, 1961.

The spin and nuclear moments of Cd^{109} (475d) have been determined by the optical double resonance technique. An isotopically pure sample was prepared by proton bombardment of silver. Radio frequency resonances in the $^3P_1$ state were detected by a change in the polarization of scattered 3261A cadmium resonance radiation. The spin was determined to be I = 5/2 from a study of the low-field Zeeman resonances. The hyperfine structure has been determined by observing the transitions $\Delta F = 0, \Delta m_F = \pm 1$ at magnetic fields sufficiently large to resolve the individual Zeeman lines. The intervals so obtained are f (7/2 ↔ 5/2) = 4204 ± 20 mc/sec and f (5/2 ↔ 3/2) = 2610 ± 35 mc/sec. The hyperfine interaction constants derived from these intervals are A ($^3P_1$) = -1149 ± 6 mc/sec and B ($^3P_1$) = -174 ± 17 mc/sec. An incomplete analysis gives μ_I = -0.829 ± 0.005 nm and Q = +0.80 ± 0.20 barns. The ordering of the hyperfine levels and thus the sign of μ_I was unambiguously determined by utilizing circularly polarized exciting radiation.

559

[Columbia U.] Columbia Radiation Lab., New York.

NUCLEAR SPIN OF Cd^{107} (Abstract), by M. [N.] McDermott and R. Novick. [1961] [1]p. [AF 49(638)-936] Unclassified

Presented at meeting of the Amer. Phys. Soc., Chicago, Ill., Nov. 24-25, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 427, Nov. 24, 1961.

The ground state nuclear spin of Cd^{107} has been determined to be I = 5/2 by an optical double resonance technique. The determination thus far rests on the observation of a single Zeeman resonance in the $5\,^3P_1$ state as well as on the lack of resonances which would be expected for other spins. Difficulties arising from the presence of a large stable cadmium contamination have prevented a second expected resonance from being seen. The identity of the nucleus involved is established by noting the decay of the resonance signal with time. This decay is well fitted by an exponential with a decay constant of 6.7 hr corresponding to the known half-life of Cd^{107}. (Contractor's abstract)

560

Columbia U. Columbia Radiation Lab., New York.

OPTICAL DETECTION OF LEVEL CROSSING IN THE $(5s5p)^3P_1$ STATE OF Cd^{111} AND Cd^{113}, by P. Thaddeus and R. Novick. [1961] [22]p. incl. illus. diagrs. tables, refs. (AFOSR-1695) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)996, Office of Naval Research, and Signal Corps) AD 407808 Unclassified

Also published in Phys. Rev., v. 126: 1774-1780, June 1, 1962.

The magnetic field at which crossing occurs for the $|F, m_F\rangle = |3/2, 3/2\rangle$ and $|\tfrac{1}{2} - \tfrac{1}{2}\rangle$ hyperfine levels of the $(5s5p)\,^3P_1$ state of Cd^{111} and Cd^{113} has been measured to high precision by observing the change in intensity at an angle of 90° of the resonance fluorescence of the 3261 A intercombination line. The measured crossing fields, in units of the nuclear magnetic resonance frequency of protons in mineral oil, are H_c^{111} = 8363.408(30) kc/sec, H_c^{113} = 8748.734(20) kc/sec. Using these results and the known values of the $(5s5p)\,^3P_1$ hyperfine interval for the 2 isotopes, it is found that the Lande g_J factor for this state is $g_J^{111} = 3/2 - 160(9) \times 10^{-6}$, $g_J^{113} = 3/2 - 146(9) \times 10^{-6}$. These results include corrections for second-order interaction with the adjacent fine-structure levels of the 5s5p configuration. (Contractor's abstract)

561

Columbia U. Dept. of Chemistry, New York.

THEORETICAL INTERPRETATION OF CARBON-13 HYPERFINE INTERACTIONS IN ELECTRON SPIN

RESONANCE SPECTRA, by M. Karplus and G. K. Fraenkel. [1961] [12]p. incl. diagrs. tables, refs. (Technical note no. [9]; rept. no. CU-9-61 AF520-Chem) (AFOSR-398) (AF 49(638)520) AD 255802 Unclassified

Also published in Jour. Chem. Phys., v. 35: 1312-1323, Oct. 1961.

A quantitative theory of the isotropic electron-nuclear spin interactions of C-13 in pi-electron radicals is presented and applied to the hyperfine splittings observed in the electron spin resonance spectra of these substances. The theory predicts both the magnitude and sign of the hyperfine splittings and is readily applied to a variety of compounds. For the methyl radical, the measured C-13 splitting is shown to be consistent with a planar model and limits the deviation from planarity to less than or approximately equal to 5 degrees. The theory provides a useful criterion for the validity of approximate wave functions. The sigma-pi interaction parameters are shown to depend on the bond length, the type of hybridization, and on the nature of the bonding atoms. For pi-electron systems, the results demonstrate that the magnitude of the sigma-pi exchange energy is a small fraction of the total energy.

562

Columbia U. Dept. of Chemistry, New York.

CARBON-13 HYPERFINE SPLITTING IN THE ELECTRON SPIN RESONANCE SPECTRA OF SEMIQUINONES AND CYCLOOCTATETRAENE, by H. L. Strauss and G. K. Fraenkel. Apr. 15, 1961, 1v. incl. diagrs. tables, refs. (Technical note no. 8; rept. no. CU-8-61AF520-Chem) (AFOSR-559) (AF 49(638)520) AD 255803 Unclassified

Also published in Jour. Chem. Phys., v. 35: 1738-1750, Nov. 1961.

Measurements were performed on the C-13 hyperfine splitting in the electron spin resonance spectra of a series of methyl- and chloro-substituted semiquinones and of the cyclooctatetraene anion radical. The splittings were observed from C-13 nuclei present in natural abundance (about 1%); the C-13 satellites were distinguished from spurious low-intensity lines arising from side-reaction produced radical impurities by means of careful intensity measurements as well as other techniques. The largest observed C-13 splitting had a magnitude of 1.7 gauss. In the p-benzosemiquinone ion, a previously observed line of low intensity was identified as a splitting arising from C-13 nuclei, and was assigned, on the basis of intensity measurements, to the 4 CH carbon atoms. Splitting constants tentatively identified with the methyl C atoms of the methyl-substituted compounds were in the neighborhood of 1.5 gauss. The splitting in the cyclooctatetraene anion indicates that the 3 sigma bonds attached to a C atom lie in a single plane. (Contractor's abstract)

563

Columbia U. Dept. of Chemistry, New York.

ELECTRON SPIN RESONANCE STUDIES OF ELECTROLYTICALLY REDUCED TETRACYANOETHYLENE DERIVATIVES, by P. H. Rieger, I. Bernal, and G. K. Fraenkel. [1961] [2]p. incl. diagr. (AFOSR-1311) (AF 49(638)520) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 3918-3919, Sept. 20, 1961.

The anion radical of tetracyanoethylene ($TCNE^-$) was the polarographic reduction product of tetracyanoethylene (TCNE), 1,1,2,2-tetracyanocyclopropane (TCNP), and 1,1,2,2-tetracyanoethane dissolved in dimethylformamide (DMF), acetonitrile, or their mixtures. TCNE was reduced spontaneously in pure DMF and had a half-wave potential, -0.2 v, in acetonitrile. The half-wave potential of TCNP was -1.4 and -0.2 v, respectively, in DMF and in acetonitrile. The hyperfine splitting constant of the nitrile carbon in TCNE is $a_2^C = 2.203 \pm 0.01$ gauss.

564

Columbia U. Dept. of Chemistry, New York.

ELECTRON SPIN RESONANCE STUDIES OF THE CYCLOOCTATETRAENYL ANIONS, by H. L. Strauss, T. J. Katz, and G. K. Fraenkel. [1961] [5]p. incl. diagrs. table, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)520] and National Science Foundation) Unclassified

Presented at meeting of the Amer. Phys. Soc., California U., Los Angeles, Dec. 27-29, 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 513, Dec. 27, 1961.

Also published in Jour. Amer. Chem. Soc., v. 85: 2360-2364, Aug. 20, 1963.

The ESR spectrum of the cyclooctatetraenyl radical has been studied in dimethoxyethane and tetrahydrofuran using Li, Na, and K as reducing agents. The spectra are interpreted by assuming varying concentrations of ion pairs which contribute alkali metal hyperfine structure, and radical species which do not. The parameters which characterize the spectrum of the uncomplexed radical are: hydrogen splitting 3.209 ± 0.007 gauss; carbon-13 splitting 1.28 ± 0.03 gauss; $g = 2.0025 \pm 0.0001$; minimum linewidth 0.17 gauss; $T_1 \approx T_2$. The disproportionation constant of the radical is about 5×10^8. This leads to an estimate of about 56 kcal/mol for the compression energy. The relative rates of electron exchange among the anions were found to depend strongly on the alkali metal and the solvent. The conflicting evidence concerning the planarity of the radical is discussed. (Contractor's abstract)

565

Columbia U. Dept. of Chemistry, New York.

THE THEORY OF CARBON-13 SPLITTINGS IN ELECTRON SPIN RESONANCE SPECTRA, by G. K. Fraenkel. [1961] [13]p. incl. diagrs. tables, refs. [AF 49(638)520] Unclassified

Presented at Fifth European Cong. on Molecular Spectroscopy, Amsterdam (The Netherlands), May 29-June 3, 1961.

Published in Pure and Appl. Chem., v. 4: 143-155, 1962.

A valence-bond derivation of the theory of the splittings of C^{13} nuclei in π-electron radicals is given. (Contractor's abstract)

566

Columbia U. Dept. of Chemistry, New York.

SPIN RELAXATION IN OPTICAL PUMPING, by R. A. Bernheim. [1931] [6]p. incl. diagrs. tables, refs. (AFOSR-900) [AF 49(638)785] AD 613788 Unclassified

Also published in Jour. Chem. Phys., v. 36: 135-140, Jan. 1962.

The spin relaxation of optically aligned rubidium vapor has been studied as a function of helium buffer gas pressure. Relaxation times as long as 0.68 sec were observed in helium at ½-atm pressure. The diffusion constant D_0 for rubidium in helium at 50°C was evaluated as 0.54 cm^2 sec^{-1}. The disorientation cross section σ for rubidium-helium collisions was found to be 6.2×10^{-25} cm^2. A mechanism for spin relaxation in optically aligned alkali vapors is proposed and discussed. It is found that the relaxation arises from the coupling of the alkali electron spin to orbital and rotational motion accompanying the collision. The variation of σ for rubidium in the presence of other inert gases is also discussed. (Contractor's abstract)

567

Columbia U. [Dept. of Chemistry] New York.

SPIN RELAXATION OF OPTICALLY ALIGNED RUBIDIUM VAPOR IN HELIUM (Abstract), by R. A. Bernheim. [1961] [1]p. [AF 49(638)785] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 234, Apr. 24, 1961.

The spin relaxation time of rubidium vapor has been measured at 50°C as a function of helium buffer gas pressure. The measurement was performed by interrupting the optical pumping radiation after the method of Franzen. The vapor was contained in an uncoated 300 cc spherical bulb. The analysis of the data yields a value of $0.54 \pm 0.02 \times 10^{-24}$ cm^2 for the disorientation cross section for a collision between an aligned ground state rubidium atom and a helium atom.

568

Columbia U. [Dept. of Chemistry] New York.

EFFECT OF BUFFER GASES ON ATOMIC HYPERFINE FREQUENCIES (Abstract), by G. A. Clarke. [1961] [1]p. [AF 49(638)785] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 248, Apr. 24, 1961.

Recent experiments on the effect of buffer gases (B) on the atomic hyperfine frequencies of the hydrogen isotopes show a dependence of the fractional frequency shift $\Delta\nu/\nu_0$ on the buffer gas and the hydrogen isotope. In principle, the fractional frequency shift, as a function of the internuclear coordinates R, is obtained from the expectation value of the hyperfine Hamiltonian using, in the two body collision approximation, an appropriately antisymmetrized system wave function $\Psi_{H\text{-}B}(r_e;R)$. The quantity of physical interest, the statistically averaged frequency shift, can be computed classically using the intermolecular energies associated with the system wave function. This procedure has been carried out for the H-He system using an approximation to the system wave function, the antisymmetrized product of 1s state orbitals. The calculation results in a fractional frequency shift which is in good agreement with experiment. Corrections to the classical distribution function for this near-classical system have been made in order to ascertain the nature of the mass dependence. For this most favorable system calculation shows that the quantum statistical correction is small (~2%).

569

Columbia U. Dept. of Chemistry, New York.

NUCLEAR QUADRUPOLE INTERACTION IN PURE METALS, by T. P. Das and M. Pomerantz. [1961] [7]p. incl. diagr. tables, refs. [AF 49(638)785] Unclassified

Published in Phys. Rev., v. 123: 2070-2076, Sept. 15, 1961.

Calculations of the ionic part of the electric field gradient at the nuclei of certain metals are combined with available experimental data to obtain information about the electronic structures of the metals, or estimates of nuclear quadrupole moments. The metals considered are Be, Sc, Re, La, Mg, Co, An,

and Cd, which have the hexagonal close-packed structure, and indium, which has centered tetragonal structure. Some comparison is made with other information about the shapes of the Fermi surfaces and a pertinent experiment on Zn is suggested. (Contractor's abstract)

570

Columbia U. Dept. of Chemistry, New York.

EFFECTS OF HELIUM BUFFER GAS ATOMS ON THE ATOMIC HYDROGEN HYPERFINE FREQUENCY, by G. A. Clarke. [1961] [6]p. incl. tables, refs. (AFOSR-J653) (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-62-228] and Atomic Energy Commission) AD 415396
Unclassified

Also published in Jour. Chem. Phys., v. 36: 2211-2216, Apr. 15, 1962.

Calculations are made for the pressure, mass, and temperature dependence of the atomic hydrogen hyperfine frequency shift arising from the perturbing influence of He buffer gas atoms. The calculated fractional pressure shift is found to be $+1.73 \times 10^{-9}$ mm Hg^{-1} compared with the experimental value of $+3.7 \times 10^{-9}$ mm Hg^{-1}. This discrepancy may be related to a failure of the simple wave function employed to adequately characterize the unpaired electron spin density at the hydrogen nucleus. The results of the calculations for the temperature variation and mass dependence indicate that these are very small effects. The form of the mass dependent quantum statistical correction used to elucidate the mass effect, suggests that the relatively large variations experimentally observed with other buffer gases, due to hydrogen isotope variation, are in error. Finally, a calculation is made for the pressure shift from a kinetic theory point of view and the result obtained ($+1.79 \times 10^{-9}$ mm Hg^{-1}) is in fair agreement with the above mentioned quantum statistical calculation. (Contractor's abstract)

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Columbia U. [Dept. of Mathematics] New York.

FAMILIES OF PRINCIPAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS, by E. W. Chamberlain. [1961] [12]p. (AF 49(638)644)
Unclassified

Published in Trans. Amer. Math. Soc., v. 107: 261-272, May 1962.

In the present paper the author shows that if the factorization sequence $W_1, W_2, \ldots W_l$ satisfies the additional condition that $W_i \sim W_j$ implies $i = j$, then a second factorization sequence $(V_1, V_2, \ldots, V_n)$ with $V_i \sim W_i$ can be found such that the associated approximate factorization is an exact factorization; this exact factorization is used to show that for a broad class of asymptotically (=weakly) quasi-linear equations with linear part Ly, the totality of principal solutions includes a u-parameter family, where u is the number of strictly negative f_i.

572

Columbia U. Dept. of Mathematics, New York.

ON THE ALGEBRAIC CLOSURE OF CERTAIN PARTIALLY ORDERED FIELDS, by W. Strodt. [1961] [22]p. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)644 and National Science Foundation under G12984) Unclassified

Presented at meeting of the Amer. Math. Soc., June 3, 1961.

Published in Trans. Amer. Math. Soc., v. 105: 229-250, 1962.

The main theorem states the following: If (a) ζ_0 (a subfield) is algebraically closed, and (b) whenever an asymptotically inscribed polynomial F and a point p of instability of multiplicity 1 is given, then F has a root $y \sim p$; then (c) every asymptotically inscribed polynomial of degree n has n roots in A_0. Further, (c) implies (a) and (b). These ideas and results are applied to meromorphic functions in the finite complex plane. Various explicit choices of U (a divisible totally ordered subgroup of a field K) are given, e.g., U is chosen such that M (where M equals C_0 U) is the set of all logarithmic monomials. Application is made to the theory of algebraic differential equations.

573

Columbia U. [Dept. of Physics] New York.

A FIVE-PORT MATCHED PSEUDO-MAGIC TEE, by A. Okaya. [1960] [4]p. incl. illus. diagrs. table. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)631], Office of Naval Research, and Signal Corps) Unclassified

Published in I. R. E. Trans. on Microwave Theory and Tech., v. MTT-9: 216-219, May 1961.

The 5-port matched pseudo-magic tee consists of an input waveguide, 2 load arm waveguides which are coupled into the input waveguide with +90° and -90° phase shifts, respectively, and an output waveguide which is split into 2 load waveguides by a septum. The improvements include a much broader matching and isolation bandwidth, higher isolation between arms, and a variety of modifications for different applications. These characteristics have been obtained by employing frequency-insensitive phase shifters, hence, frequency coverage is mainly limited by mechanical asymmetry and the characteristics of the directional coupler in the magic tee. While this type of hybrid junction is not a true magic tee because

the load arms are not used as the input arm, it does have several applications which an ordinary magic tee does not have. X-, K-, and M-band models were examined experimentally, and highly sensitive and accurate impedance measurements were made. (Contractor's abstract)

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Columbia U. Dept. of Physics, New York.

A CW SOLID STATE, PUSH-PULL MASER IN THE 5- TO 6-MILLIMETER WAVELENGTH REGION, by D. L. Carter. [1961] [10]p. incl. diagr. refs. (AFOSR-621) (AF 49(638)631) AD 255417 Unclassified

Also published in Jour. Appl. Phys., v. 32: 2541-2542, Dec. 1961.

CW maser oscillation and amplification from 49-57 kmc/sec was achieved with 0.12% Fe^{3+}-doped rutile, using push-pull pumping at 78.2 kmc/sec. A short experiment on cross-relaxation effects was also carried out. (Contractor's abstract)

575

Columbia U. [Dept. of Physics] New York.

ELECTRIC DIPOLE MOMENT OF OH RADICAL (Abstract), by G. Ehrenstein. [1961] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)631], Office of Naval Research, and Signal Corps)

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 20, Feb. 1, 1961.

The two A-doubling transitions for the J = 1/2 rotational state of the $^2\pi_{3/2}$ electronic state of OH radical was observed using a microwave spectrometer with sine wave Stark modulation. The absorption cell used in the experiment was glass-lined in order to protect the radicals from the metal walls of the waveguide and the Stark septum. The obtained spectrum showed unresolved Stark components and a preliminary dipole moment of 2.1 ± 0.4 debyes.

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Columbia U. [Dept. of Physics] New York.

A NEW METHOD OF MEASUREMENT OF DIELECTRIC CONSTANT AND LOSS TANGENT AT MICROWAVE RANGE (Abstract), by A. Okaya and L. F. Barash. [1961] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)631], Office of Naval Research, and Signal Corps) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 235, Apr. 24, 1961.

A piece of dielectric material acts as a microwave resonator due to large reflection at the surface, if ϵ is 10 or more and the loss tangent is 0.01 or less. TiO_2 (Rutile) and some other crystals have shown good resonance characteristics in centimeter- and millimeter-wave-range. The detailed interpretation of dielectric resonator characteristics will be discussed. The temperature frequency dependence of ϵ and tan δ, and the accurate measurement of an anisotropic ϵ will be presented.

577

Columbia U. Dept. of Physics, New York.

THE TEFLON WAVEGUIDE PLUNGER, by A. Okaya. [1961] [1]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)-631], Office of Naval Research, and Signal Corps) Unclassified

Published in Proc. Inst. Radio Engineers, v. 49: 1083, June 1961.

Diagrams for teflon waveguide plunger are illustrated. Carefully made teflon plungers have been found to be as good electrically as metal plungers having spring fingers or chokes on the tips, and mechanically they are very much superior to the metal plungers.

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Columbia U. [Dept. of Physics] New York.

OPERATION OF A CW PUSH-PULL SOLID-STATE MASER FROM 48 TO 56 KMC/SEC (Abstract), by D. L. Carter. [1961] [1]p. [AF 49(638)631] Unclassified

Presented at Second Internat'l. Conf. on Quantum Electronics, Berkeley, Calif., Mar. 23-25, 1961.

Published in Advances in Quantum Electronics, New York, Columbia U. Press, 1961, p. 426.

Operation of an Fe^{3+}-doped rutile maser with a pump frequency of 78.2 kmc/sec and signal frequencies ranging from 48 to 56 kmc/sec has been achieved. The push-pull operation utilizes the upper 4 of 6 levels at a magnetic field orientation of 73° from the [110] direction in the [001] plane of the crystal. At this orientation the pump levels maintain equal splittings for a large range of magnetic field strengths. The crystals were doped with 0.18% Fe to TiO_2 by weight. The pumping radiation was supplied by a Raytheon QKK866 reflex klystron and delivered approx 50 mw to the maser crystal. The doped rutile served as its own multimode dielectric resonator. Both oscillation and amplification over the stated

frequency range was achieved by varying the magnetic field strength from 7000 to 5400 gauss without any change in pump frequency or crystal orientation. Preliminary root gain bandwidth measurements yielded typical values of 30 to 40 mc/sec throughout the band. It is believed that further adjustment of pump frequency and crystal orientation will permit a slight extension in the range of signal frequencies.

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Columbia U. [Dept. of Physics] New York.

REACTION $\mu + N \rightarrow e + N'$: INTERMEDIATE BOSON THEORY, by F. J. Ernst. [1960] [3]p. incl. diagrs. table. [AF AFOSR-60-19] Unclassified

Published in Phys. Rev. Ltrs., v. 5: 478-480, Nov. 15, 1960.

The branching ratio of $\mu + N \rightarrow e + N'$ is calculated on the basis of a μ-e-γ interaction mediated by an intermediate boson. Values are calculated for various cutoff momenta and boson masses. Taking the absence of the real process $\mu \rightarrow e + \gamma$ into account, a branching ratio of order 10^{-6} is found.

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Columbia U. Dept. of Sociology, New York.

ANTICIPATED ALIGNMENTS OF NATIONS IN THE COLD WAR, by J. N. Nehnevajsa. Jan. 20, 1961, 45p. incl. tables. (AFOSR-92) (AF 49(638)743) AD 251732 Unclassified

Propensities on the part of nations to shift from one major ideological posture into another are analyzed. Specifically, some nations might become Communistic in the future either by force or voluntarily. Communist nations may accept democratic governmental models; or they may adapt Communism to their nationalistic strivings; or there may be anti-Communist rebellions. Brazilian and Finnish respondents were interviewed about general likelihood of these outcomes; about their desirability; about the likelihood and desirability of such changes in the United States and their own country on one hand, and in the Soviet Union and China on the other hand. The subjects were then provided with alternative lists of nations to state which ones of the countries cited might change in any one of the ways considered. The findings are presented and discussed. (Contractor's abstract)

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Columbia U. [Dept. of Sociology] New York.

SOME POSSIBLE APPLICATIONS OF PROJECT "OUTCOMES" RESEARCH METHODOLOGY, by A. S. Frances. Mar. 31, 1961, 25p. incl. refs. (AFOSR-444) (AF 49(638)743) AD 256332 Unclassified

Section I, refers to the possibility of using the theory and methodology of Project Outcomes to problems of strategic information. It is felt that once the methods of this Project have been satisfactorily developed, they might be standardized and operationalized for the use of the agencies concerned with gathering strategic information. Section II covers possible applications of this Project to problems of intelligence, evaluation and control of specific foreign operations as related to logistic and tactical problems. Section III discusses possible development of our methodology for the purposes of assessing present and future organizational effectiveness. Section IV refers to the applications that the study may have for problems of personnel selection, training and evaluation. Specifically, it is possible that the inclusion of ex-ante data in the standard procedures currently in use for personnel selection, training and evaluation, might lead to substantive improvements in predictive power and reliability. (Contractor's abstract)

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Columbia U. Dept. of Sociology, New York.

COMPARATIVE STUDY OF PERSONAL AND PERCEIVED NATIONAL IDEOLOGIES, by C. W. Wheatley. May 5, 1961, 32p. incl. diagrs. tables. (AFOSR-575) (AF 49(638)743) AD 259195 Unclassified

This report is concerned with the problem of how citizens of contemporary societies relate to their countrymen, to their nation, and to other nations in ideological terms. The survey was attempted by requesting that each Finnish and Brazilian legislator and student in the sample designate which from a list future outcomes would be most, next most, least, and next least desired by specific referent nations. The respondent was requested to rate these outcomes for their personal desirability. From these data, indices of ideological orientation were obtained for each respondent group with respect to each nation. Such indices might take values between minus and plus twelve. Subjects were then characterized as being either in agreement or disagreement with their national ideology. The resulting empirical distributions were found to correlate with other central variables of this study, as specified in the body of this report. The approach represented is viewed as an initial step in assessing the ideological constitution of particular nations and their citizenry on a replicable basis.

583

Columbia U. [Electronics Research Lab.] New York.

RESEARCH ON SAMPLED DATA FEEDBACK CONTROL SYSTEMS, by G. M. Kranc. Final rept. May 1, 1961 [42]p. (Rept. no. CU-66-61AF677-EE) (AFOSR-666) (AF 18(600)677) AD 257403 Unclassified

Research is presented in the field of control systems; particularly in the field of sampled data systems. Investigations demonstrated the feasibility and

superiority of the Z-transform methods for linear sampled data systems. The Z-transformation was recognized as the effective tool for the analysis and synthesis of the linear sampled systems. A radically new concept in sampled-data compensation techniques was developed. The work on various synthesis problems yielded new analytical techniques utilizing Z-transforms as the main tool of the investigations. A particularly novel approach to the design of sampled systems was also developed. A sampled data processing unit was constructed based on analog multiplication and digital storage. Work was also carried out in the field of continuous systems. (Contractor's abstract)

584

Columbia U. [Electronics Research Labs.] New York.

OPTIMAL CONTROL METHODS FOR ON-OFF SAMPLING SYSTEMS, by W. L. Nelson. [1961] [2]p. incl. refs. (AF 18(600)677) Unclassified

Published in Proc. Joint Automatic Control Conf., Colorado U., Boulder (June 28-30, 1961), New York, Lewis Winner, 1961, p. 41, 53.

This paper considers the problem of achieving optimal or near-optimal on-off control of sampling systems in the sense of minimum time to reach the desired equilibrium state from any initial state. The approach used is to imbed the optimal control problem in the broader problem of determining the inherent capability of a given class of control inputs to drive the plant to the desired state in a given number of steps (sampling periods). The class of systems considered is described by the vector differential equation: $\dot{x} = Ax + b\mu(t)$ where x, the state of the plant, is an n-vector having elements or conditions, x_i in the n-dimensional state space x; A is an nxn matrix with constant elements a_{ij}; b is an n-vector with constant elements, b_i and $\mu(t)$ is the control input to the plant. The optimal control problem is therefore 1 of selecting the control input $\mu(t)$, within the prescribed class of control inputs, which takes the plant from an arbitrary initial state, x (0), into the origin in the minimum possible time.

585

Columbia U. Electronics Research Labs., Ithaca, N. Y.

REPORT ON THE WORKING GROUP ON HARD POINT DEFENSE: FEASIBILITY OF AN INTERIM SYSTEM (Unclassified title), by S. Rabinowitz. Dec. 29, 1961, 43p. (AFOSR-2055) (AF 49(638)1113) AD 350485 Secret

586

Columbia U. Inst. of Air Flight Structures, New York.

VIBRATIONS OF INFINITELY LONG CYLINDRICAL SHELLS UNDER INITIAL STRESS, by A. E. Armenakas and G. Herrmann. Oct. 1961, 29p. incl. illus. table. (Technical note no. 6; rept. no. CU-17-61AF430-CE) (AFOSR-1150) (AF 49(638)430) AD 265846 Unclassified

The bending theory of shells under the influence of initial stress is applied in this investigation to study the effect of initial uniform circumferential stress, uniform bending moment and uniform radial shear on the dynamic response of an infinitely long (motion is independent of the axial coordinate) elastic circular cylindrical shell. (Contractor's abstract)

587

Columbia U. [School of Engineering] New York.

DEFORMATION AND FRACTURE OF CADMIUM AND CADMIUM-MAGNESIUM ALLOYS, by N. S. Stoloff. Apr. 1961, 123p. incl. illus. diagrs. tables, refs. (AFOSR-593) (AF 49(638)408) AD 257735 Unclassified

An attempt was made to determine the mechanisms of deformation and fracture in polycrystalline Cd, to correlate these mechanisms with pertinent aspects of single crystal behavior, and to determine whether the slip systems and mode of fracture of polycrystalline Cd could be altered by reduction of the axial ratio (1.886) by alloying. Tests on polycrystalline Cd and Cd-Mg alloys indicated that the yield stress, flow stresses for arbitrary small strains, and the average coefficient of work hardening were relatively insensitive to temperature from room temperature to 4.2°K. The tensile strength of Cd was strongly temperature dependent but relatively independent of grain size between room temperature and -175°C; below -175°C it was dependent on grain size, but not on temperature. Cd had a ductile to quasi-brittle transition at about -155°C which did not depend on grain size or purity. The minimum ductility, about 15% reduction in area, was reached near -196° and persisted at -269°C.

588

Columbia U. [School of Engineering] New York.

PYRAMIDAL SLIP IN CADMIUM CRYSTALS, by N. S. Stoloff and M. Gensamer. [1961] [6]p. incl. illus. tables, refs. (AFOSR-3361) (AF 49(638)408) Unclassified

Also published in Trans. Metall. Soc. AIME, v. 224: 732-737, Aug. 1962.

Pyramidal [11$\bar{2}$2] slip was observed in cadmium single crystals deformed in compression and bending at room temperature and -196°C. Crystals tested in tension twinned with no evidence of pyramidal slip. A critical resolved shear stress law for the propagation of twin nuclei appears probable. Twinning and low-stress kinking are believed to inhibit the appearance of pyramidal slip under ordinary experimental conditions. (Contractor's abstract)

589

Communication Research Inst., Miami, Fla.

VOCAL EXCHANGES BETWEEN DOLPHINS: BOTTLENOSE DOLPHINS "TALK" TO EACH OTHER WITH WHISTLES, CLICKS, AND A VARIETY OF OTHER NOISES, by J. C. Lilly and A. M. Miller. [1961] [4]p. incl. diagrs. table. (AFOSR-2296) (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-61-62], Coyle Foundation, Department of Defense, National Institute of Mental Health, National Institute of Neurological Diseases and Blindness, and Office of Naval Research) Unclassified

Also published in Science, v. 134: 1873-1876, Dec. 8, 1961.

Observations of the vocal exchanges of bottlenose dolphins under various conditions are presented. Experimental conditions under which isolated emissions from each animal of a pair are separately recorded and in which the distance between the rostrum and the hydrophone is controlled are described. The exchanges consist of vocal alternations (A, then B, then A, and so on), "duets" (A plus B simultaneously), and long "solos" or "monologs." The emissions exchanged are: (1) whistles alone; (2) slow click trains alone; (3) simultaneous whistles and clicks from either or both animals; and (4) squawks, quacks, blats, and so on, alone or simultaneously with whistles. Any or all of these sounds may occur in a given period. The significant carriers of meaning are to be determined. (Suggestions include various functions of relative amplitudes, absolute and relative frequency, frequency modulations, phase-shift variations, and durations of whistle emissions.) Average and peak amplitudes (at the rostrum) of each class of sound cover at least a 100-decibel range (controlled by the dolphin). (Contractor's abstract)

590

Communication Research Inst., Miami, Fla.

SOUNDS EMITTED BY THE BOTTLENOSE DOLPHIN, by J. C. Lilly and A. M. Miller. [1961] [5]p. incl. diagrs. (AFOSR-2516) (Sponsored jointly by [Air Force Office of Scientific Research under AF AFOSR-61-62] and Office of Naval Research) Unclassified

Also published in Science, v. 133: 1689-1693, May 26, 1961.

The sonic emissions of the bottlenose dolphin are discussed. Three classes of these sounds are presented: (1) sine-wave type whistles; (2) slow trains of clicks (buzzings); and (3) a class of complex waves emitted in bursts (quacks, squawks, blats). The sine-type wave whistles range in frequency from approx 4000 - 18,000 c/sec. The clicks contain components of this same frequency range plus some components of higher frequencies. Complex waves of high amplitude and of many frequencies are also emitted in water or in air. Situations in which sounds of one or more of these classes can be elicited simultaneously from 1 and from 2 restrained animals are described.

591

Compagnie de Recherches et d'Etudes Aeronautiques, Paris (France).

CONTROL OF CIRCULATION AROUND A CYLINDER, by J. Brocard. Technical final rept. Feb. 1-Nov. 30, 1961. Dec. 20, 1961, 1v. incl. illus. diagrs. tables. (AFOSR-2110) (AF 61(052)501) AD 272010 Unclassified

Research conducted on the control of circulation around a circular cylinder by means of a combination of suction and blowing of the boundary layer conveniently distributed around the cylinder, is reported. A new blowing technique has been developed which consists in using a skinning made of expanded metal, instead of using conventional slots. The method, which has proved superior to blowing with conventional slots, is described.

592

Connecticut U. [Dept. of Mathematics] Storrs.

ON TRANSLATION CONTINUITY AND TRIGONOMETRIC POLYNOMIALS, by R. P. Gosselin. Mar. 1961, 27p. incl. refs. (AFOSR-390) (AF 49(638)608) AD 253375 Unclassified

The notion of translation continuity is introduced, and it is shown that if a certain integral involving the first difference of a function is finite, then the function is translation continuous almost everywhere. With the hypothesis of translation continuity, convergence theorems for sequences of trigonometric polynomials are proved. With the hypothesis of the finiteness of some integrals, further convergence theorems are proved. (Contractor's abstract)

592A

Connecticut U. [Dept. of Mathematics] Storrs.

SOME INTEGRAL INEQUALITIES by R. P. Gosselin. [1961] [7]p. (AFOSR-3611) (AF 49(638)608) AD 428413 Unclassified

Also published in Proc. Amer. Math. Soc., v. 13: 378-384, June 1962.

The purpose of this paper is to present a general integral inequality concerning subadditive functions and to make applications of this inequality. The applications pertain to relations among integrals involving first and second differences of L^p functions. The finiteness of some of the integrals is connected with generalized Lipschitz conditions and with the existence of fractional derivatives. These facts are exploited to obtain new and known theorems. Finally it is shown that in some cases the finiteness of the integral is not affected by interchanging the first and second differences of the function.

593

Cook Research Labs., Skokie, Ill.

DYNAMICS OF SEPARATING BODIES. VOLUME II. MEASUREMENTS AT MACH 2, 4, AND [illegible] by H. L. Wackelin and R. O. Fredette. Mar. 1961, 69p. incl. diagrs. tables. (AFOSR-106) (AF 29(600)1711)
AD 257734 Unclassified

Wind tunnel tests were conducted on a data capsule shape in the interference field of a carrier vehicle model at Mach numbers of 4.0 and 5.0 with limited data at Mach 2. The data obtained were analyzed and a preliminary evaluation made as to the agreement with methods of prediction. It is shown that in areas where the flow field is known, estimated values of the derivatives obtained with relatively simple calculation techniques agree reasonably well with the data. A discussion of the direct application of these data to capsule separation analyses is presented.

593A

Cook Research Labs., Skokie, Ill.

DYNAMICS OF SEPARATING BODIES. VOLUME I. THEORETICAL ANALYSIS, by A. H. Solarski, R. Turner, and F. Doerr. Mar. 1961, 161p. incl. diagrs. tables, refs. (AFOSR-109) (AF 29(600)1711)
AD 271998 Unclassified

The theoretical foundations of a detailed study of the dynamics of separating bodies at supersonic speeds are established. Carrier vehicle flow field characteristics are investigated to define the environment into which the ejected bodies are projected. The aerodynamic properties of representative capsule configurations in locally varying flows are documented, and the equations of motion pertinent to the several modes and techniques of ejection and separation are stated. Trajectory computations based upon a realistic summary of the problem inputs are discussed, and the relative importance of the operational parameters assessed. Separation system requirements are compared for the several ejection modes and capsule configurations considered. Particular emphasis is given to the section describing the wake structure behind a body representative of a carrier vehicle traveling at supersonic speeds. (Contractor's abstract)

594

Copenhagen U. [Dept. of Chemistry] (Denmark).

THE DETERMINATION OF THE STRUCTURE OF ALPHA- AND BETA-FLUORONAPHTHALENES AND OTHER SELECTED MOLECULES BY INFRARED AND MICROWAVE TECHNIQUES, by B. Bak. Final rept. Sept. 1, 1958-Apr. 30, 1961. May 25, 1961 [36]p. incl. tables, refs. (AFOSR-1035) (AF 61(052)73)
AD 262113 Unclassified

Summaries are presented of research performed in the following areas: (1) attempted analysis of α- and β-fluoronaphthalene microwave spectra; (2) determination of the structures of thiophene and ethyl fluoride; (3) microwave analysis of 5 isotropic benzonitriles; (4) preparation of 15-N and 13-C enriched benzonitrile and 13-C furans; (5) microwave analysis of α 13-C enriched furan; and (6) molecular structure correlations. Publications resulting from the research are listed.

595

Copenhagen U. [Dept. of Chemistry] Denmark.

ANALYSIS OF THE MICROWAVE SPECTRUM OF 2-FLUORONAPHTHALENE WITH A DISCUSSION OF STRUCTURE DETERMINATION POSSIBILITIES, by B. Bak, D. Christensen and others. [1961] [10]p. incl. tables. (AFOSR-1244) (AF 61(052)73)
Unclassified

Also published in Spectrochim. Acta, v. 18: 229-233, Feb. 1962.

The microwave spectrum of gaseous 2-fluoronaphthalene has been recorded in the 12,800-20,800 mc/s region and successfully analyzed, the final analysis accounting very precisely for 21 observed lines. The rotational constants are: A = 2864 ± 1; B = 808.18 ± 0.01; C = 629.49 ± 0.01 mc/s. For structure determination purposes in which changes of rotational constants on isotopic substitution are decisive, A, B and C may be fixed more sharply according to procedures indicated. An estimate of the accuracy, with which the position of each of the 7 hydrogen atoms and 10 carbon atoms may be found by means of the method of isotopic substitution, is given.

596

Copenhagen U. [Dept. of Chemistry] (Denmark).

PREPARATION OF BENZONITRILE, ISOTOPICALLY LABELLED IN THE CYANIDE GROUP, by B. Bak, J. T. Nielsen, and L. Lipschitz. [1961] [1]p. (AFOSR-3807) [AF 61(052)73] Unclassified

Also published in Acta Chem. Scand., v. 15: 949, 1961.

As a pre-requisite for the study of infrared and microwave spectra of benzonitrile, species isotopically labelled in the cyanide group were prepared. The procedure of Murray and Williams (Organic Syntheses with Isotopes I, New York, Interscience Publishers, 1958) gave 41% $PhC^{13}N$. The procedure of Swan and Kelly (Jour. Chem. Soc., 1954: 416-417) gave 58% $PhCN^{15}$.

597

Copenhagen U. [Dept. of Chemistry] (Denmark).

SYNTHESIS OF ALPHA- AND BETA CARBON ISOTOPICALLY LABELLED FURAN, by B. Bak, J. T. Nielsen, and M. Schottländer. [1961] [4]p. (AFOSR-3809) (AF 61(052)73) Unclassified

Also published in Acta Chem. Scand., v. 16: 123-126, 1962.

The preparation of 200 mg quantities of 22% enriched [α-^{13}C] furan and [β-^{13}C] furan from enriched K^{13}CN is described. The over-all yields are, respectively, 11 and 8% with respect to K^{13}CN. The first synthesis involves 6 steps, the second 17 steps. The purity, as controlled by the infrared gas-spectrum, was highly satisfactory. (Contractor's abstract)

598

Copenhagen U. [Dept. of Chemistry] (Denmark).

MICROWAVE DISCHARGE PRODUCTION OF HYDROGEN ATOMS. CONTROL OF HYDROGEN ATOM QUANTITY PRODUCED, by B. Bak and J. Rastrup-Andersen. [1961] [6]p. incl. diagrs. table. [AF 61-(052)73] Unclassified

Published in Acta Chem. Scand., v. 16: 111-116, 1962.

Production of hydrogen (and deuterium) atoms by a microwave discharge is described. Three different methods of estimating the quantity of atoms produced have been tested. A hotwire detector, a thermometric detector, and a chemical, luminescent detector. Application of each of the 3 types of indicator is useful in various phases of experimental work. (Contractor's abstract)

599

Cork U. Coll. (Ireland).

ON THE ARGUMENT OF THE DERIVATIVE OF A UNIVALENT FUNCTION, by P. J. Donohoe and P. B. Kennedy. Mar. 20, 1961, 8p. (Technical scientific note no. 1) (AFOSR-269) (AF 61(052)263) AD 264867 Unclassified

By consideration of an example due to Littlewood (Quart. Jour. Math., v. 9: 14-20, 1938) it is shown that, for functions f(z) regular and univalent in $z < 1$, the known estimate $V(r,f) = \int_0^{2\pi} |d_\theta \arg f'(re^{i\theta})| = 0(1)/(1 - r)$ (as $r \to 1$) is best-possible in the sense that $V(r,f) > A/(1 - r)$ for some function f of the class under consideration, some constant $A > 0$ and all sufficiently small $1 - r > 0$. This is an improvement on a result due to Flett (Quart. Jour. Math., v. 6: 59-72, 1955). (Contractor's abstract)

600

Cork U. Coll. (Ireland).

GROWTH AND COEFFICIENT PROPERTIES OF MULTIVALENT FUNCTIONS, by P. B. Kennedy. Final technical rept. Sept. 25, 1961 [5]p. (AFOSR-1333) (AF 61(052)263) AD 272312 Unclassified

Statement of the main problem is investigated (multivalent functions with sequence of zero coefficients). Size of circumferential variation of arg f', where f is univalent in the unit circle is described. (Contractor's abstract)

601

Cork U. Coll. (Ireland).

A SURVEY OF SOME NUMERICAL WEATHER PREDICTION METHODS, by G. V. Kelly. Dec. 1961, 32p. incl. tables. (Technical note no. 13) (AFOSR-2688) (AF EOAR-61-4) AD 289477 Unclassified

A report is made of numerical weather prediction techniques which consist in solving the thermo- and hydro-dynamical equations of motion of the atmosphere. Most of the experimentation has been performed on quasi-geostrophic models. Appropriate expressions for gradient, divergence, and vorticity are obtained for a co-ordinate system in which pressure is used as the vertical co-ordinate. The equation of continuity is developed and the vorticity equation, which is the basis of numerical prediction techniques, is derived from the horizontal equation of motion. The geostrophic wind vector is introduced and the relation between geostrophic vorticity and the change of height of an isobaric surface is demonstrated. Two simultaneous partial differential equations in which the unknowns are the vertical velocity and the local change of height of the surface are derived, and it is shown how these equations may be solved by the relaxation technique to give estimates of the future values of the unknowns. Particular atmospheric models are presented in detail.

602

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

KINETIC STUDIES IN A SINGLE-PULSE SHOCK TUBE, by A. Hertzberg and H. S. Glick. [1961] [22]p. incl. illus. diagrs. refs. (AF 18(600)1332) Unclassified

Published in Fundamental Data Obtained from Shock-Tube Experiments, ed. by A. Ferri. London, Pergamon Press, 1961, p. 161-182. (NATO AGARDograph no. 41)

The single-pulse shock tube method is reviewed, using studies that have been performed on nitric oxide formation and aliphatic hydrocarbon decomposition as illustrative examples. The aim of the single-pulse method is to raise the temperature and pressure of a reactant gas sample very quickly to known values, allow the gas to react for a time of the order of msec, and then cool the gas sample rapidly so as to "freeze" the composition of the reactant gas that existed just prior to the initiation of cooling. The kinetic measurements carried out thus far have demonstrated the technique to be flexible and capable of producing reliable data. The density-controlled freezing capability of the method offers the possibility of creating large

concentrations of free radicals by the high temperature and short duration phase of the temperature pulse, and then capturing a large fraction of these reactive species by reducing the density of the reaction mixture rapidly.

603

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

THE CAL PRESSURE WAVE CHEMICAL REACTOR, by A. Hertzberg, W. Squire and H. S. Glick. Jan. 1956 [27]p. incl. illus. diagrs. refs. (Rept. no. AD-1052-A-13) (AFOSR-64-2530) (AF 18(603)10)
AD 611139 Unclassified

A novel type of chemical reactor which utilizes strong pressure waves to heat and cool gases rapidly and uniformly is proposed. Its principal advantages over existing devices are claimed to be: (1) extremely rapid rates of heating and cooling reacting gases, (2) very precise control over reaction parameters, (3) effective reaction temperatures far above maximum wall temperatures, (4) a continuous flow system with a rate of chemical production competitive with other units of comparable size, and (5) low energy consumption per unit mass of product as compared with other reactors using similar chemistry. On the basis of a preliminary survey of reactions to which such a reactor might be applied, a detailed analysis was made of its application to the fixation of atmospheric nitrogen. Calculations of the mass handling capacity, net energy requirement, size of auxiliary equipment, etc., for an industrial wave reactor were carried out. The calculated yields and energy requirements compared favorably with other processes.

604

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

RADIATION AT HYPERSONIC SPEEDS, by C. E. Treanor. [1961] [26]p. incl. diagrs. table, refs. [AF 18(603)141] Unclassified

Presented at ARS Internat'l. Hypersonic Conf., Cambridge, Mass., Aug. 16-18, 1961.

Also published in Prog. in Astronaut. and Rocketry, v. 7: 255-280, 1962.

The optical radiation from the heated air which enveiopes a high speed vehicle is of interest in many different problems related to re-entry vehicles. In this report, the data available for the radiation from equilibrated high temperature air are reviewed. The results available are presented in graphical form, showing the absorption coefficient for each radiating species as a function of temperature and wavelength. The temperature range considered is from ~3000K to ~8000K, the wavelength range from ~0.2 to 1.5 μ. Seven molecular band systems are considered. For 2 of these ($NO\nu$ and O_2S-R) there is good agreement among the various experimental results. For 4 bands ($N_2(1+)$, $N_2^+(1-)$, NO_β and NO_2 continuum) there is substantial disagreement. For the other molecular band system ($N_2(2+)$, and for the oxygen free-bound and free-free radiation, there is only a single source of data. (Contractor's abstract)

605

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

TRANSITION PROBABILITIES FOR NITRIC OXIDE IN THE FAR ULTRAVIOLET, by J. W. Daiber and M. J. Williams. [1960] [8]p. incl. illus. diagr. tables, refs. [AF 49(638)269] Unclassified

Published in Jour. Quant. Spectros. and Radiative Transfer, v. 1: 135-142, Nov. 1961.

For abstract see item no. 552, Vol. IV.

606

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

EXACT SOLUTION FOR NONEQUILIBRIUM EXPANSIONS OF AIR COUPLED REACTIONS, by A. Q. Eschenroeder, D. W. Boyer, and J. G. Hall. May 1961, 21p. incl. diagrs. tables, refs. (Rept. no. AF-1413-A-1) (AFOSR-622) (AF 49(638)792)
AD 257396 Unclassified

Results of numerical integrations of the coupled chemical rate equations and gasdynamic equations are presented for nozzle airflows. Composition histories are shown for a kinetic mechanism including 6 species and 14 reactions. The freezing process is complex because the N-O shuffle reactions couple the dissociation-recombination reactions. In many cases where the energy in N dissociation is significant, the fast shuffle reactions prevent N atom freezing which would otherwise occur if 3 body recombination were the only process operating. Nitric oxide concentrations undershoot the equilibrium values in many cases. Oxygen freezing is affected little by the shuffle reactions. Results suggest the applicability of simplified chemical kinetic models based on the shuffle reactions for airflows in various regimes of the initial state. (Contractor's abstract)

607

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

INVESTIGATION OF ROCKET FLOW PROBLEMS BY MEANS OF SHORT DURATION FLOW DEVICES, by R. C. Weatherston and A. Hertzberg. [1961] [3]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)792 and Goddard Space Flight Center (NASA) under NAS 5-670) Unclassified

Published in ARS Jour., v. 31: 1149-1151, Aug. 1961.

The purpose of this report is to discuss short duration flow devices and the techniques employed to

investigate the problems associated with nonequilibrium nozzle flow, heat transfer, and rocket base heating. Schematic illustrations of pre- and post-combustion short duration flow devices are presented.

608

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

DEVELOPMENT OF A SHOCK-TUBE DRIVEN MOLECULAR BEAM, by G. T. Skinner. Oct. 1961 [64]p. incl. diagrs. (Rept. no. RM-1396-A-1) (AFOSR-166) (AF 49(638)793) AD 266365 Unclassified

The preliminary development of a high intensity molecular beam, in which a small tailored-interface hypersonic shock-tunnel is used as the gas source, is reported. The aim is to extend molecular beam techniques into the 1-10 ev per particle range by utilizing the capability of the shock tube to generate high temperatures. A 0.7 ev nitrogen beam was produced in the pilot apparatus. The intensity of 2.5×10^{18} molecules 1/sq cm/sec and the spreading angle of 6° agree with a theoretical analysis which takes into account attenuation caused by scattered molecules which have been thermally accommodated at the walls of the apparatus. A modified Kantrowitz-Grey system is used to obtain the high-energy beam. (Contractor's abstract)

609

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

MOLECULAR BEAM FOR THE STUDY OF HIGH-TEMPERATURE-GAS COLLISION PROCESSES, by G. T. Skinner. [1961] [5]p. incl. diagrs. refs. (AFOSR-578) [AF 49(638)793] AD 268309 Unclassified

Also published in Phys. Fluids, v. 4: 1172-1176, Sept. 1961.

A high-intensity molecular beam is described, in which a tailored-interface shock tube is used as the gas source. The purpose of the apparatus is to extend molecular beam techniques into the 1-10 ev per particle range, in order to study collision processes in high-temperature gases. The principles of the apparatus are discussed. Experimental intensity profiles agree with the predicted profiles. A 0.7-ev nitrogen beam was produced in experiments which were designed to determine whether high-intensity high-energy beams could be obtained when the stagnation temperature of the gas is an order of magnitude higher than the apparatus temperature. (Contractor's abstract)

610

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

ON THE VISCOSITY OF DISSOCIATED AIR, by F. K. Moore. Sept. 1961 [18]p. incl. diagrs. (Rept. no. RM-1396-A-2) (AFOSR-1554) (AF 49(638)793) AD 265747 Unclassified

Also published in ARS Jour., v. 32: 1415-1416, Sept. 1962. (Title varies)

Using a particular set of interaction parameters, it is shown that the viscosity of dissociated high-temperature air is well represented by a simple formula which is a perturbation from the pure-molecule result. To this order, information about atom-atom interactions is not needed. The perturbation formula is then used to show that there is no point in calculating the effect of composition on viscosity unless the atom-molecule interaction parameters are known within a very few per cent. Finally, it is noted that the composition effect on boundary-layer transport properties stems chiefly from the dilatation factor in the state equation, tending to justify calculation of viscosity on a pure-molecule basis. (Contractor's abstract)

611

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

SHOCK TUBE DRIVEN MOLECULAR BEAM FOR THE 1-10 EV RANGE (Abstract), by G. T. Skinner. [1961] [1]p. [AF 49(638)793] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 41, Feb. 1, 1961.

A small tailored interface hypersonic shock tunnel, consisting of shock tube and two-stage expansion nozzle, is being used as a source for an atomic or molecular beam. Such a source provides a stream of high-velocity particles at low ambient temperature, giving a high degree of energy collimation. Dissociation products in the shock tube can be preserved intact by operating at moderately low density and allowing gas composition to freeze early in the expansion. The beam is defined by a collimating orifice placed in the hypersonic flow at a point where the mean free path is large compared with the orifice diameter. The beam intensity is of the order of 10^{19} molecules cm^{-2} sec^{-1}. In passing such an intense stream of high-energy particles through a cold orifice, certain problems arise from collision processes which can be neglected in conventional molecular beams. These are essentially rarefied gas dynamic phenomena. This apparatus gives a well-defined beam for several diameters downstream of the orifice.

612

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

RESEARCH ON TRANSFER MECHANISMS (Unclassified title), by R. E. Kell. Jan. 1961, 7p. (Semi-annual technical rept. no. ZC-1440-P-1) (AFOSR-143) (AF 49(638)854) AD 323896 Secret

613

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

ON NUMERICAL COMPARISON BETWEEN EXACT AND APPROXIMATE THEORIES OF HYPERSONIC INVISCID FLOW PAST SLENDER BLUNT-NOSED BODIES, by H. K. Cheng and A. L. Chang. [1961] [3]p. incl. diagr. (AFOSR-604) (AF 49(638)952) Unclassified

Also published in ARS Jour., v. 31: 1024-1026, July 1961.

The purpose of this note is to point out that the increase of cross flow energy when correctly calculated from the flow quantities provided by the characteristics methods remains essentially constant. It is also shown that the cross flow energy agrees within the expected degree of accuracy with that required by blast wave theory.

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Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

DEVELOPMENT OF THE SHOCK TUNNEL AND ITS APPLICATION TO HYPERSONIC FLIGHT, by A. Hertzberg, C. E. Wittliff, and J. G. Hall. [1961] [57]p. incl. illus. diagrs. tables, refs. (AF 49(638)-952) Unclassified

Presented at ARS Internat'l. Hypersonics Conf., Cambridge, Mass., Aug. 16-18, 1961.

Also published in Prog. in Astronaut. and Rocketry, v. 7: 701-758, 1962.

The development of the shock tunnel, its present capabilities and future prospects are reviewed and discussed. The ability of the shock tunnel to produce air flows at stagnation temperatures and pressures associated with hypersonic flight has been well established. The chief difficulty associated with this type of tunnel has been very short (millisecond) testing time. The "tailored interface" technique has significantly increased the available testing time in a shock tunnel. This testing time extension, plus the development of effective rapid response instrumentation, now permits the accurate measurement of pressures, forces, and heat transfer rates. The hypersonic shock tunnel in its present form is capable of duplicating re-entry flight conditions for various hypersonic vehicles over an important area of the re-entry flight corridor. However, complete duplication over the entire range of interest for re-entry flight cannot be obtained with present shock tunnels. For some regions it is necessary to resort to the techniques of partial simulation. However, the flexibility of the shock tunnel permits a wide range of simulation conditions to be studied. In its present form the shock tunnel has exceeded initial expectations regarding both range of performance and scope of testing. Exploratory experiments have demonstrated the usefulness of the shock tunnel for the investigation of hypervelocity rarefied-gas flows associated with the re-entry of manned vehicles. Anticipated developments in the technique of operation indicate the possibility of extending the range of complete flight duplication so that nearly the entire range of critical flight re-entry can be conveniently studied.

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Cornell U., Ithaca, N. Y.

COALITIONS AND INTERACTION CONCEPTS OF SUPPORT IN THREE-PERSON GROUPS, by E. F. Borgatta and M. L. Borgatta. [1961] [13]p. incl. tables. (AFOSR-1414) (In cooperation with New York U., N. Y.) (AF 49(638)195 and AF AFOSR-61-30) Unclassified

Also published in Social Forces, v. 41: 68-75, 1962.

A method of definition for coalition structures is through indices of relative support in interaction. Factors involved in such definitions are analyzed, and particular attention is given to the work of Mills. The type of index used and possible artifacts may account for the failure of several studies to replicate Mills' findings. The relationship of empirically based concepts as contrasted to speculative theory is noted with regard to the construction of indices. (Contractor's abstract)

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Cornell U., Ithaca, N. Y.

[DIMENSIONS OF BEHAVIORAL RATINGS], by E. F. Borgatta. Final rept. [1961] 5p. (AF AFOSR-61-30) AD 267904 Unclassified

The purpose of this project was to examine the stability of findings previously reported for another AFOSR project (AF 49(638)195, New York U., N. Y.). The objectives of the research were (1) to reanalyze the dimensions of behavioral ranking, (2) to review experience of paper-and-pencil predictors of interaction or behavioral characteristics as indicated in peer rankings, (3) to attempt to design value and personality items that would have a high likelihood of predicting this behavior, and (4) to explore the use of a new instrument, the Word Associations Form, to ascertain whether or not an objective test (based on empirical correlation) could be developed that had meaningfulness for the prediction of observed behavior.

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Cornell U. [Center for Radiophysics and Space Research] Ithaca, N. Y.

EFFECT OF PRESSURE ON THE ENERGY GAP OF Bi_2Te_3, by C.-Y. Li, A. L. Ruoff, and C. W. Spencer. [1961] [3]p. incl. diagrs. refs. (AFOSR-1111) (Sponsored jointly by Advanced Research Projects Agency, and Air Force Office of Scientific Research under AF 49(638)480) Unclassified

Also published in Jour. Appl. Phys., v. 32: 1733-1735, Sept. 1961.

The effect of hydrostatic pressure on the energy gap of Bi_2Te_3 has been investigated in the pressure range 1-30,000 atm. From resistivity measurements as a function of temperature and pressure, it has been determined that the energy gap decreases from 0.171 ev at 1 atm to 0.104 ev at 30,000 atm, corresponding to $\partial E_g(0)/\partial p = -2 \times 10^{-6}$ ev/atm. (Contractor's abstract)

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Cornell U. Center for Radiophysics and Space Research, Ithaca, N. Y.

THE INTERSTELLAR ABUNDANCE OF THE HYDROGEN MOLECULE, by R. J. Gould. Aug. 31, 1961, 42p. incl. diagrs. tables, refs. (AFOSR-1401) (AF 49(638)915) AD 264674 Unclassified

Presented at 109th meeting of the Amer. Astronom. Soc., Denver, Colo., Dec. 26-30, 1961.

Abstract published in Astronom. Jour., v. 67: 115A, Mar. 1962.

The various processes which determine the concentration of molecular hydrogen in HI clouds are investigated. It is shown that, contrary to the results of previous investigations, the processes involving a dissociation of the molecule are quite negligible compared to the relatively rapid formation of H_2 on the surfaces of grains. As a result there is a gradual build-up of molecular hydrogen in the clouds until the clouds, thru their random motion, pass near a bright star whereby the H_2 is dissociated again. The percentage of hydrogen which should have associated to molecular form is estimated under various conditions. In particular, calculations are made for the case of a constant ratio of gas to dust density and for the case where the dust density is independent of the gas. The results of the calculations vary considerably, depending on the conditions but the general results point to the likelihood of a molecular hydrogen concentration comparable to that of the observed atomic hydrogen and in some circumstances to a value much greater than that of the atomic concentration. (Contractor's abstract)

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Cornell U. Dept. of Biochemistry, Ithaca, N. Y.

THE HETEROLACTIC FERMENTATION. III. POSITION OF C^{14} IN THE PRODUCTS OF FRUCTOSE DISSIMILATION BY LEUCONOSTOC MESENTEROIDES, by M. Busse, P. K. Kindel, and M. Gibbs. [1961] [4]p. incl. tables, refs. (AFOSR-1072) (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and National Science Foundation under AF 49(636)798) Unclassified

Also published in Jour. Biol. Chem., v. 236: 2650-2653, Nov. 1961.

Leuconostoc mesenteroides ferments fructose to carbon dioxide, ethanol, acetic acid, lactic acid, and mannitol. Degradation data for specifically labelled fructoses show that most of the tracer is distributed among the fermentation products in the same way as in the case of glucose fermentation. Some tracer, however, is spread to other positions in the fermentation products. These data indicate that some of the mannitol formed is reoxidized resulting in an exchange of radioactive carbon 14. The pattern of radioactive carbon 14 distribution among the fermentation products also indicates the action of fructose phosphoketolase. In crude extracts of Leuconostoc mesenteroides, a reversible, diphosphopyridine nucleotide-specific mannitol dehydrogenase has been found. The organism cannot be used to determine isotope distribution in fructose.

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Cornell U. Dept. of Biochemistry, Ithaca, N. Y.

STUDIES ON PHOTOSYNTHETIC PROCESSES. II. ACTION SPECTRA AND QUANTUM REQUIREMENT FOR TRIPHOSPHOPYRIDINE NUCLEOTIDE REDUCTION AND THE FORMATION OF ADENOSINE TRIPHOSPHATE BY SPINACH CHLOROPLASTS, by C. C. Black, J. F. Turner and others. [1961] [4]p. incl. diagrs. refs. (AFOSR-1182) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)798, National Science Foundation, and Public Health Service) AD 295898 Unclassified

Also published in Jour. Biol. Chem., v. 237: 580-583, Feb. 1962.

Action spectra and quantum requirements were determined with spinach chloroplast fragments for the processes of triphosphopyridine nucleotide reduction, adenosine triphosphate formed during reduction, and adenosine triphosphate formation supported by phenazine methosulfate. The action spectrum for triphosphopyridine nucleotide reduction showed peaks at 450, 500, and 675 mμ; peaks for concomitant phosphorylation were at 430 and 660 mμ, with a shoulder at 500 mμ. Phosphorylation in the presence of phenazine methosulfate exhibited peaks at 430, 500, and 680 mμ. Carotenoid pigments appeared to function in the processes studied. The quantum requirement for triphosphopyrine nucleotide reduction was 9 at 675 mμ, and for the associated phosphorylation, 15, but the phosphorylation supported by phenazine methosulfate had a quantum requirement from 10 - 15 times greater. The molar ratio of adenosine triphosphate to reduced triphosphopyridine nucleotide only approached one at high light intensities. The highest ratios were obtained in the blue absorption bands; in contrast, the highest quantum yields were in the red region for both phosphorylation and reduction. (Contractor's abstract)

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Cornell U. Dept. of Biochemistry, Ithaca, N. Y.

STUDIES ON PHOTOSYNTHETIC PROCESSES. I. THE EFFECT OF LIGHT INTENSITY ON TRIPHOSPHOPYRIDINE NUCLEOTIDE REDUCTION, ADENOSINE TRIPHOSPHATE FORMATION, AND CARBON DIOXIDE ASSIMILATION IN SPINACH CHLOROPLASTS, by J. F. Turner, C. C. Black, and M. Gibbs. [1961] [3]p. incl. diagrs. refs. (AFOSR-1183) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)798 and National Science Foundation) AD 296204 Unclassified

Also published in Jour. Biol. Chem., v. 237: 577-579, Feb. 1962.

The effect of light intensity on CO_2 fixation, triphosphopyridine nucleotide reduction and adenosine triphosphate formation by spinach chloroplasts was investigated. Increasing light intensity brought about a higher rate of CO_2 fixation but low light intensities produced a lag in the rate. At low and high chlorophyll concentrations the rate of TPN reduction increased linearly with increasing light intensity. In contrast, ATP formation showed a distinct lag at intensities of 25 foot-candles or less at the low chlorophyll concentration and a more pronounced lag of up to 250 foot-candles at higher chlorophyll concentrations. With low chlorophyll reaction mixtures, the molar ratio of ATP to reduced TPN approached unity at 3000 foot-candles. The ratio reached a maximum of 0.5 at 3000 foot-candles and high chlorophyll concentrations. No exchange reaction between inorganic phosphate and ATP was observed with these preparations.

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Cornell U. Dept. of Biochemistry, Ithaca, N. Y.

ROLE OF ALDOLASE IN PHOTOSYNTHESIS. 1. ENZYME STUDIES WITH PHOTOSYNTHETIC ORGANISMS WITH SPECIAL REFERENCE TO BLUE-GREEN ALGAE, by C. A. Fewson, M. Al-Hafidh, and M. Gibbs. [1961] [5]p. incl. tables, refs. (AFOSR-2044) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)798 and National Science Foundation) Unclassified

Also published in Plant Physiol., v. 37: 402-406, May 1962.

Several enzymes involved in carbohydrate metabolism were assayed in extracts of blue-green, green, red, and golden-brown algae, the photosynthetic bacterium Rhodospirillum rubrum (von Esmarch) Molisch, and spinach. Aldolase was absent from the blue-greens but could be detected in all the other organisms. Glucose-6-phosphate and gluconate-6-phosphate dehydrogenases were especially active in the 3 blue-greens examined and it is suggested that the pentose phosphate pathway is the main method of hexose dissimilation in these organisms. These dehydrogenases were low in the red alga Chondrus crispus (L.) Stackhouse, but a non-specific glucose oxidase was very active. It is suggested that the apparent absence of aldolase from some photo-autotrophic organisms makes it likely that the formation of hexoses during photosynthesis does not necessarily proceed by the condensation of 2 molecules of triose phosphate. (Contractor's abstract)

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Cornell U. Dept. of Biochemistry, Ithaca, N. Y.

FACTORS AFFECTING CO_2 FIXATION BY CHLOROPLASTS, by M. Gibbs, C. C. Black, and B. Kok. [1961] [4]p. incl. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)798 and National Science Foundation) Unclassified

Published in Biochim. et Biophys. Acta, v. 52: 474-477, Sept. 30, 1961.

The low rate of CO_2 uptake by spinach chloroplasts may be due to the loss of photosynthetic pyridine nucleotide reductase during isolation of the particle. The addition of orthophosphate, adinosine diphosphate (ADP) and Mg^{2+} accelerates triphosphopyridine nucleotide (TPN) reduction, which may account for an earlier observation that small amounts of phosphate stimulate CO_2 reduction by chloroplasts. Aging destroys the ability of chloroplasts to assimilate CO_2 but does not affect TPN reduction. (Contractor's abstract)

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Cornell U. Dept. of Chemistry, Ithaca, N. Y.

CONTRIBUTION TO THE THEORY OF INELASTIC MOLECULAR COLLISIONS, by J. Weinstock. [1959] [47]p. incl. diagr. tables, refs. (AFOSR-338) (AF 18(603)111) AD 282841 Unclassified

The validity of the distorted wave (dw) approximation for the solution of the vibrational energy transfer problem is investigated. The behavior of the transition probability integral is shown to be determined by the behavior of its integral at a single point. This critical point is used to obtain an exact solution of the transition probability with which the dw solution is compared. The dw solution is found to lie within 20% of the exact solution whenever the transition probability is less than roughly 0.6. The existence of the critical point leads to a simple expression for the transition probability in terms of an arbitrary interaction potential. The effects of adiabatic changes due to short range repulsive forces are investigated by means of the method of perturbed stationary states. (Contractor's abstract)

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Cornell U. Dept. of Chemistry, Ithaca, N. Y.

SOME ASPECTS OF THE THEORY OF VIBRATIONAL

TRANSITION PROBABILITIES IN MOLECULAR COLLISIONS, by B. Widom. [1961] [7]p. incl. diagr. refs. (AFOSR-1840) [AF 18(603)111] AD 295861
Unclassified

Also published in Faraday Soc. Discussions, No. 33: 37-43, 1962.

An exponential formula commonly used in the discussion of vibrational transition probabilities in molecular collisions is analyzed with the object of determining the extent to which it is dependent on specific (but questionable) assumptions about the form of the interaction energy. Using a principle of Landau, a very general expression is derived for the exponential appropriate to the 1-dimensional case. It is shown that the leading term is very insensitive to the precise nature of the interaction, so that this term in its commonly used form has a great degree of generality. The correction terms in the exponential, on the other hand, depend sensitively on the assumed form of the interaction in the region of strong repulsion, so the corrections in current use must be considered very uncertain.

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Cornell U. Dept. of Chemistry, Ithaca, N. Y.

ANISOTROPY OF NUCLEAR MAGNETIC RESONANCE IN VANADIUM PENTOXIDE, by J. L. Ragle. [1961] [2]p. incl. diagr. (AFOSR-643) (AF 49(638)191)
Unclassified

Also published in Jour. Chem. Phys., v. 35: 753-754, Aug. 1961.

The NMR spectra of V^{51} in V_2O_5 at high fields show a marked asymmetry of the central component of the 7-line quadrupole pattern. The proportionality of this asymmetry to field strength indicates that its origin lies in an anisotropic magnetic shielding.

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Cornell U. Dept. of Chemistry, Ithaca, N. Y.

STUDIES IN NON-STOICHIOMETRY. ELECTRICAL CONDUCTIVITY AND CARRIER MOBILITY IN LITHIUM TUNGSTEN BRONZES, by M. J. Sienko and T. B. N. Truong. [1961] [5]p. incl. diagr. tables, refs. (AFOSR-644) (AF 49(638)191) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 3939-3943, Oct. 5, 1961.

Single crystal resistivity measurements, x-ray spacings and densities are reported for 3 lithium tungsten bronzes: $Li._{.394}WO_3$, $Li._{.377}WO_3$, and $Li._{.365}WO_3$. In the range −150 to 90°, conduction is metallic, in contradiction to previous reports. The electron mobility increases with lithium content and decreases with temperature. Arguments are given for believing there should be a transition from localization of electrons to delocalization at approximately $Li._{.25}WO_3$. Reexamination of previously reported magnetic results suggest a maximum in the effective mass of the carriers at $M._{.30}WO_3$. The change in effective mass and mobility is attributed mainly to the effect of cationic point charge defects on the 5d conduction band. (Contractor's abstract)

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Cornell U. Dept. of Chemistry, Ithaca, N. Y.

STUDIES IN NON-STOICHIOMETRY. MAGNETIC SUSCEPTIBILITIES IN THE TUNGSTEN-OXYGEN SYSTEM, by M. J. Sienko and B. Banerjee. [1961] [4]p. incl. diagr. tables, refs. (AFOSR-645) (AF 49(638)-191)
Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 4149-4152, Oct. 20, 1961.

Magnetic susceptibilities have been measured by the Gouy method for several tungsten oxides of the series WO_x. At 297.5°K the susceptibility per unit volume is found to increase monotonically from -0.65×10^{-6} to $+0.46 \times 10^{-6}$ as x in WO_x decreases from 3 to 2. Results are interpretable in terms of a defect structure in which 3 − x oxygen atoms have been removed from a host WO_3 lattice leaving 2(3 − x) electrons in the conduction band of the host. Quantitative agreement with a Pauli-Peierls calculation is surprisingly good. The model may be applicable to other nonstoichiometric oxides for which "mixed-oxidation-state" structures have been postulated. (Contractor's abstract)

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Cornell U. [Dept. of Chemistry] Ithaca, N. Y.

CARRIER CHARACTERISTICS IN COPPER-DOPED WO_3 FROM CONDUCTIVITY, HALL VOLTAGE, AND THERMAL E. M. F. STUDIES, by M. J. Sienko and P. F. Weller. [1961] [25]p. incl. diagrs. table, refs. (AFOSR-1705) (AF 49(638)191) AD 269007
Unclassified

Also published in Inorg. Chem., v. 1: 324-331, May 1962.

Single crystals of $Cu_{0.076}WO_3$, $Cu_{0.094}WO_3$, and $Co_{0.95}WO_{3+\delta}$ have been prepared by thermal decomposition of $CuWO_4$ and WO_3. Potential-probe resistivity measurements in the range 120 to 770°K indicate complex semiconducting behavior. $Cu_{0.094}WO_3$, which is orthorhombic, shows 3 linear segments in the log ρ vs 1/T dependence, the apparent activation energies being 0.05 ev below 170°K, 0.4 ev between 170 and 220°K, and 0.45 ev above 500°K. Between 220 and 500 K, behavior is metallic. $Cu_{0.95}WO_{3+\delta}$, which is triclinic, shows no metallic region but has 2 linear segments with activation energy 0.10 ev below 700°K and 0.15 ev above. Measurements of the Hall voltage and of the thermoelectric power indicate that

carriers are electrons. At 300°K, representative carrier densities are 5×10^{18}, 15×10^{18}, and 1×10^{18} electrons/cc with mobilities 6, 10, and 0.4 cm^2/v sec for $Cu_{0.076}WO_3$, $Cu_{0.094}WO_3$, and $Cu_{0.95}WO_{3+\delta}$, respectively. Thermal emf values fall in the range -2[illegible] to -300 μv/deg. Results are interpreted in terms of [illegible]nduction band model with destruction of the b[illegible]low room temperature due to a probable ferr[illegible]ectric transition in the host lattice. Excess oxygen acceptor centers of appreciable ionization energy apparently are present in small concentration in the low-copper materials and in large concentration in the high-copper material. (Contractor's abstract)

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Cornell U. Dept. of Chemistry, Ithaca, N. Y.

A RAMAN STUDY OF THE BROMIDE SOLUTIONS OF ZINC AND CADMIUM, by W. Yellin and R. A. Plane. [1960] [3]p. incl. diagrs. table, refs. (AFOSR-1024) (AF 49(638)279) AD 454548 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 2448-2452, June 5, 1961.

Raman intensity measurements were made of zinc bromide solutions containing various ratios of total zinc to total bromide. These results led to the following as the most probable assignments for the 3 polarized lines: ν_{172} cm^{-1} ($\rho = 0.06$), $ZnBr_4^=$; ν_{186} cm^{-1} ($\rho = 0.09$), $ZnBr_2$; ν_{205} cm^{-1} ($\rho = 0.13$), $ZnBr^+$. Comparison with $ZnBr_2$ in non-aqueous solvents indicated that the aqueous $ZnBr_2$ molecule is different from that in other solvents and may be tetrahedral $Zn(H_2O)_2Br_2$. Stepwise formation constants for the 3 complexes were found in concentrated solution to be: $(ZnBr^+)/(Zn^{++})(Br^-) = 0.3$, $(ZnBr_2)/(ZnBr^+)(Br^-) = 1$, $(ZnBr_4^=)/(ZnBr_2)(Br^-)^2 = 0.2$. If $ZnBr_3^-$ were present, its principal Raman band was coincident with that of 1 of the other species. In cadmium bromide solution of various ratios of total Br^- to total Cd^{++}, only 1 polarized line was found. Coincident with that line, at 166 cm^{-1} ($\rho = 0.08$) which was due to $CdBr_4^=$, was the principal line of 1 (or more) lower species. The lower species appeared to be of less importance than in the zinc system, while the tetrabromo species was of greater importance: $(CdBr_4^=)/(Cd^{++})(Br^-)^4 > 1$. (Contractor's abstract)

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Cornell U. Dept. of Chemistry, Ithaca, N. Y.

POLYMERIZATION IN COBALTIC PERIODIC SOLUTIONS, by C. J. Nyman and R. A. Plane. [1960] [4]p. incl. diagrs. (AFCSR-1575) (AF 49(638)279) AD 454549 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 2617-2620, June 20, 1961.

Acidified solutions of $Na_5H_2Co(IO_6)_2 \cdot 10H_2O$ show the presence of 2 types of periodate ions as evidenced by the fact that a portion, but not all, of the periodate may be removed by precipitation or reduction without changing the absorption spectra. Polymerization of the cobalt species to form a soluble polynuclear complex having a cobalt (III) to periodate ratio of 4:3 occurs at a measurable rate which increases with increasing hydrogen ion concentration. From a 2 M perchloric acid solution, a dark green crystalline solid is obtained which has 3 strongly ionized hydrogen ions and 3 iodine atoms per 4 cobalts. The crystals are soluble in water and have an elemental analysis and equivalent weight leading to a postulated formula $H_3[Co_4I_3O_{30}H_{24}]$ for their composition. (Contractor's abstract)

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Cornell U. Dept. of Chemistry, Ithaca, N. Y.

NATURE OF THE METAL-LIGAND BOND IN SOME COMPLEX CYANIDES FROM A STUDY OF RAMAN INTENSITIES, by G. W. Chantry and R. A. Plane. [1961] [5]p. incl. tables, refs. (AFOSR-4310) [AF 49(638)279] Unclassified

Also published in Jour. Chem. Phys., v. 35: 1027-1031, Sept. 1961.

A study of the Raman spectra of solutions of $Zn(CN)_4^=$, $Cd(CN)_4^=$, $Hg(CN)_4^=$, $Co(CN)_6^{-3}$, $Cu(CN)_4^{-3}$, $Ag(CN)_4^{-3}$, and $Fe(CN)_6^{-4}$ shows that these complex ions fall into 2 distinct sets. For the first set, consisting of the first 4 species, the A_1 CN frequencies are 2143, 2145, 2148, and 2152 cm^{-1} and the $\bar{\alpha}_{CN'}$ lie intermediate between those determined for free CN^- and CH_3CN. For the latter 3 species, the corresponding frequencies are 2094, 2097, and 2094 cm^{-1}. Furthermore, members of the latter set have abnormally large Raman intensities, i.e., large $\bar{\alpha}_{CN'}$, and an additional ultraviolet absorption band at 2600A. For the first group, the assumption of partial sigma bonding of metal to C, consistent with the principle of essential electroneutrality, explains both the observed force constant and the values of $\bar{\alpha}_{CN'}$. The low intensity found for the ν_2 mode is explained in terms of the effect on this quantity of the large amount of s character in the carbon sigma orbital. The second group cannot be simply treated and appears to present an example of the breakdown of bond localized polarizabilities. (Contractor's abstract)

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Cornell U. Dept. of Chemistry, Ithaca, N. Y.

ENAMINES OF 2-INDANONES, by A. T. Blomquist and E. J. Moriconi. Dec. 15, 1960, 31p. incl. tables, refs. (AFOSR-TR-60-166) (AF 49(638)688) Unclassified

Also published in Jour. Org. Chem., v. 26: 3761-3769, Oct. 1961.

Enamines 2-(N-pyrrolidyl) (IIa), 2-(N-piperidyl) (IIb), 2-(N-hexamethyleneimino) (IIc), and 2-(N-morpholinyl)indene (IId) were prepared from 2-indanone and the appropriate sec-amines; similarly 3-phenyl-2-(N-hexamethyleneimino)indene was obtained from 1-phenyl-2-indanone (VIII). C-Alkylation of IIa-IId with bromomethyl benzyl ether was highest with IIc. 1-Methyl (V), 1-benzyloxymethyl- (VI), and 1-benzyl-2-indanone (VII) were prepared by C-alkylation of IIc with the appropriate alkyl halide. A shift of 100-131 cm^{-1} in the double bond stretching maximum was observed in going from IIa-IId to their respective ternary iminium salts. Selenium dioxide oxidation of VIII and 3-phenyl-1-indanone gave, respectively, 1-hydroxy-1-phenyl-2-indanone and 3-hydroxy-3-phenyl-1,2-indandione, and 3-phenylindone. Nitrosation of V and VI under alkaline conditions gave no o-oximinoindanones but unexpectedly yielded ring expanded products tentatively identified as alkylated 3-hydroxyisoquinoline N-oxides. (Contractor's abstract)

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Cornell U. Dept. of Chemistry, Ithaca, N. Y.

MASS SPECTROMETRIC STUDIES OF LOW PRESSURE PYROLYSIS REACTIONS OF CHLORINATED AND FLUORINATED C_1 AND C_2 COMPOUNDS ON GRAPHITE, by D. R. Bidinosti and R. F. Porter. [1961] [7]p. incl. diagrs. table, refs. (AFOSR-531) [AF AFOSR-60-25] Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 3737-3742, Sept. 20, 1961.

The pyrolysis behavior of chlorinated derivatives of methane, ethane and ethylene has been investigated in graphite ovens at pressures between 10^{-2} and 1 mm of Hg in the temperature range 450-1300°K. Several C_2 compounds studied transfer chlorine atoms from adjacent carbon atoms to the graphite surface. The pressure dependence of the yield of dechlorinated products indicated a first-order relationship between product and reactant. This is interpreted as evidence for the existence of an equilibrium reaction with graphite. Heats of reaction for the removal of 2 chlorine atoms from adjacent carbon atoms are found to vary between +12 and +25 kcal. The compound sym-tetrachloroethane pyrolyses to both sym-dichloroethylene and trichloroethylene, the latter by the elimination of HCl(g). The HCl elimination reactions are found to follow a more complex pressure dependence than those observed for dechlorination. Several fluoro-chloro C_1 and C_2 compounds also have been dehalogenated over graphite. (Contractor's abstract)

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Cornell U. Dept. of Chemistry, Ithaca, N. Y.

MASS SPECTROMETRIC STUDY OF THE REACTIONS OF $BF_3(g)$ WITH $BCl_3(g)$, $B(OH)_3(g)$, AND $B_2O_3(l)$, by R. F. Porter, D. R. Bidinosti, and K. F. Watterson. [1961] [5]p. incl. diagrs. tables. (AFOSR-1366) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-60-25 and Advanced Research Projects Agency) Unclassified

Also published in Jour. Chem. Phys., v. 36: 2104-2108, Apr. 1962.

Exchange reactions of halogen and hydroxyl with $Bx_3(g)$ have been studied mass spectrometrically. The major product produced by the reaction of $BF_3(g)$ with boric acid at 25°C and pressures of the order of 10^{-6} atm is $B(OH)F_2(g)$. The species $B(OH)_2F(g)$ is also formed at higher temperatures when $B(OH)_3(g)$ is observable. Equilibria involving the reactions $1/3\ BF_3(g) + 2/3\ BCl_3(g) = BFCL_2(g)$, $2/3\ BF_3(g) + 1/3\ BCl_3(g) = BF_2Cl(g)$, $1/3\ BF_3(g) + 2/3\ B(OH)_3(g) = B(OH)_2F(g)$, and $2/3\ BF_3(g) + 1/3\ B(OH)_3(g) = B(OH)F_2(g)$, have been studied as a function of temperature. Heats of formation at 298°K for $BFCl_2(g)$, $BF_2Cl(g)$, $B(OH)_2F(g)$, and $B(OH)F_2(g)$ are found to be -154.1 ± 1.0, -211.9 ± 2.0, -249.8 ± 2.5, and -260.2 ± 2.5 kcal/mol, respectively. Reactions of $BF_3(g)$ with $B_2O_3(l)$ have also been studied at pressures between 10^{-6} and 10^{-3} atm and temperature between 400 and 1000°K. Results are consistent with published data from studies with BF_3 at pressures near 1 atm and show that $(BOF)_3(g)$ is the primary product at both pressure extremities. For the reaction $BF_3(g) + B_2O_3(l) = (BOF)_3(g)$ we obtain $\Delta H_T^o = 3.46 \pm 0.30$ kcal/mol. (Contractor's abstract)

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Cornell U. [Dept. of Mathematics] Ithaca, N. Y.

SIMULTANEOUS CHANNELS, by J. Wolfowitz. [1959] [16]p. [AF 18(600)685] Unclassified

Published in Arch. Rational Mech. Anal., v. 4: 371-386, Feb. 18, 1960.

Let $\{w(i|j|s)\}$ $(i = 1, \ldots, a;\ j = 1, \ldots, b;\ a, b \geq 2$ $s \in S$ an arbitrary index set) be a family of a x b

matrices such that $w(i|j|s) \geq 0$ and $\Sigma_{i=1}^{a} w(i|j|s) = 1$ for all j, s. The following results are established. Let u and v stand for n-component vectors whose components range over the integers $1,\ldots,b$ and $1,\ldots,a$, respectively. Define a code of length N, word length n, and error probability $\leq \lambda$, as a set $u_1,\ldots,u_N$ of distinct u's, and disjoint v-sets $A_1,\ldots,A_N$, such that if $P(v|u|s) = w(y_1|x_1|s)\, w(y_2|x_2|s)\cdots w(y_n|x_n|s)$, where $u = (x_1,\ldots,x_n)$ and $v = (y_1,\ldots,y_n)$, then $P(A_k|u_k|s) \geq 1 - \lambda$ $(k = 1,\ldots,N;\ s \in S)$. The coding theorem is as follows: There exists a number $C_0 \geq 0$ with the property that for any $\lambda > 0$ there is a $K \geq 0$ such that for every n there exists a code of length $N \geq 2^{nC_0 - K\sqrt{n}}$, word length n, and error probability $\leq \lambda$. Strong converse: There exists a $K' \geq 0$ such that the length of any code of word length n and error probability $\leq \lambda$ satisfies $N \geq 2^{nC_0 + K'\sqrt{n}}$. These results correspond to the case when the channel is unknown to transmitter or receiver (except that it is a member of S) but remains fixed over a word. If the family $A_1,\ldots,A_N$ is permitted to depend upon s and if $P(A_k(s)|u_k|s) \geq 1 - \lambda$ $(k = 1,\ldots,N;\ s \in S)$, then the above results are unchanged. If the set $u_1,\ldots,u_N$ is permitted to depend upon s, there is a $C_1 \geq C_0$ in terms of which the coding theorem and strong converse are valid. Simple expressions for C_0 and C_1 are given. (Math. Rev. abstract)

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Cornell U. Dept. of Mathematics, Ithaca, N. Y.

A NOTE ON THE STRONG CONVERSE OF THE CODING THEOREM FOR THE GENERAL DISCRETE FINITE-MEMORY CHANNEL, by J. Wolfowitz. [1959] [5]p. (AF 18(600)685) Unclassified

Published in Inform. and Control, v. 3: 89-93, Mar. 1960.

The present note is a proof of the strong converse of the coding theorem for the special discrete finite-memory channel. Two theorems are proven. The first states: Let C be the capacity of a general discrete finite-memory channel. Let $\epsilon > 0$ and λ, $0 \leq \lambda < 1$, be arbitrary. For n sufficiently large any code (N, λ) must satisfy $N < 2^{n(C+\epsilon)}$. The second reads: The capacity C of the general discrete finite-memory channel satisfies, for every positive integer l,

$$\frac{C(l+m)}{(l+m)} \leq C \leq \frac{C(l+m)}{l+m) + \frac{m}{l+m}}.$$

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[Cornell U. Dept. of Mathematics, Ithaca, N. Y.]

MARKOFF CHAINS AND MARTIN BOUNDARIES, by G. A. Hunt. [1959] [28]p. [AF 18(600)685] Unclassified

Published in Illinois Jour. Math., v. 4: 313-340, Sept. 1960.

This paper presents an argument, using only the basic properties of Martingales and Markoff chains, in which the main convergence theorem of Doob (Jour. Math. Mech., v. 8: 433-458, 1959) is proved at the beginning by reversing the sense of time in a Markoff chain. In view of the symmetry of past and future in the notion of Markoff chain, the lack of such symmetry in defining Markoff chains with stationary transitions must puzzle many a probabilist. Now, a slight and momentarily ugly alteration of the latter definition yields the notion of random chain with approximately stationary transitions, a notion symmetric in past and future. This symmetry is used to establish the convergence mentioned above and to reduce problems concerning the entrance boundary to ones concerning the exit boundary. Doob's convergence theorem, established directly, leads to the proofs of the Poisson-Martin representation of excessive functions, the behavior of excessive functions near the Martin boundary, and the resolutivity of the Martin boundary.

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Cornell U. Dept. of Mathematics, Ithaca, N. Y.

THE SEMI-GROUP PROPERTY OF POISSON TRANSFORMATION AND SNOW'S INVERSION FORMULA, by H. Pollard. July 1961, 9p. (AFOSR-1509) [AF 49-(638)226] AD 267686 Unclassified

Also published in Proc. Amer. Math. Soc., v. 14: 285-290, Apr. 1963.

The set F stands for the family of functions f which are integrable on each finite interval of the real axis and for which the integrals $\int^{\infty} \frac{f(x)}{x^2}\,dx$ and $\int_{-\infty} \frac{f(x)}{x^2}\,dx$ converge. For each member f of this set and each positive number a the Poisson transform $P_a f$ is defined by the point function $(P_a f)(x) = \frac{1}{\pi} \int_{-\infty}^{\infty} \frac{a f(\xi)}{(x-\xi)^2 + a^2}\,d\xi$, $-\infty < x < \infty$. The main purpose of this paper is to establish the validity of the semi-group property of this transform $P_b P_a f = P_{a+b} f$, $a > 0$, $b > 0$.

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Cornell U. [Dept. of Mathematics] Ithaca, N. Y.

CHANNELS WITH ARBITRARILY VARYING CHANNEL PROBABILITY FUNCTIONS, by J. Kiefer and J. Wolfowitz. [1961] [11]p. incl. table. (AFOSR-3324) [AF 49(638)226] Unclassified

Also published in Inform. and Control, v. 5: 44-54, Mar. 1962.

Codes are described which apply to the cases (1) where neither the sender nor the receiver knows the channel sequence which governs the transmission of a word, and (2) where the sender or the receiver, or both, do know the channel sequence which governs the transmission of a word. For these situations, the present paper gives necessary and sufficient conditions for the existence of a positive (possible) rate of transmission. In the case where both sender and receiver know the channel probability function, a determination is made of the capacity. The codes described are all "nonrandomized".

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Cornell U. Dept. of Physics, Ithaca, N. Y.

THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF THE ATOMIC PHENOMENA OCCURRING ON AND NEAR THE SURFACES OF SOLIDS, by B. M. Siegel. Final rept. Mar. 10, 1961, 27p. (AFOSR-383) (AF 18(600)674, Task 1) AD 254688 Unclassified

Efforts were directed towards obtaining an understanding of properties and phenomena such as structure, oxidation, corrosion, and electron emission. The recently developed ultra high vacuum techniques were deemed essential for obtaining controlled surface conditions and efforts were directed to employing these conditions in all phases of the program. The atomic structure and surface morphology of surfaces and evaporated films were investigated by high resolution electron optical devices. A large amount of the work was directed toward the development of the necessary apparatus and conditions for the utilization of ultra high vacuum so necessary for the realization of controlled conditions on surfaces. (Contractor's abstract, modified)

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Cornell U. [Dept. of Physics, Ithaca, N. Y.]

SCATTERING OF 50-KV ELECTRONS AT VERY SMALL ANGLES (Abstract), by B. M. Siegel and L. Bachmann. [1961] [1]p. (Sponsored jointly by Advanced Research Projects Agency and Air Force Office of Scientific Research under [AF 18(600)674, Task 1]) Unclassified

Presented at meeting of the Amer. Phys. Soc., Monterey, Calif., Mar. 20-23, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 109, Mar. 20, 1961.

The differential scattering cross-section of 50-kv electrons from C and Cu was measured in the angular range of $1\text{-}5 \times 10^{-3}$ radians. Using the optics of the electron microscope and monitoring the incident intensity with a Faraday cage, absolute values were obtained and compared with the theoretical curves given by Lenz (see Zeitr. Naturforsch., v. 9a: 185, 1954). Good agreement was obtained for C if the screening radius of the potential field of the nucleus used by Leisegang (Zeitschr. Physik, v. 132: 183, 1952) is chosen. The measured values of the scattering cross section obtained for Cu are larger by a factor of 2 than the calculated values.

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Cornell U. Dept. of Physics, Ithaca, N. Y.

MULTIPLE EXCITATION AND IONIZATION OF INNER ATOMIC SHELLS BY X RAYS, by H. W. Schnopper. Dec. 15, 1961 [6]p. incl. diagr. (Research rept. no. 9) (AFOSR-1732) (AF 49(638)402) AD 282339 Unclassified

Also published in Phys. Rev., v. 131: 2558-2560, Sept. 15, 1963.

Re-investigation of the argon K absorption edge region 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 the 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 from 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. (Contractor's abstract)

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Cornell U. Dept. of Physics, Ithaca, N. Y.

K X-RAY FLUORESCENCE YIELD OF ARGON, by T. Watanabe, H. W. Schnopper, and F. N. Cirillo. Dec. 19, 1961, 8p. incl. diagrs. table. (Research rept. no. 10) (AFOSR-1932) (AF 49(638)402) AD 270919 Unclassified

Also published in Phys. Rev., v. 127: 2055-2057, Sept. 15, 1962.

Reported values of the K x-ray fluorescence yield of argon lie in 2 distinct groups, low values (about 0.07) and high values (about 0.13). A new measurement is reported which gives 0.14 ± 0.014. This measurement is made from the escape peak in the pulse-height-distribution of a flow proportional counter with

monochromatic x-rays. An Fe^{55} radio-isotope was used as the source of primary x-rays. Corrections were made for the L and M ionizations in the argon gas, for the reabsorption of the K fluorescent x-rays, and for background counts. (Contractor's abstract)

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Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

SHOCK PROFILES IN HYPERSONIC FLOW OF A RELAXING GAS ABOUT A WEDGE, by F. R. Dressler. Feb. 1961, 39p. (AFOSR-263) (AF 49(638)544) PB 155550 Unclassified

A small-perturbation technique is used to give the change in the shock inclination on a thin wedge in steady, 2-dimensional, hypersonic flow. This change in shock angle is due to either dissociation or a lagging vibrational heat capacity in the flow behind the bow shock-wave. The problem is solved by transferring the physical domain into a "piston" plane with one less space dimension. The resulting unsteady, 1-dimensional problem is solved here. A general result is obtained giving the shock perturbation as a function of the unperturbed-flow parameters, body shape and equilibrium conditions behind the shock. An expression for the final shock inclination is given in closed form. (Contractor's abstract)

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Cornell U. [Graduate School of Aeronautical Engineering] Ithaca, N. Y.

ON SIMILAR SOLUTIONS FOR STRONG BLAST WAVES AND THEIR APPLICATION TO STEADY HYPERSONIC FLOW, by E. F. Brocher. [1961] [8]p. incl. diagrs. refs. (AFOSR-580) (AF 49(638)544) Unclassified

Also published in Jour. Aerospace Sci., v. 29: 694-701, June 1962.

The general solution of the strong blast waves is found in the Newtonian approximation – i. e., neglecting terms of order ϵ (density ratio across the shock) compared with terms of order 1. The expressions obtained for the pressure, temperature, density, and velocity profiles are simple. The results are applied to power-law bodies in hypersonic flow using the equivalence principle. Higher-order approximations for strong blast waves are investigated for the cases in which the shock layer is thin. A simple pressure formula is found, which constitutes an improvement upon the Newton-Busemann formula, and some of its applications are shown. (Contractor's abstract)

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Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

A THEORETICAL APPROACH TO A STUDY OF STALL-FLUTTER PROBLEMS, by J. M. Li. June 1961, 64p. incl. refs. (AFOSR-899) (AF 49(638)-544) Unclassified

An analytic method for the study of stall flutter with one degree of freedom in torsion is developed. The aerodynamic moment is determined from quasi-steady theory, 2 essential features being introduced: (1) account is taken of nonlinear behavior by expansion of the static-moment curve in a Taylor series about the mean incidence angle for terms up to the third power in the effective angle of attack; and (2) the influence of the von Kármán vortices shed from the given blade, or from the aerodynamic interference of other blades, is represented by a forcing function of general harmonic form. The response of the system after a quasi-steady state is reached is determined by the method of Kryloff and Bogoliuboff. The stability problem, and distinctive nonlinear characteristics such as the limit cycle and jump phenomena are discussed. An illustrative example is included, and it is shown that the method holds considerable promise.

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Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

LINEARIZED OSCILLATIONS IN A PLASMA, by G. Schubert. Sept. 1961 [82]p. incl. diagrs. (AFOSR-1026) (AF 49(638)544) AD 265101 Unclassified

The possible modes of oscillation of a plasma are determined from the linearized equations of the 2-fluid model. The linearization is carried out in the presence of a strong steady magnetic field, and only wave propagation normal to the magnetic field is considered. These equations determine the regimes of applicability for the single-fluid equations and the magnetoionic theory; and both theories are found to be special cases of the general equations. The linearized equations of the single-fluid model are used to investigate the interaction of a low frequency electromagnetic wave with a semi-infinite plasma. The magnetoionic theory is found to be a special case of the linearized 2-fluid equations. (Contractor's abstract)

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Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

THEORY OF VISCOUS MAGNETOGASDYNAMIC FLOW IN SLOWLY DIVERGENT TWO-DIMENSIONAL CHANNELS, by B. U. O. Sonnerup. Sept. 1961, 160p. incl. illus. tables. (AFOSR-1332) (AF 49(638)-544) AD 265103 Unclassified

Also published in Plasma Hydromagnetics; Sixth Lockheed Symposium on Magnetohydrodynamics, Palo Alto, Calif. (Dec. 15-16, 1961), Stanford U. Press, 1962, p. 124-136.

A class of viscous magnetogasdynamic flows at moderate Reynolds number in slightly divergent 2-dimensional channels is treated theoretically. The

conducting walls of the channel serve as electrodes and are connected to an external load so that the device operates as a power generator. The main component of the applied magnetic field is perpendicular to the flow direction but parallel to the channel walls. The flowing medium is a slightly ionized gas with variable fluid properties. In particular 2 different mathematical models of the electrical conductivity are used. The theory pertains to low values of the magnetic Reynolds number, based on the channel height, and to moderate values of the Hall parameter. Entrance and exit effects are not considered. Numerical examples pertaining to various types of boundary conditions on temperature, wall heat transfer, or potential difference across the channel are presented showing channel shapes, velocity and temperature profiles and efficiency data. (Contractor's abstract)

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Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

INTERACTION OF LOW-FREQUENCY ELECTROMAGNETIC WAVES WITH A PLASMA, by D. L. Turcotte and G. Schubert. [1961] [6]p. (AFOSR-2396) [AF 49-(638)544] Unclassified

Also published in Phys. Fluids, v. 4: 1156-1161, Sept. 1961.

The interaction of a low-frequency electromagnetic wave with a semi-infinite plasma is considered. The single-fluid equations of magneto-gas dynamics are linearized in the presence of a strong, uniform, steady magnetic field. Solutions are obtained for both normal incidence and parallel propagation of the electromagnetic wave. In both cases the strong, steady magnetic field is parallel to the interface and the magnetic component of the incident wave has the same direction. In the examples considered, the parameter $\mu_0^2 \sigma_0 H_0^2 / \rho_0 \omega$ determines the interaction between electromagnetic and acoustic modes. With normal incidence an acoustic mode is excited if this parameter is of order one. In the case of parallel propagation an appreciable parallel velocity component is excited when the governing parameter is quite small. (Contractor's abstract)

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Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

THE EFFECT OF SLIP, PARTICULARLY FOR HIGHLY COOLED WALLS, by N. Rott and M. Lenard. [1961] [5]p. incl. diagr. (AFOSR-2841) (AF 49-(638)544) Unclassified

Also published in Jour. Aerospace Sci., v. 29: 591-595, May 1962.

It is found that for boundary conditions on the velocity slip and on the temperature jump which are not oversimplified in an unrealistic way, the effect of these phenomena on the heat transfer and the shear at a stagnation point is of the order of the ratio of the mean free path outside the boundary layer to the boundary layer thickness, even for highly cooled walls. A simplified theory of this effect is given, which puts the physical reasons for the results in evidence and agrees closely with the more accurate calculations. It is concluded that the effects of slip and jump are not negligible in comparison with other low-Reynolds number corrections, even for very cold walls. (Contractor's abstract)

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Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

SOME PARADOXES OF SUB-ALFVENIC FLOW OF A COMPRESSIBLE CONDUCTING FLUID, by W. R. Sears. [1961] [10]p. incl. diagrs. table, refs. (AFOSR-3393) (AF 49(638)544) Unclassified

Also published in Proc. Symposium on Electromagnetics and Fluid Dynamics of Gaseous Plasma, New York (Apr. 4-6, 1961) Brooklyn, Polytechnic Press, 1962, p. 363-372. (AFOSR-3388)

Steady magnetogasdynamic flows in the category called "aligned-fields flows" may be classified as sub-Alfvénic or super-Alfvénic when the flow speed is respectively, less or greater than the Alfvén-wave speed. For plane or axisymmetric sub-Alfvénic flow of a perfectly conducting gas, there are both elliptic and hyperbolic regimes in both the subsonic and supersonic speed ranges. It is shown that these are consequences of the anisotropic propagation properties of magnetosonic waves. One result is a possibility of smooth transition directly from elliptic to hypercritical flow at points in the flow field. Some examples illustrating this phenomenon are shown. An apparent paradox is posed by supersonic-elliptic flow; it is conjectured that this must be resolved by introduction of magnetogasdynamic shock waves, and some possible flow patterns are sketched. (Contractor's abstract)

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Cornell U. [Graduate School of Aeronautical Engineering] Ithaca, N. Y.

ON "TRANSCRITICAL" AND "HYPERCRITICAL" FLOWS IN MAGNETOGASDYNAMICS, by [A.] R. Seebass. [1961] [7]p. incl. diagrs. (AF 49(638)544) Unclassified

Published in Quart. Appl. Math., v. 19: 231-237, Oct. 1961.

The existence of smooth flows in the transonic, trans-Alfvênic, and hypercritical regimes has been determined. The flow behavior in the hypercritical regime will generally be regular for the special case $\gamma = 2$.

The new and interesting phenomena associated with the flow of a highly conducting gas in the presence of a strong aligned magnetic field have been exemplified in 2 simple solutions.

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Cornell U. [Graduate School of Aeronautical Engineering] Ithaca, N. Y.

THEORY OF UNSTEADY FLOW ABOUT THIN CYLINDERS IN FLUIDS OF HIGH ELECTRICAL CONDUCTIVITY, by L. E. Ring. [1961] [23]p. incl. diagrs. refs. (AF 49(638)544) Unclassified

Published in Jour. Fluid Mech., v. 11: 417-439, Nov. 1961.

A theory is developed for the incompressible flow of a fluid with high electrical conductivity about thin cylinders (airfoils) in non-uniform motion. A uniform magnetic field is applied parallel to the free stream and solutions are obtained subject to the restriction of small perturbations. The effects of viscosity are included, for the most part, only through the use of the Kutta condition, where applicable, for lifting airfoils. The validity and range of applicability of the infinite-conductivity assumption are determined on the basis of an order-of-magnitude analysis; the general character of the flow is discussed at length. The flow-field for infinite conductivity is changed from the non-magnetic case only through the new transport speed of vorticity; the forces on the airfoil are changed due to surface currents. For the case of the Alfvén speed less than the free-stream speed, the airfoil lift and pitching moment are given in integral form for general unsteady-airfoil motion and are given in closed form for harmonic oscillations. The forces at moderate frequencies may be larger than in the corresponding nonmagnetic case. The response to a unit-step change in the downwash is studied and the asymptotic form of the lift is obtained for small and large time. For the case of the Alfvén speed greater than the free-stream speed, vorticity and current are shed from both the leading and trailing edges. Therefore the extension of the usual Kutta condition is not obvious. It is shown that if finite viscosity and/or conductivity tend to remove the trailing-edge singularity, the flow is unstable and no steady flow can be obtained. (Contractor's abstract)

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Cornell U. [Graduate School of Aeronautical Engineering] Ithaca, N. Y.

SUB- AND SUPER-ALFVÉNIC FLOWS PAST BODIES, by W. R. Sears and E. L. Resler, Jr. [1961] [18]p. incl. diagrs. refs. (AF 49(638)544) Unclassified

Published in Advances in Aeronaut. Sci., v. 3-4: 657-674, 1961.

In steady magnetohydrodynamic flows past obstacles an important parameter is the "Alfvén number" m, defined as the ratio of stream speed to the speed of Alfvén waves. To illustrate the significance of this parameter, the particular category of flow is considered in which the undisturbed velocity and magnetic-field vectors far from the obstacle are parallel or anti-parallel, i.e. "aligned-fields" flow. For such flows the change from $m > 1$ (super-Alfvénic) to $m < 1$ (sub-Alfvénic) is especially profound. Contrasts between super- and sub-Alfvénic flows are described in terms of the following categories of sub-Alfvénic phenomena: (1) upstream wakes, (2) upstream-inclined waves, and (3) elliptic supersonic and hyperbolic subsonic flows; negative lift of airfoils at positive incidence. These phenomena are discussed with a view toward explaining their origins. It is concluded that none violates simple physical principles, but that the lift produced in elliptic sub-Alfvénic regimes cannot be predicted with confidence until the analog of the Kutta-Joukowski condition is understood. Finally, an attempt is made to assess the probability of laboratory observations of these phenomena. It is concluded that values of the magnetic Reynolds number can be realized that will permit these effects to be studied before they are attenuated by diffusion.

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Cornell U. [Graduate School of Aeronautical Engineering] Ithaca, N. Y.

DIFFUSION OF A MAGNETIC FIELD INTO A HIGH-DENSITY PLASMA (Abstract), by D. L. Turcotte and T. J. Falk. [1961] [1]p. [AF 49(638)544] Unclassified

Presented at meeting of the Amer. Phys. Soc., Berkeley, Calif., Nov. 20-22, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 371, Apr. 23, 1962.

If a plasma with infinite conductivity is confined by a strong magnetic field, the current sheath at the edge of the plasma has zero thickness. However, if the plasma has finite conductivity, the thickness of the current sheet increases with time. The complete magnetohydrodynamic equations appropriate for the confinement of a high-density plasma are simplified by a boundary-layer type of approximation. The parameter analogous to the viscous Reynolds number is a magnetic Reynolds number based on time and the Alfvén velocity. After this simplification, a similarity solution is used to reduce the equations to 3 total differential equations. Preliminary numerical results have been obtained for a range of thermal conductivity values.

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Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

HIGH-FIELD EFFECTS IN MAGNETOHYDRODYNAMICS, by W. R. Sears. [1961] [7]p. incl. diagrs. refs. [AF 49(638)544] Unclassified

Published in Proc. Internat'l. Conf. on High Magnetic Fields, Cambridge, Mass. (Nov. 1-4, 1961), Cambridge, M.I.T. Press and New York, Wiley and Sons, 1962, p. 652-658, 1962.

Flows in which a uniform, steady stream is only slightly perturbed as it flows past a slender obstacle are studied. It is assumed that these bodies are cylinders placed across the stream, so that the flow is two-dimensional. The most interesting phenomena predicted by these studies are "forward-inclined waves and upstream wakes" and "wave free supersonic flow." Both of these topics are discussed after a description of pertinent dimensionless parameters characterizing magnetohydrodynamic flows (Alfvén, Reynolds, Mach and magnetic Prandtl numbers) are given.

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Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

SOME STUDIES OF COUETTE-TYPE FLOWS, by J. Kondo. Jan. 1961 [78]p. incl. refs. (AFOSR-70) (AF 49(638)674) PB 155549 Unclassified

Some mathematical models are introduced and the exact treatment of compressible Couette-type flow is shown, although numerical results are not yet obtained. The simple Couette flow is obtained as the first approximation of the exact treatment, and some effects of mathematical models are investigated. Couette flow with air injection is solved and the solution is obtained in a closed form under certain conditions. This is the unique case where a cross flow exists and still the flow is uniform in the direction of the main flow. Numerical results are obtained. Couette flow of equilibrium dissociating air is analyzed and numerical examples assuming the specific heat of the gas at constant pressure, Cp, to be constant are shown. A method of improvement to include cases of variable Cp is suggested. (Contractor's abstract)

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Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

ON THE FLOW OF INVISCID CONDUCTING FLUID PAST A CIRCULAR CYLINDER WITH APPLIED MAGNETIC FIELD, by K. Tamada. July 1961 [47]p. incl. diagrs. (AFOSR-1087) (AF 49(638)674) AD 265102 Unclassified

An analysis is made on the steady flow of an incompressible, inviscid, electrically conducting fluid past a circular cylinder, in the presence of an applied magnetic field parallel to the undisturbed stream. The fundamental equations are linearized by making use of the Oseen-type (or small-perturbation) approximation in order to make the problem tractable. This approximation is difficult to justify in the vicinity of the cylinder. Qualitatively correct pictures of the flow and magnetic fields may be obtained, just as in the classical Oseen theory for the ordinary viscous flow. Explicit solutions for the velocity and magnetic fields are obtained in series expansion in R_m, the magnetic Reynolds number, correct to $O \times R_m^4$. More complete solutions are given for the special case in which S (pressure number) is infinite and SR_m is finite, and for the case where S = 1 and $(S-1) R_{m=0}$ or finite.

Some numerical discussions of the results are also made. (Contractor's abstract)

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Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

ON THE DISTORTION OF WEAK MAGNETIC FIELD BY THE FLOW OF CONDUCTING FLUID PAST A CYLINDRICAL OBSTACLE, by K. Tamada. Sept. 1961, 26p. incl. diagrs. (AFOSR-1551) (AF 49(638)-674) AD 272081 Unclassified

The distortion of a uniform magnetic field, which is parallel to the flow at infinity, caused by the flow of an incompressible inviscid fluid with large electric conductivity past a cylindrical obstacle is studied. The magnetic field is assumed to be so weak that its influence upon the flow may be neglected. The analysis revealed the following features: The magnetic field outside the cylinder is aligned with the flow owing to high conductivity of the fluid except in a thin layer along the surface of the cylinder and in a wake behind it. The field inside the cylinder (supposed to be non-conducting) is almost zero, except in the vicinity of the rear stagnation point where the lines of force converge and form a singularity (sink inside and source outside the cylinder) for infinite conductivity of the fluid. (Contractor's abstract)

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Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

THE BLUNT-LEADING-EDGE PROBLEM IN HYPERSONIC FLOW, by H. Oguchi. Dec. 1961 [28]p. incl. diagrs. refs. (AFOSR-1866) (AF 49(638)674) AD 272083 Unclassified

Study was made of the hypersonic flow over a flat plate with a blunt nose. The analysis is based on the flow model in which the flow field behind the shock wave may be divided into 2 regions: (1) the inviscid-hypersonic-flow region and (2) the entropy layer, across which the pressure undergoes no appreciable change. (Contractor's abstract)

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Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

ON COMBINED FREE AND FORCED CONVECTIVE LAMINAR MAGNETOHYDRODYNAMIC FLOW AND

HEAT TRANSFER IN CHANNELS WITH TRANSVERSE MAGNETIC FIELD, by Y. Mori. [1961] [7]p. incl. diagrs. (AF 49(638)674) Unclassified

Published in Internat'l. Developments in Heat Transfer; Proc. 1961-1962 Heat Transfer Conf., Boulder, Colo. (Aug. 28-Sept. 1, 1961) and London (Gt. Brit.) (Jan. 8-12, 1962), New York, Amer. Soc. Mech. Engineers, 1963, p. 1031-1037.

The problem of fully developed, combined free and forced convective, laminar magnetohydrodynamic flow and heat transfer in vertical channels with transverse magnetic field is studied, and the effects of the magnetic field on the flow and temperature patterns are discussed. When M denotes Hartmann number and Ra Rayleigh number, this problem is found to be divided into 3 cases. The first one is that for $M^4 < 4Ra$, where the magnetic field is shown to flatten the velocity profiles. The second case considers the flow when $M^4 > 4Ra > 0$, which has the Hartmann flow as its limit. It is also shown that between these 2 cases there exists a very narrow region where the ratio of the mean velocity to that without the magnetic field has a weak singularity. The third case is for $Ra < 0$. This includes the problem of dependence of the flow direction on Rayleigh number, and it is shown that the magnetic field resists the reversal of the flow direction and increases the Rayleigh number required for flow reversal. (Contractor's abstract)

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Cornell U. [Graduate School of Aeronautical Engineering] Ithaca, N. Y.

CHEMICAL KINETICS: A GENERAL INTRODUCTION, by S. H. Bauer. [1961] 38p. incl. diagrs. table, refs. (AFOSR-3578) (AF 49(638)716) AD 284537 Unclassified

Presented at ARS Internat'l. Hypersonic Conf., Cambridge, Mass., Aug. 16-18, 1961.

Also published in Prog. in Astronaut. and Rocketry, v. 7: 143-180, 1962.

The relationships between the experimentally determined quantities and molecular parameters are reviewed, and attention is called to the fundamental assumptions. In hypersonic gas dynamics, with the fluid at the high temperatures and low densities, the half times for chemical reactions are comparable to characteristic flow times. The corresponding terms which must be inserted in the flow equations appear as phenomenological rate constants. In the low density regimes, one should describe the system in molecular variables only; the chemical rate constants would then be replaced by averages over differential collision cross sections which are very sensitive to the molecular structures and the details of the collisions. Even for the simplest reactions, such expressions are very complex, and the data are insufficient to permit an adequate formulation. Gas dynamic procedures have permitted the extension of rate measurements to temperatures and densities not ordinarily available to the chemical kineticist. (Contractor's abstract)

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Cornell U. Lab. of Atomic and Solid State Physics, Ithaca, N. Y.

POSITIVE ION EMISSION FROM METAL SURFACES, by R. [C.] Bradley and E. Ruedl. [1961] [11]p. incl. diagrs. table, refs. (AFOSR-791) [AF 49(638)748] 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. 1: 150-160, 1962.

Some recent studies with a mass spectrometer of the emission of positive ions from metal surfaces are discussed. Analysis of thermionic emission of impurities gives quantitative information concerning diffusion through and desorption from samples of copper and platinum. Similarities and differences between secondary ions (that is, ions released by ion bombardment) and sputtered particles are discussed, and some observations made regarding the efficacy of sputtering as a method of cleaning surfaces. Evidence in support of the hypothesis that reflected gaseous ions are sputtered from surface layers rather than reflected is presented. (Contractor's abstract)

664

Cornell U. Lab. of Atomic and Solid State Physics, Ithaca, N. Y.

IONS SPUTTERED FROM COPPER, by R. C. Bradley and E. Ruedl. [1961] [9]p. incl. diagrs. tables, refs. (AFOSR-1376) (AF 49(638)748) Unclassified

Also published in Jour. Appl. Phys., v. 33: 880-888, Mar. 1962.

Positive ions sputtered from copper under a variety of different bombardment and surface conditions have been mass analyzed and found to include species characteristic of the incident ions ("reflected" ions), of copper and some of its compounds, and of alkali metal impurities. A model is described which accounts for most of the properties of the reflected ions, not in terms of reflection but in terms of the amount of gas trapped and released by the surface. The ionizing agent is unknown but is thought to be the bombarding ions (or their secondary electrons) rather than the surface. The Cu^+ ions, on the other hand, seem to be surface ionized sputtered particles originating from patches of high local work function. Yield data seem to correlate qualitatively with probable changes in work function caused by absorption of impurities, sputtering, or vacuum annealing. The CuO^+ peak is believed to be caused by dissociation and ionization of cuprous oxide molecules under the action of the ion bombardment. The rates of formation and disappearance of this peak were studied under various

circumstances. An unusually high sputtering rate was found to occur at an argon bombarding energy of 75 ev. Na and K impurities sputtered from and ionized by the copper surface showed some interesting transient effects which can be interpreted in terms of a low sputtering probability compared to the base metal. The relevance of these experiments to sputtering theories, ion pumping, oxidation, cleanup, and surface ionization theory is discussed. (Contractor's abstract)

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Cornell U. Lab. of Atomic and Solid State Physics, Ithaca, N. Y.

VAPORIZATION OF IMPURITIES IN COPPER, INCLUDING THOSE INTRODUCED BY ION BOMBARDMENT, by E. Ruedl and R. C. Bradley. [1961] [6]p. incl. diagrs. table, refs. (AFOSR-4150) [AF 49-(638)748] Unclassified

Also published in Jour. Phys. and Chem. Solids, v. 23: 885-890, July 1962.

A mass spectrometric analysis has been made of particles sputtered and/or evaporated from the (221) plane of a high-purity single crystal copper surface in high vacuum. The results are relevant to such processes as heterogeneous catalysis and nucleation, as well as to the techniques of cleaning solid surfaces by ion bombardment and annealing. Copper oxide layers may be completely removed from a copper surface (or at least reduced to a very small fraction of a monolayer) by repeated cycles of inert gas ion bombardment and annealing. During ion bombardment, particles of the bombarding beam and the ambient gas are physically trapped by the surface. These may be released from the copper by heating it to 200°C. The activation energy for this release is 0.3 ± 0.1 ev (measured only for argon). Sodium and potassium bulk impurities diffuse readily to the surface at a temperature of 600°C with activation energies of 2.8 ± 0.1 and 2.3 ± 01. ev, respectively. These same impurities also desorb from copper at 600°C with an activation energy (for potassium) of 1.2 ± 0.1 ev. The surface concentration of sodium and potassium, while always less than a monolayer, was never found to be zero; it was less after annealing, however, than after ion bombardment. (Contractor's abstract)

666

Cornell U. Sibley School of Mechanical Engineering, Ithaca, N. Y.

A SEQUENTIAL MULTIPLE-DECISION PROCEDURE FOR SELECTING THE BEST ONE OF SEVERAL NORMAL POPULATIONS WITH A COMMON UNKNOWN VARIANCE. II. MONTE CARLO SAMPLING RESULTS AND NEW COMPUTING FORMULAE, by R. E. Bechhofer and S. Blumenthal. May 1, 1961, 26p. incl. tables. (Technical rept. no. 16) (AFOSR-671) (AF 49(638)230) AD 257405 Unclassified

Also published in Biometrics, v. 18: 52-67, Mar. 1962.

Reference is made to an earlier paper by R. E. Bechhofer (Biometrics, v. 14: 408-429, 1958) in which the sequential multiple-decision procedure used in the present paper, was described. The purpose of the present work is to present results which are important for the practical application of the procedure. Studies were made using a high-speed electronic computer to simulate the operation of applying the procedure to experimental data. In the course of programming the procedure for the electronic computer it was found that the computing formulas could be considerably simplified. As a result, the computations at each stage of experimentation can be reduced to working with certain sums and sums of square which are quite similar to those used with the associated one-stage analysis of variance. Report is made of the statistical assumptions, a statement of the experimenter's goal, specification, and requirement, and a description of the sequential procedure.

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Cornell U. Sibley School of Mechanical Engineering, Ithaca, N. Y.

CONTRIBUTIONS TO THE THEORY OF THE TWO-SAMPLE PROBLEM, by S. Blumenthal. Oct. 1, 1961, 71p. incl. refs. (Technical rept. no. 17) (AFOSR-1786) (AF 49(638)230) AD 266267 Unclassified

The problem of determining whether 2 samples came from the same population (2-sample problem) is discussed. Based on m and n independent observation on 2 independent stochastic variables, x and y, the null hypothesis that x and y have identical cumulative distribution functions is tested. A sequential test for the 2-sample problems is described, and its properties studied. When the size of the test is small and the power near unity, the Wald approximations to the average sample size of the Wald sequential probability ratio test applied to the binomial distribution are shown to be valid approximations to the average sample size of the proposed 2-sample test. An estimate of the efficiency of the proposed sequential test is obtained by comparing the approximation of its expected sample size to an approximation of the sample size required by a fixed sample size test when the 2 tests guarantee the same error probabilities.

668

Council for International Organizations of Medical Sciences, Paris (France).

BRAIN MECHANISMS AND LEARNING; A SYMPOSIUM, Montevideo (Uruguay), Aug. 2-8, 1959, ed. by J. F. Delafresnaye, A. [E.] Fessard and others. Oxford, Blackwell Scientific Publications, 1961, 702p. incl. illus. diagrs. tables, refs. (AFOSR-1191) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(062)207 and Science Co-operation Office of Unesco for Latin America) AD 262096 Unclassified

A comprehensive collection of research concerning learning, memory and behavior patterns is presented. Some of the topics discussed are distinctive features of learning in the higher animal, changing concepts of the learning mechanism, and the role of the cerebral cortex in the learning of an instrumental conditional response.

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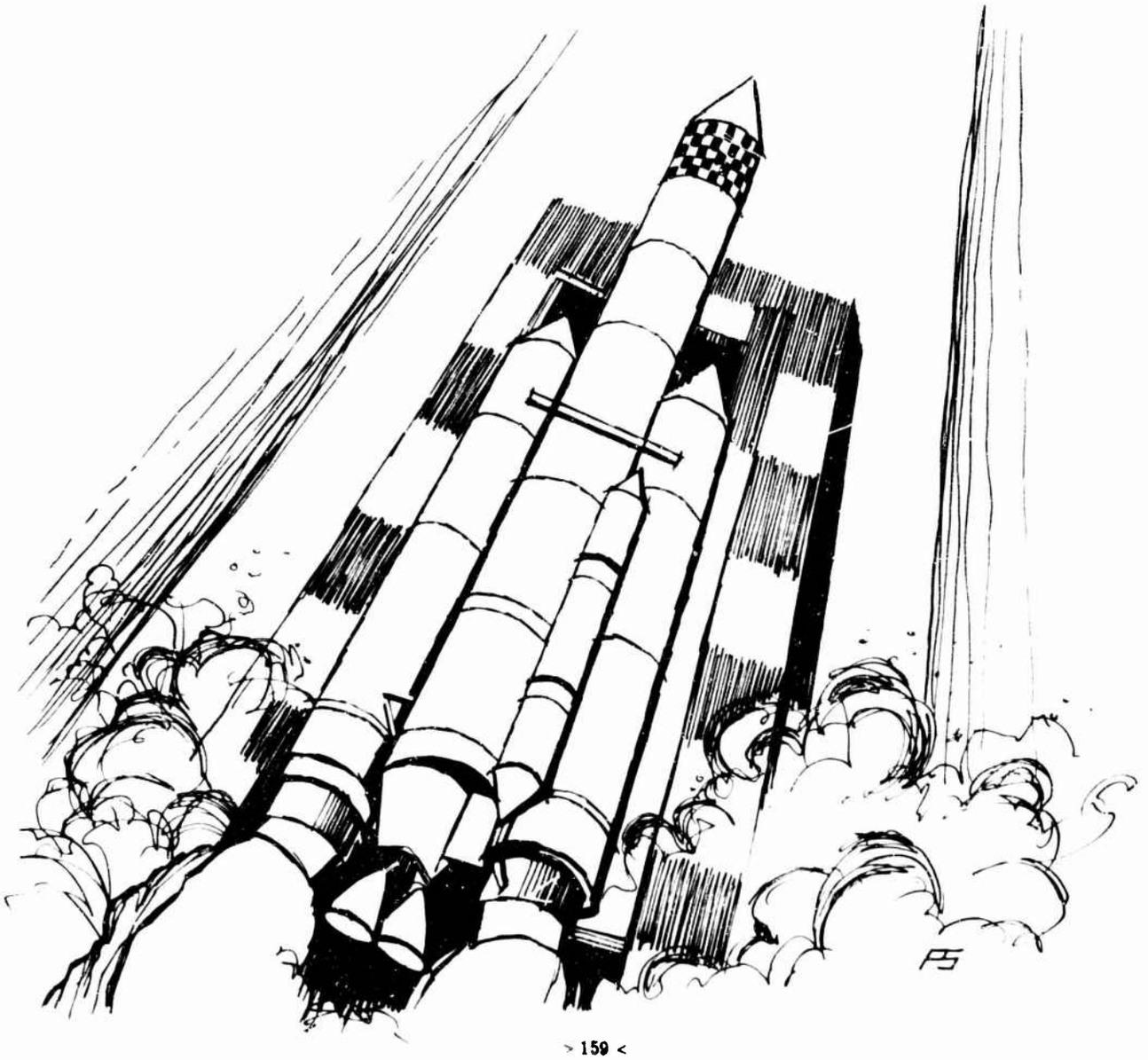
Cranfield Coll. of Aeronautics, Bletchley, Bucks (Gt. Brit.).

HEAT TRANSFER IN THE INCOMPRESSIBLE BOUNDARY LAYER ON A FLAT PLATE WITH ARBITRARY HEAT FLUX, by A. G. Smith and V. L. Shah. [1960] [2]p. incl. diagrs. (AF 61(052)287) Unclassified

Published in Jour. Aerospace Sci., v. 28: 738-739, Sept. 1961.

Recently equations have been derived to find wall temperature for an arbitrary heat flux, from the heat-transfer equations for an arbitrary wall temperature. The equations presented in the present paper have been derived directly from an integral energy equation, they are simple, and they give results within 1.5% of those of Reynolds et al and Rubesin.

Cruft Lab., Cambridge, Mass.
see Harvard U. Cruft Lab., Cambridge, Mass.



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Delaware U. [Dept. of Chemical Engineering] Newark.

SELF-DIFFUSION IN DELTA IRON, by L. I. Staffansson and C. E. Birchenall. Apr. 1961 [21]p. incl. diagrs. table, refs. (AFOSR-733) (AF 49(638)-872) AD 259447 Unclassified

Self-diffusion of Fe was measured in delta Fe between 1404 and 1518°C. Although the delta Fe results are adequately described by the equation $D = 0.019 \exp(-2400/RT)$ cm^2/sec, in order to join these coefficients in a reasonable way with the self-diffusion coefficients of α Fe, it is necessary to introduce a curved line in the plot of logarithm of diffusivity versus reciprocal of absolute temperature. Although this curved line diminishes the magnitude of the Curie point anomalies observed for self-diffusion in α Fe and probably for diffusion in Fe-V alloys, it does not appear that the excess vacancy formation energy arising from spin ordering is enough to account for the whole Curie point effect. Possible ways to obtain information about changes in the activation energy for vacancy motion are discussed. (Contractor's abstract)

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Delaware U. Dept. of Chemical Engineering, Newark.

OXIDATION OF METALS AND ALLOYS, by C. E. Birchenall. Final rept. July 1, 1960-Dec. 31, 1961, 10p. (AFOSR-1965) (AF 49(638)872) AD 270051 Unclassified

Effort was made to study the transport processes that contribute to, or control, the oxidation of metals and alloys at high temperatures. Attention centsred mainly on diffusion of ions in metals, alloys, oxides and sulfides and the dependence of these processes on defect concentrations and other aspects of the structure including electron spin order. Preparations are being made to explore the relation between the diffusive phenomena and oxide plasticity, because these processes affect the adherence of scales. Some preliminary studies were made of methods of preparing large single crystals. (Contractor's abstract)

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Delaware U. Dept. of Chemistry, Newark.

RELATIONSHIP BETWEEN CERTAIN LATTICE SUMS AND THE MADELUNG CONSTANT, by R. H. Wood. [1961] [2]p. (AFOSR-J57) (AF 49(638)1054) AD 400083 Unclassified

Also published in Jour. Chem. Phys., v. 37: 681-682, Aug. 1962.

It is the purpose of this note to present a simple method of deriving relationships between lattice sums representing the energy of separating 2 hemicrystals and the Madelung constant which is not limited to any type of crystal and which has a simple physical meaning. The basic method is to find a set of forces which will counteract the electrostatic forces and keep the crystal in its position. In order to affect a simplification, the set of forces should be smaller in number than the electrostatic forces. The simplest case is nearest-neighbor forces. Once the forces have been calculated, the lattice energy is simply the work done by the forces in uniformly expanding the crystal to infinite separation.

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Denver U. Research Inst., Colo.

THEORETICAL STUDY OF INTERACTION OF SINGLE-DOMAIN PARTICLES, by A. W. Jenkins, Jr. Final rept. Sept. 1961 [9]p. incl. diagr. (AFOSR-1374) (AF AFOSR-61-50) Unclassified

Investigation of the magnetic properties of bulk samples of single-domain powder materials is made, taking into account the interaction between particles. A model of 2 spheroidal, single-domain particles is used assuming coherent rotation of magnetization in each domain with a description of the total magnetization vector of the 2 particles as a function of the direction and magnitude of the impressed field. The separation, size, and orientation of the 2 particles are treated as parameters in the calculations and are varied over appropriate ranges and averaged.

674

Documentation, Inc., Washington, D. C.

EXPERIMENTS WITH THE IBM-9900 AND A DISCUSSION OF AN IMPROVED COMAC AS SUGGESTED BY THESE EXPERIMENTS, by M. Taube. Apr. 1961, 20p. (AFOSR-475) (AF 49(638)91) AD 155555 Unclassified

This paper presents the system and machine considerations which led, in the first instance, to the development of the design of a Continuous Multiple Access Comparator; a description of the IBM 9900, which is IBM's reduction to practice of the COMAC principle; certain improvements in design of the COMAC to make it a more efficient low-priced device for the storage and retrieval of information; and finally, the concept of using a wholly new method of logical comparison in order to achieve maximum efficiency from the use of E. P. P. equipment in the storage and retrieval of information. (Contractor's abstract)

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Documentation, Inc., Washington, D. C.

RESEARCH ON THE DEVELOPMENT OF A STORAGE AND SEARCH THEORY. Nov. 1961 [14]p. incl. refs. (AFOSR-1837) (AF 49(638)91) AD 267606
Unclassified

The research on this contract, for the development of a storage and search theory, was begun in December 1956 and concluded in September 1961. The investigations started with identification, descriptions, and definitions of the relationships among basic concepts in storage and retrieval, in order to determine the general characteristics of storage and retrieval systems, and to describe these characteristics in quantitative terms. The development of formal techniques for the logical analysis of storage and search systems was accomplished. A systematic mathematical statement of the storage and search theory, as a special branch of information theory, was worked out. A system was designed, with generalized concepts applicable to any information problem involving the storage and retrieval of changing sets of information. A brief report of the use of this system is given. The frequency of use of the system was considered a significant reflection of the utility value of the Experimental Contract Highlight Operation as an instrument for assisting in the administration of the Air Force research program.

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Duke U. [Dept. of Mathematics] Durham, N. C.

ALGEBRA OF POLYNOMIALS IN SEVERAL VARIABLES FOR A DIGITAL COMPUTER, by L. H. Williams. [1961] [12]p. incl. diagr. refs. (AFOSR-2328) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)1341 and Office of Ordnance Research under DA 36-034-ORD-1535 and DA 31-124-ORD-10-8) Unclassified

Also published in Jour. Assoc. Comp. Mach., v. 9: 29-40, Jan. 1962.

An interpretive system for automatic formal manipulation of polynomials by a digital computer is presented. Its purpose is to make practical the solution of certain types of problems which require formal manipulation of polynomials. For example, it can be used for the formal solution of systems of polynomial equations. The manipulations of the system are those producing the sum, difference, product, remainder after division, greatest common factor, and eliminant of 2 polynomials in any reasonable number of variables. Euclid's Algorithm is used for the greatest common factor, and the eliminant. Applications are discussed and examples are given. The system has been programmed for an IBM 650. (Contractor's abstract)

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Duke U. Dept. of Mathematics, Durham, N. C.

SOME NONLINEAR SYSTEMS OF DIFFERENTIAL EQUATIONS EQUIVALENT TO LINEAR SYSTEMS, by F. G. Dressel and J. J. Gergen. [Oct. 1961] [11]p. (AFOSR-1419) (AF 49(638)892) AD 266468
Unclassified

Also published in Proc. Internat'l. Symposium on Nonlinear Differential Equations and Nonlinear Mechanics, Air Force Academy, Colorado Springs, Colo. (July 31-Aug. 4, 1961), New York, Academic Press, 1963, p. 218-223.

The problem, what equations of order n have general solutions expressible in the form of a variable set of solutions of a fixed linear differential equation, is considered for systems of 2 and 3 equations. Results for the case n = 2 , closely parallel the results for linear homogeneous second order equations. For linear systems in 3 unknowns, information of a negative nature is obtained. That is, results for n = 2 cannot be extended to systems in 3 unknowns within the broad class of solution forms examined.

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Duke U. [Dept. of Mathematics] Durham, N. C.

AN AXISYMMETRIC BOUNDARY VALUE PROBLEM OF MIXED TYPE FOR A HALF-SPACE, by M. Lowengrub and I. N. Sneddon. Oct. 1961 [12]p. (AFOSR-1667) (AF 49(638)892) AD 266471 Unclassified

Also published in Proc. Edinburgh Math. Soc., v. 13: 39-46, 1962.

In problems in the mathematical theory of elasticity related to the symmetric deformation of an infinite elastic solid with an external crack we encounter the problem of determining an axisymmetric function which is harmonic in the half-space and satisfies the mixed boundary conditions. The solution of this mixed boundary value problem is reduced to that of a pair of dual integral equations whose solution is derived by an elementary method. By means of this solution, an integral representation of the axisymmetric function can be constructed; its properties are discussed. The forms of the solution in certain special cases are then derived.

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Duke U. [Dept. of Mathematics] Durham, N. C.

THE SOLUTION OF A PAIR OF DUAL INTEGRAL EQUATIONS, by M. Lowengrub and I. N. Sneddon. Sept. 1961 [9]p. incl. refs. (AFOSR-1822) (AF 49(638)892) AD 414048 Unclassified

Also published in Proc. Glasgow Math. Assoc., v. 6: 14-18, Jan. 1963.

The dual integral equations

$$\int_0^\infty \xi^n \psi(\xi) J_\nu(\xi\rho)d\xi = f(\rho),\ 0 \le \rho \le 1,\ -2 < n < 2,$$

$$\int_0^\infty \psi(\xi) J_\nu(\xi\rho)d\xi = 0,\ \rho > 1,$$ where $f(\rho)$ is prescribed

and J_ν is the Bessel function of order ν, are solved for $\psi(\xi)$ by an extension of a method due to Copson which is simpler than those employed by several authors. [The authors have tacitly restricted ν so that for $-2 < n < 0$, $2\nu + n + 2 > 0$ and for $0 < n < 2$, $2\nu + n > 0$.] (Math. Rev. abstract)

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Duke U. [Dept. of Mathematics] Durham, N. C.

A NOTE ON SOME RELATIONS BETWEEN FOURIER AND HANKEL TRANSFORMS, by I. N. Sneddon. Sept. 1961 [12]p. (AFOSR-2458) (AF 49(638)892) AD 279940 Unclassified

Also published in Bull. Acad. Polon. Sér. Sci. Math. Astronom. Phys., v. 9: 799-806, 1961.

The author has found a relation between Fourier's sine and cosine transforms, the exponential transform and the Hankel transform $H_\nu\{f(n); \zeta\} = \int_0^\infty xf(n)J_\nu(\zeta n)dn$. He generalizes his results from the single transform to double and triple transforms. He shows how these formulae can be used in the solution of certain problems in potential theory. (Math. Rev. abstract)

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Duke U. [Dept. of Mathematics] Durham, N. C.

BOUSSINESQ'S PROBLEM FOR A HEATED PUNCH. II. SOLUTION FOR A CYLINDRICAL PUNCH. III. SOLUTION FOR A CONICAL PUNCH, by D. L. George and I. N. Sneddon. Sept. 1961 [33]p. incl. diagrs. tables, refs. (AFOSR-2734) (Also bound with its AFOSR-4207) (AF 49(638)892) AD 276567 Unclassified

Also published in Jour. Math. Mech., v. 11: 674-689, Sept. 1962.

A general theory of the Boussinesq problem for the case in which the rigid punch is heated and the elastic body conducts heat was given recently (item no. 618, Vol IV). In this report the detailed calculations are carried out for the case in which the rigid punch has the shape of a flat-ended cylinder or a right circular cone. Solutions are carried out for the cylindrical punch and the conical punch.

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Duke U. [Dept. of Mathematics] Durham, N. C.

THE AXISYMMETRIC BOUSSINESQ PROBLEM FOR A HEATED PUNCH, by D. L. George and I. N. Sneddon. [1961] [35]p. incl. diagrs. refs. (AFOSR-4207) (AF 18-(600)1341 and AF 49(638)892) Unclassified

Also published in Jour. Math. Mech., v. 11: 665-690, Sept. 1962.

For abstract see item no. 618, Vol. IV and item no. 681, Vol. V.

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Duke U. [Dept. of Mathematics] Durham, N. C.

DUAL INTEGRAL EQUATIONS WITH TRIGONOMETRICAL KERNELS, by I. N. Sneddon. Aug. 26, 1961, 6p. (AFOSR-J731) (AF 18(600)1341 and AF 49(638)892) AD 414193 Unclassified

Also published in Proc. Glasgow Math. Assoc., v. 5: 147-152, Jan. 1962.

Given the dual integral equations:

$$(A)\ \int_0^\infty \xi^{-1}\psi(\xi)\cos(x\xi)\,d\xi = f(x),\ 0 \le x \le 1,$$

$$\int_0^\infty \psi(\xi)\cos(x\xi)\,d\xi = 0,\ x > 1.$$

If $f(x)$ can be represented in a series of Jacobi polynomials in the form

$f(x) = \sum_{q=1}^\infty p_q \mathfrak{P}_q(0, \tfrac{1}{2}, x^2)$ $(\mathfrak{P}_q(0, \tfrac{1}{2}, u) = {}_2F_1(-q, q; \tfrac{1}{2}; u))$ and satisfies the condition

$$\int_0^1 \frac{f(x)\,dx}{\sqrt{(1-x^2)}} = 0,$$ then a solution to (A) is

$\psi(\xi) = 2\sum_{q=1}^\infty qp_q J_{2q}(\xi)$, where $J_q(\xi)$ is the Bessel function of order q. If in (A), $\cos x\xi$ is replaced by $\sin x\xi$ and $f(0) = 0$, the solution is analogous to the above. (Math. Rev. abstract)

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Duke U. Dept. of Zoology, Durham, N. C.

OSMOTIC TOLERANCE OF THE MUSCLES OF THE CRAB-EATING FROG RANA CANCRIVORA, by S. Thesleff and K. Schmidt-Nielsen. [1961] [4]p. incl. illus. diagr. (AFOSR-1984) (AF AFOSR-61-16) Unclassified

Also published in Jour. Cellular and Comp. Physiol., v. 59: 31-34, Feb. 1962.

Muscles of the crab-eating frog R. cancrivora, which unlike other amphibians lives in water of high salinity, are about twice as resistant to hypertonic solutions as are muscles of fresh water frogs. In R. cancrivora tension failure and a reduced speed of contraction occur when the external medium has a salinity of about 300 mm NaCl and a total osmotic concentration which is 3—4 times higher than that of ordinary frog's plasma. The resting and action potentials of single muscle fibers of R. cancrivora are similar in magnitude and time course to those of ordinary frogs. (Contractor's abstract)

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Duke U. Dept. of Zoology, Durham, N. C.

AN ELECTROPHYSIOLOGICAL STUDY OF THE SALT GLAND OF THE HERRING GULL, by S. Thesleff and K. Schmidt-Nielsen. [1961] [4]p. incl. diagrs. (AFOSR-1985) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-16 and National Institutes of Health) Unclassified

Also published in Amer. Jour. Physiol., v. 202: 597-600, 1962.

When the salt gland of the herring gull excretes sodium chloride the duct of the gland becomes positive relative to the blood. Strophanthin, an inhibitor of active sodium transport, prevents the establishment of the positive potential and also blocks gland secretion. The findings suggest that an active transport of sodium from the blood to the gland lumen may be a primary secretory mechanism. (Contractor's abstract)

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Duke U. Medical Center, Durham, N. C.

INFLUENCE OF PSYCHODYNAMIC FACTORS ON CENTRAL NERVOUS SYSTEM FUNCTIONING IN YOUNG AND AGED SUBJECTS, by S. I. Cohen, A. J. Silverman, and B. M. Shmavonian. [1959] [15]p. incl. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)354, Duke U. Regional Center for the Study of Aging, Foundation's Fund for Research in Psychiatry, John and Mary Markle Foundation, and National Institute for Mental Health) Unclassified

Presented at annual meeting of Amer. Psychosom. Soc., Atlantic City, N. J., May 2, 1959.

Published in Psychosom. Med., v. 23: 123-137, 1961.

A matched group of 10 young and 10 old subjects were presented pure tones, neutral phrases, and phrases designed to be charged for the young and for the old subjects while continuous GSR (galvanic skin resistance) recordings were obtained as a measure of CNS (central nervous system) activity. The subjects were then interviewed by a technique structured to evaluate the degree of memory for the preceding experimental period, as well as the meaning of and the affective response to the test situation and stimuli. Arousing expressions appeared to facilitate the older subjects' memories by allowing them to form highly personalized associations. The expressions causing the highest level arousal in the young subjects were associated with a high degree of forgetting which appeared to be analogous to various psychological defenses such as repression and denial, in spite of the fact that the young subjects' over-all recognition was superior to that of the older subjects. The data suggested that the cognitive results were influenced by the old subjects' perception of the experiment as a test of their intellectual capabilities and the young subjects' perception of the experiment as an attempt to uncover information about their feelings, impulses, and values. The results indicated that studies assessing perception and cognitive functions should take into consideration the influence of: (1) reception and conduction of specific sensory inputs; (2) the level of nonspecific CNS activation; and (3) the psychological adaptive mechanisms activated by the psychodynamic implications of the experimental stimul and the emotional arousal produced. (Contractor's abstract)

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Duke U. Medical Center, Durham, N. C.

PSYCHOPHYSIOLOGICAL MECHANISMS OF STRESS RESPONSIVITY, by S. I. Cohen and A. J. Silverman. Annual rept. June 1961 [55]p. incl. diagrs. tables, refs. (AFOSR-1515) (AF 49(638)354) Unclassified

This report briefly summarizes the work in 4 areas which has been investigated by the Dept. of Psychiatry under this contract. The first was on the central nervous system, peripheral, physiological, endocrinological and psychological responses of body and field oriented subjects to experimental situations characterized by uncertainty, social and sensory isolation, and limitation of movement. Studies also include analysis of personality, physiological and central nervous system correlates of body and field perceptual modes, and the exploration of other individual determinants of the response to low sensory input experiments. In addition, a study was made of the influence of

drugs acting on the central nervous system in body and field oriented subjects in low sensory input experiments. Finally, an exploratory study was done on the influence of a psychochemical (LSD) on the response to 2 hr low sensory input experimental conditions.

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[Duke U. Medical Center, Durham, N. C.]

NEUROPHYSIOLOGICAL HUMORAL AND PERSONALITY IN THE RESPONSE TO EXPERIMENTAL STRESS (Abstract), by S. I. Cohen, A. J. Silverman, and B. M. Shmavonian. [1961] [2]p. (AFOSR-J47) [AF 49(638)354] AD 400093 Unclassified

Also published in Abstracts of Proc. Third World Cong. on Psychiatry, Montreal (Canada) (June 4-10, 1961), p. 788-789.

This investigation was aimed at studying the relationship of environmental conditions and individual psychological characteristics to the response of 35 subjects in an experiment designed to create a state of uncertainty by reducing environmental information input. No uniform or psychological effects could be attributed to the experimental conditions when the total subject population was considered. However, sub-groups of subjects, based on pre-experimental testing of perceptual mode and personality characteristics, did not demonstrate a random distribution of responses in that field oriented subjects with high anxiety test scores showed the highest levels of central nervous system arousal, urinary adrenaline, psychological discomfort and anxiety, and the poorest sensory discrimination. A significant correlation was noted between the level of psychological discomfort and the level of urinary adrenaline and peripheral sympathetic nervous system activity. Anxious-passive responses were associated with higher percentages of urinary adrenaline than angry-aggressive responses. EEG evidence of cortical alerting correlated with skin resistance evidence of increased peripheral sympathetic nervous system activity. It was concluded that an individual's psychophysiological response is a function of (1) the environmental condition to which he is exposed, (2) individual personality and perceptual characteristics, and (3) the influence of psychological and neurophysiological activation of physiological and endocrinological changes.

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Duke U. [Microwave Lab.] Durham, N. C.

MICROWAVE DETERMINATION OF ELECTRON CONCENTRATIONS IN FLAME GASES USED AS A SPECTROSCOPIC LIGHT SOURCE, by F. W. Hofmann, H. Kohn, and J. Schneider. [1960] [4]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)765] and Office of Naval Research) Unclassified

Published in Jour. Opt. Soc. Amer., v. 51: 508-511, May 1961.

Measurements of the attenuation of a microwave beam upon crossing a column of flame gases were performed, and the electron concentrations in an acetylene-air flame (T = 2500°K) containing 1 or 2 mixtures of alkali elements were obtained. Results indicate that the ionization of the metallic flame additives is thermally equilibrated in the flame zone chosen for the optical line-intensity measurements. (Contractor's abstract)

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Duke U. Microwave Lab., Durham, N. C.

DEUTERIUM SUBSTITUTION IN AN ESR STUDY OF RADIATION-INDUCED FREE RADICALS, by I. Miyagawa and W. Gordy. [1961] [26]p. incl. diagrs. refs. (AFOSR-1021) (Also bound with its Quarterly progress rept. no. 32, Jan. 1-Mar. 31, 1961) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)-765 and Office of Ordnance Research) AD 259009 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 1036-1040, Mar. 1961.

Effects of deuterium substitution on the electron spin resonance of X-irradiated organic compounds were investigated. The compounds range from carboxylic acids, amino acids, and amides to proteins. Substitution of deuterium for hydrogens of polar groups - hydroxyl, carboxyl, and amino - showed that the hydrogens of these groups generally do not contribute, or give only a slight contribution, to the hyperfine structure of the resonance pattern. Exceptions were found, however, notably formic acid and glycine. Most often the hydrogens bonded to carbon gave the hyperfine structure of the ESR patterns. In some instances the additional information provided by deuterium substitution allowed a fairly definite identification of the free radicals. (Contractor's abstract)

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Duke U. Microwave Lab., Durham, N. C.

THE MILLIMETER WAVE SPECTRUM OF METHYL CYANIDE AND THE A-TYPE DOUBLING, by P. Venkateswarlu, J. G. Baker, and W. Gordy. [1961] [32]p. incl. diagrs. tables, refs. (AFOSR-1022) (Also bound with its Quarterly progress rept. no. 32, Jan. 1-Mar. 31, 1961) (AF 49(638)765) AD 259009 Unclassified

Also published in Jour. Molec. Spectros., v. 6: 215-228, Feb. 1961.

The millimeter wave spectrum of methyl cyanide corresponding to the transitions J = 4 → 5 to J = 11 → 12 in the region 90 kmc – 225 kmc has been studied. Transitions corresponding to the molecules in the ground vibrational state as well as in the excited states

$\nu_8 = 1$ and $\nu_8 = 2$ are observed. The B_O, D_J and D_{JK} obtained for the ground vibrational state are 9198.899 mc, 3.81 kc, and 176.9 kc, respectively and for the excited state $\nu_8 = 1$, 9226.444 mc, 3.8 kc, and 176.9 kc respectively. The pattern for the excited state $\nu_8 = 1$ is equalitatively as expected according to Nielsen's theory, but it has been found that the theory is inadequate to give a quantitative fit. (Contractor's abstract)

692

Duke U. Microwave Lab., Durham, N. C.

TEMPERATURE EFFECTS ON THE FORMATION OF FREE RADICALS IN THE AMINO ACIDS, by F. Patten and W. Gordy. [1961] [38]p. incl. diagrs. refs. (AFOSR-1023) (Also bound with its Quarterly progress rept. no. 32, Jan. 1-Mar. 31, 1961) (AF 49(638)765)
AD 259009 Unclassified

Also published in Radiation Research, v. 14: 573-589, May 1961.

The present investigations show that the free radicals at room temperature in the amino acids are generally not the same as those found when the sample is irradiated at the much lower temperature of liquid nitrogen, 77°K. They show, however, that when the sample is irradiated at the lower temperature and is allowed to warm to room temperature, the radical obtained is usually the same as that produced by irradiation at room temperature. It thus appears that the free radicals observed earlier at room temperature are generally not the primary ones produced by the ionizing irradiation, but are secondary free radicals produced by molecular motions after the primary event of ionization. (Contractor's abstract)

693

Duke U. Microwave Lab., Durham, N. C.

ASYMMETRY OF CYCLOTRON RESONANCE LINES IN THE REACTION ZONES OF LOW-PRESSURE ACETYLENE AND CYANOGEN FLAMES, by E. M. Bulewicz and P. J. Padley. [1961] [17]p. incl. diagrs. tables. (AFOSR-1356) (Also bound with its Quarterly progress rept. no. 33, Apr. 1-June 30, 1961) (AF 49-(638)765) Unclassified

Also published in Jour. Chem. Phys., v. 35: 1590-1593, Nov. 1961.

A marked asymmetry and shift of line maximum (at 17,000 gauss) by more than 100 gauss is reported for cyclotron resonance lines obtained in or very close to the reaction zones of low-pressure flames containing high concentrations of free electrons. The effect is interpreted in terms of the variation of the real part of the refractive index of the flame plasma, at microwave frequencies, in the neighborhood of the absorption line. The electron concentration gradients in the vicinity of the reaction zone then have the effect of refracting the microwaves traversing the finite thickness of the plasma towards or away from the microwave receiver. (Contractor's abstract)

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Duke U. Microwave Lab., Durham, N. C.

ESR SPECTRA OF A GAMMA-IRRADIATED SINGLE CRYSTAL OF DL-SERINE, by D. V. G. L. Narasimha Rao and W. Gordy. [1961] [6]p. incl. diagrs. table. (AFOSR-1357) (Also bound with its Quarterly progress rept. no. 33, Apr. 1-June 30, 1961) (AF 49(638)765)
Unclassified

Also published in Jour. Chem. Phys., v. 35: 764-765, Aug. 1961.

Single crystals of DL serine were grown by slow evaporation of aqueous solutions for a few weeks. The crystals have monoclinic symmetry. There are 4 molecules in the unit cell. Selected crystals of the order of 3 x 2 x 1 mm in size were given gamma-ray dosages of the order of 10^7 r at room temperature. The induced ESR was observed at 9 kmc/sec. The patterns were found to be complex for all orientations of the crystal in the magnetic field, even for the field in the [0 1 0] plane. In an effort to obtain a simpler spectrum single crystals were grown from heavy water solutions. In this process the amino and hydroxyl hydrogens are replaced by deuterium, but the CH hydrogens are not. The following free radical is proposed to explain the isotropic doublet, $COODCH(NDD)CH_2ODO$. In the formation of this free radical presumably one of the C=O bonds of the original molecule is broken, and the oxygen gains the deuterium of the hydrogen bridge. The resulting unpaired electron is localized on the C atom and is coupled to the nearest CH proton spin through the mechanism of hyperconjugation.

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Duke U. Microwave Lab., Durham, N. C.

ELECTRON SPIN RESONANCE OF AN IRRADIATED SINGLE CRYSTAL OF UREA OXALATE, by D. V. G. L. Narasimha Rao and W. Gordy. [1961] [38]p. incl. diagrs. tables, refs. (AFOSR-1358) (Also bound with its Quarterly progress rept. no. 33, Apr. 1-June 30, 1961) (AF 49(638)765) Unclassified

Also published in Jour. Chem. Phys., v. 35: 362-368, July 1961.

The present article describes a study of a single crystal of urea oxalate. Free radicals produced in a single crystal of urea oxalate by gamma-irradiation have been investigated with the method of electron spin resonance.

Only one species of free radical was observed at room temperature. Analysis of the resonance leads to the conclusion that the free radical has the form RĊHOH and has the electron spin density concentrated mostly on the CH carbon. The radical was found to be very stable. While working on some of the substitution products of urea in the powder form, it was found that ureau oxalate when irradiated with gamma-rays gave a spectrum with 4 hyperfine components which are almost symmetric.

696

Duke U. Microwave Lab., Durham, N. C.

ELECTRON SPIN RESONANCE INVESTIGATIONS OF THE PROTEINS, by W. Gordy. [1961] [30]p. incl. diagrs. table, refs. (AFOSR-1359) (Also bound with its Quarterly progress rept. no. 33, Apr. 1-June 30, 1961) (AF 49(638)765) Unclassified

Presented at Colloquium on Applications of Radiofrequency Spectroscopy to Biochemistry and Chemical Structure, Royal Academy of Belgium, Apr. 6-7, 1961.

The progress made to date in electron spin resonance studies is briefly reviewed. Particular attention is given to the doublet resonance of which the free radical giving rise to the resonance is of the form, RHNĊHCOR. The cystine-like resonance is also discussed. It is considerably anisotropic. The cystine-like resonance should be a sensitive device for finding the direction of the C-S bonds in sulfur-containing proteins. Unfortunately, however, in all the species so far investigated only resonances like those in powdered cystine have been observed.

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Duke U. Microwave Lab., Durham, N. C.

ELECTRON SPIN RESONANCE OF AN IRRADIATED SINGLE CRYSTAL OF DEUTERATED DL-TARTARIC ACID, by D. V. G. L. Narasimha Rao and W. Gordy. [1961] [14]p. incl. diagrs. tables. (AFOSR-1658) (Bound with its rept. no. 34, July 1-Sept. 20, 1961) (AF 49(638)765) AD 262001 Unclassified

Also published in Jour. Chem. Phys., v. 36: 1143-1145, Mar. 1, 1962.

The electron spin resonance spectra of an irradiated single crystal of DL-tartaric acid grown from water was found to be complex, but the spectra of a deuterated single crystal could be analyzed and the nature of the free radical ascertained. Measurements were made at 9 and at 23 kmc/sec. For some orientations of the crystals in the external magnetic field an unresolved doublet was observed with weak satellite lines separated by 5 gauss at 9 kmc/sec and 13 gauss at 23 kmc/sec. These satellite lines evidently arise from second-order transitions. The principal values of g are 2.0025, 2.0026, and 2.0047. The principal elements of the nuclear coupling of the CH protons are ± 0.2, ± 1.1, and ± 6.5 gauss. (Contractor's abstract)

698

Duke U. Microwave Lab., Durham, N. C.

ELECTRON SPIN RESONANCE OF AN IRRADIATED SINGLE CRYSTAL OF TRIFLUORCACETAMIDE (Abstract), by R. Lontz and W. Gordy. [1961] [1]p. (AFOSR-2082) (Bound with its Quarterly progress rept. no. 35, Oct. 1-Dec. 31, 1961) (AF 49(638)765) AD 270043 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: 44-45, Jan. 24, 1962.

Also published in Jour. Chem. Phys., v. 37: 1357-1366, Sept. 15, 1962. (Title varies)

Electron spin resonance measurements have been made on gamma irradiated single crystals of CF_3CONH_2. Analysis of the results shows that the irradiation breaks a CF bond, to leave the free radical CF_2CONH_2. The remaining CF bonds become reoriented so that the $\geq C\text{-}CF_2$ group is planar and probably in the plane of the $CONH_2$ group. Although the structure of the crystal is unknown, its form is approximately monoclinic. The present study indicates that there are 2 molecules in the unit cell. The free radicals formed from these have their molecular planes parallel to the 2 crystal faces, ac and bc, which have relative orientations of 68°. Nuclear couplings of the 2 F atoms of the free radical are equivalent and are symmetric about an axis perpendicular to the plane of the free radical with principal elements parallel and perpendicular to the symmetry axis: $A_{\parallel} = 178$ gauss, $A_{\perp} = 24$ gauss. Also the elements of g are axially symmetric and their principal axes have the same direction as those of A, with $g_{\parallel} = 2.0025 \pm 0.0010$ and $g_{\perp} = 2.0045 \pm 0.0010$. It is concluded that the electron spin density is in a π orbital perpendicular to the plane of the free radical with approximately 11% of the density in a p orbital of each of the F atoms.

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Duke U. Microwave Lab., Durham, N. C.

MILLIMETER WAVE SPECTROSCOPY OF HIGH TEMPERATURE MOLECULAR BEAMS. CESIUM AND RUBIDIUM HALIDES (Abstract), by J. R. Rusk and W.

Gordy. [1961] [1]p. (AFOSR-2083) (Also bound with its Quarterly progress rept. no. 35, Oct. 1-Dec. 31, 1961) (AF 49(638)765) AD 270043 Unclassified

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

Also published in Bull. Amer. Phys. Soc., Series II, v. 7: 43, Jan. 24, 1962.

The high temperature molecular beam microwave spectrometer designed by Garrison and Gordy (Phys. Rev., v. 108: 899, 1957) has been improved and used for high precision measurements of millimeter wave rotational spectra of most of the alkali halides. Some of the derived constants are given. Mass ratios obtained for bromine and rubidium isotopes are $\frac{Br^{79}}{Br^{81}}$ = 0.9753102 and $\frac{Rb^{85}}{Rb^{87}}$ = 0.9770177. Similar results have been obtained for the corresponding halides of Li, Na, and K.

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Duke U. Microwave Lab., Durham, N. C.

ELECTRON SPIN RESONANCE OF FREE RADICALS PRODUCED BY GAMMA IRRADIATION OF VARIOUS SUBSTANCES AT 4.2°K, by H. N. Rexroad and W. Gordy. [1961] [24]p. incl. diagrs. refs. (AFOSR-2084) (Also bound with its Quarterly progress rept. no. 35, Oct. 1-Dec. 31, 1961) (AF 49(638)765) AD 270043 Unclassified

Also published in Phys. Rev., v. 125: 242-247, Jan. 1, 1962.

Hydrogen atoms and other free radicals were produced by gamma-irradiation of a number of substances at 4.2°K. Electron spin resonance was employed for detection and study of the free radicals within the solids at this temperature. Strong electron spin resonance signals of H atoms could then be produced by dosages of one million r or less in H_2O, HF, H_2, and CH_4, but no H atom signals could thus be produced in HCl, H_2S, NH_3, NaH, or LiH. It was concluded that in HF and H_2O the H atoms are formed from electron capture by the essentially ionic hydrogens rather than by removal of an electron from the molecule (ionization). Because this process does not require displacement of the atoms from their original sites in the lattice, it can take place in hard-frozen, rigid solids. In H_2, CH_4, and similar substances the production of H atoms requires the breaking of covalent bonds. This process, although initiated by ionization, appears to require also the displacement of the H from its original site in the lattice. (Contractor's abstract)

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Duke U. [Microwave Lab.] Durham, N. C.

SUGGESTED ORIGIN OF THE ANOMALOUS LINE-REVERSAL TEMPERATURES IN THE REACTION ZONE OF HYDROCARBON FLAMES, by E. M. Bulewicz and P. J. Padley. [1961] [10]p. incl. diagrs. tables, refs. (AFOSR-3930) (AF 49(638)765) Unclassified

Also published in Combustion and Flame, v. 5: 331-340, Dec. 1961.

Measurements of electron concentrations by the method of cyclotron resonance, and of non-thermal iron line intensities in emission, as a function of composition and dilution in the reaction zone of low-pressure acetylene-oxygen-argon mixtures, reveal a marked similarity in behavior of these 2 quantities. On this and other circumstantial evidence, the possible causes of the anomalous line-reversals can be narrowed down to 2, neither of which can, however, be considered objection-free until further experimental evidence reveals in even more detail the nature of certain of the reaction steps proposed. One of these schemes involves postulating the bimolecular production of an excited species Y* by the mechanism also responsible for electron production. Species Y* must be sufficiently energetic, and be present in sufficient quantity, to produce excited metal atom M* by energy transfer with M. The other—a more specific scheme—involves reaction between M+ and e^- to produce M*, the emitted radiation being discrete. Although there is experimental evidence for all the important steps involved in this second scheme, this scheme, too, can fail if the cross sections for capture of e^- by M+ prove to be too small. Schemes so far postulated involving termolecular reactions are eliminated as not satisfying the experimental observations presented. (Contractor's abstract)

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Duke U. [Microwave Lab.] Durham, N. C.

ELECTRON SPIN RESONANCE OF γ-IRRADIATED SINGLE CRYSTALS OF α-AMINO ISOBUTYRIC ACID, ISOBUTYRAMIDE, AND DL VALINE (Abstract), by H. Shields and W. Gordy. [1961] [1]p. [AF 49(638)765] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 257, Apr. 24, 1961.

The electron spin resonances of γ-irradiated single crystals of α-amino isobutyric acid $(CH_3)_2C(NH_2)COOH$, isobutyramide $(CH_3)_2CHC(NH_2)OH$, and DL valine $(CH_3)_2CHCH(NH_2)COOH$ have been observed at room temperature. The first 2 gave the septet patterns

characteristic of 6 protons with equal and very nearly isotropic couplings of 23 gauss. The g factor observed for both is only slightly anisotropic and is close to that for the free electron spin, 2.0023. It is concluded that the free radical is $(CH_3)_2CCOOH$ for isobutyric acid and $(CH_3)_2CC(NH_2)OH$ for isobutyramide. The pattern for DL valine is incompletely resolved for most orientations, but for H perpendicular to the flat surface of the crystal a septet pattern is observed. The pattern, apparently caused by 6 equivalent protons of 23 gauss coupling, has a triplet substructure which is probably caused by N^{14} coupling of 9 gauss. The free radical is believed to be $(CH_3)_2$ $CCH(NH_2)COOH$.

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Duke U. [Microwave Lab.] Durham, N. C.

ELECTRON SPIN RESONANCE OF H ATOMS PRODUCED BY γ-IRRADIATION OF SUBSTANCES AT 4.2°K (Abstract), by H. N. Rexroad and W. Gordy. [1961] [1]p. [AF 49(638)765] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 257, Apr. 24, 1961.

ESR has been observed in several substances γ-irradiated directly in the microwave cavity at 4.2°K. For dosages less than 10^6 r, strong doublets of H atoms were observed from HF and H_2O with spacings of 506 gauss and line widths of less than a gauss. No H atoms were detected for the same dosage in the related substances HCl and H_2S. Although resonance of H atoms in irradiated H_2O has been previously detected, an anomaly not reported has been observed. The lower field component of the H-doublet in γ-irradiated H_2O at 4.2°K was found to be many times stronger than the upper one, an effect thought to arise from an interaction of the H with an unidentified free radical having a broad resonance which overlaps the lower component and enhances its relaxation. No such anomaly was observed for the D component in irradiated D_2O, but surprisingly in this sample (D above 99%) the lower H component was observed to be an order of magnitude stronger than the D components.

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Duke U. [Microwave Lab.] Durham, N. C.

ELECTRON SPIN RESONANCE STUDIES ON AN IRRADIATED SINGLE CRYSTAL OF DEUTERATED DL-TARTARIC ACID (Abstract), by D. V. G. L. Narasimha Rao and W. Gordy. [1961] [1]p. [AF 49-(638)765] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 257, Apr. 24, 1961.

The ESR spectra of an irradiated single crystal of DL-tartaric acid grown from water is found to be quite complex, but the spectra of a deuterated single crystal could be analyzed and the nature of the free radical ascertained. Measurements were made at 9 and at 23 kmc/sec. For some orientations of the crystal in the external magnetic field an unresolved doublet with weak satellite lines separated by 5 gauss at 9 kmc/sec and 13 gauss at 23 kmc/sec was observed. These satellite lines evidently arise from second order transitions and are very similar to those already reported for a single crystal of urea oxalate. From the analysis it is suggested that the free radical is probably,

COODCODCODHCOOD with the unpaired spin on a carbon atom.

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Duke U. [Microwave Lab.] Durham, N. C.

COMPARISONS OF THE ESR OF γ-IRRADIATED PROTEINS WITH THAT OF PROPORTIONAL MIXTURES OF THEIR AMINO ACID CONSTITUENTS (Abstract), by R. Patten and W. Gordy. [1961] [1]p. [AF 49(638)765] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 258, Apr. 24, 1961.

The electron spin resonance of a number of proteins has been compared with that of proportional mechanical mixtures of their amino acid constituents, both at 77°K and 300°K. The proteins include bovine albumin, ovalbumin, chymotrypsinogen, edistin, gliadin, lysozyme, and zein. Generally, the proteins give broad, unresolved ESR patterns similar to those of their mixed constituents when irradiated and observed at 77°K. When warmed to 300°K the proteins give patterns more noticeably different from those of their constituent amino acid mixtures and more like those found in a number of other proteins irradiated and observed at room temperature. The results support the thesis that at room temperature radiation damage to proteins does not occur proportionally in all the different amino acid residue, but selectively in certain residue. Also, it appears that as the temperature is raised unpaired electrons produced in different parts of the protein at 77°K tend to migrate to the more favored sites.

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Duke U. [Microwave Lab.] Durham, N. C.

CORRELATION OF ANOMALOUS LINE-REVERSAL MEASUREMENTS OF TEMPERATURE WITH EXCESS ELECTRON CONCENTRATIONS IN ACETYLENE-OXYGEN FLAMES (Abstract), by E. M. Bulewicz and P. J. Padley. [1961] [1]p. [AF 49(638)765] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 258, Apr. 24, 1961.

Line-reversal measurements, made on the spectral lines of various metal additives, in the reaction zone of premixed hydrocarbon-oxygen-diluent flames often give rise to temperatures considerably above those expected on the basis of full thermodynamic equilibrium of the burnt gases. Line intensities of the Fe 4050A (non-resonance) group (produced by addition of $Fe(CO)_5$) were measured as a function of preburned flame gas composition (λ varying from 0.35 to 2.6) in acetylene-oxygen mixtures burning at 10-30 mm pressure. The technique of cyclotron resonance was used to measure, in these same flames, the anomalously high electron concentrations known to exist in the reaction zone – for these purposes, convenient absorption was found to take place, with 48 kmc/sec radiation, at a magnetic field strength of 17,000 gauss. When quenching is taken into consideration, a good correlation between these 2 effects can be obtained, even when the preburned gases are suitably diluted with argon or hydrogen, or when the pressure is varied from 10 mm Hg to 1 atmosphere. A scheme is proposed to account for these observations.

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Duke U. [Microwave Lab.] Durham, N. C.

A CYCLOTRON RESONANCE STUDY OF LOW-PRESSURE ACETYLENE-OXYGEN FLAMES, CONTAINING TRACES OF CHLORINE (Abstract), by P. J. Padley and E. M. Bulewicz. [1961] [1]p. [AF 49(638)-765] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 258, 1961.

The reaction zones of acetylene flames contain anomalously high concentrations of free electrons – up to a factor of 10^5 above equilibrium. At reduced pressure these concentrations can conveniently be measured by the method of cyclotron resonance. When traces of chlorine gas (of the order of 1% of the total gas) are added, a reduction in the electron concentration is observed, which can be attributed to the formation of the Cl^- ion. The flame gases normally contain about 10% of the H_2 and H atoms, and the total chlorine is distributed between HCl and Cl, in accordance with the balanced reaction $Cl + H_2 = HCl + H$. Cl^- can then be formed by 2 distinct mechanisms, (1) $HCl + e \rightarrow H + Cl^-$, or (2) $Cl + e + X \rightarrow Cl^- + X$ where X is a third body. The 2 mechanisms lead to widely different values of $[Cl^-]/[e]$, with different dependence on the flame temperature and composition. It was shown that the experimental results are consistent only with mechanism 1, in agreement with earlier work on the formation of the Cl^- ion in gaseous discharges.

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Duke U. [Microwave Lab.] Durham, N. C.

ELECTRON SPIN RESONANCE OF γ-IRRADIATED POLYPEPTIDES (Abstract), by R. Drew and W. Gordy. [1961] [1]p. [AF 49(638)765] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 258, Apr. 24, 1961.

Electron spin resonance has been observed in 19 γ-irradiated synthetic polypeptides, including polyglycine, poly-L-Alanine, poly-L-valine, poly-L-leucine, poly-L-phenylalanine, poly-L-proline, poly-L-glutamic acid, poly-L-aspartic acid, and poly-L-tyrosine. Studies have been made on powdered samples at 77°K and 300°K. The effects of air or oxygen on the resonances have been observed. The various ESR patterns and oxygen effects are compared with those for native proteins. Unlike the proteins, the synthetic polypeptides were found to give characteristically different ESR patterns when irradiated, except that poly-glycine and poly-sarcosine gave similar doublets. Of the polypeptides so far investigated, none of which contained sulfur, the ESR pattern of poly-glycine (or poly-sarcosine) is the only 1 which is strikingly similar to that found in a variety of proteins. More detailed studies are planned on oriented samples of certain of these polypeptides and an attempt is being made to obtain some polypeptides which contain sulfur.

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Duke U. [Microwave Lab.] Durham, N. C.

ELECTRON SPIN RESONANCE OF A GAMMA-IRRADIATED SINGLE CRYSTAL OF N-ACETYL METHIONINE (Abstract), by E. Cipollini and W. Gordy. [1961] [1]p. [AF 49(638)765] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 258, Apr. 24, 1961.

The ESR of a γ-irradiated single crystal of N-acetyl methionine has been investigated at 9 kmc/sec. Patterns from 2 chemically different free radicals were observed. The free radical giving the more intense pattern has principal g values 2.008, 2.022, and 2.071 and a nearly isotropic doublet splitting of 9 gauss. This free radical is believed to be · ·$SCH_2CH_2C(COOH)HNHCOCH_3$ which is similar in form to that found for L-cystine dihydrochloride in which the unpaired electron is mainly on the S. The second free radical has principal g values 2.0023, 2.0025, and 2.0045 and a nearly isotropic and equal coupling by two protons of 10.5 gauss. It is believed to have the form $CH_3SCH_2CH_2C(COOH)NHCOCH_3$, in which the spin density is concentrated on a C.

710

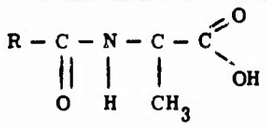
Duke U. [Microwave Lab.] Durham, N. C.

ELECTRON SPIN RESONANCE OF GAMMA-IRRADIATED SINGLE CRYSTALS OF ACETYLALANINE, CHLOROACETYLALANINE, AND ACETYL L-GLUTAMIC ACID, by M. Katayama and W. Gordy. [1961] [1]p. [AF 49(638)765] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 258, Apr. 24, 1961.

Single crystals of acetyl-, and chloroacetyl-, d,l-alanine, and acetyl L-glutamic acid have been gamma irradiated and the electron spin resonance of the radiation induced free radical observed for various orientations in the magnetic field. The spectra of the former 2 crystals are quartets of intensity ratio 1:3:3:1. The free radical for each is shown to have the form:



The ESR of acetyl-L-glutamic acid is somewhat complicated and changes with time. Its analysis is still incomplete.

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Duke U. Microwave Lab., Durham, N. C.

ELECTRON-MOLECULE AND ELECTRON-ATOM COLLISION CROSS-SECTIONS FROM A CYCLOTRON RESONANCE STUDY OF FLAME GASES, by E. M. Bulewicz. [1961] [31]p. incl. diagrs. refs. (Bound with its rept. no. 34, July 1-Sept. 30, 1961) (AF 49(638)765) AD 262001 Unclassified

Also published in Jour. Chem. Phys., v. 36: 385-391, Jan. 15, 1962.

When microwaves are passed through a partially ionized gas in a uniform magnetic field, absorption takes place at the cyclotron resonance frequency, provided the pressure of the gas is sufficiently low. The cyclotron line width is directly proportional to the electron-gas molecule collision frequency, and can thus be used to deduce electron-molecule cross-sections. In this work, acetylene-oxygen flames were used as the source of electrons; hydrocarbon flames with air or oxygen contain large concentrations of free electrons in the reaction zone and in its neighborhood. The flames were diluted with various proportions of nitrogen and the rare gases, and covered a pressure range 6-40 mm Hg and a temperature range of 1600-2400°K. The following results were obtained at 2200°K: undiluted, near stoichiometric C_2H_2-O_2 flame gases, $40A^2$; nitrogen $30A^2$, decreasing with temperature; helium, $27A^2$, decreasing with temperature; argon, $7A^2$; neon, $5A^2$; water, about $80A^2$; carbon dioxide about $37A^2$. The values are up to 3-fold larger than the cross sections for collisions with electrons reported for systems other than flame gases. (Contractor's abstract)

712

Duke U. Microwave Lab., Durham, N. C.

ELECTRON SPIN RESONANCE IN A GAMMA-IRRADIATED SINGLE CRYSTAL OF DIGLYCOLIC ACID MONOHYDRATE, by Y. Kurita. [1961] [8]p. incl. diagrs. (Bound with its rept. no. 34, July 1-Sept. 30, 1961) (AF 49(638)765) AD 262001 Unclassified

Also published in Jour. Chem. Phys., v. 36: 560-561, Jan. 15, 1962.

From single crystal studies on the electron spin resonance, radicals produced in thiodiglycolic acid by γ-irradiation were confirmed to be of the form $HOOC\text{-}CH_2\text{-}S\text{-}CH\text{-}COOH$ (I). In this free radical the electron spin density is in a π-orbital, about 60% of which is the p-orbital of CH carbon, 2% is the 1s-orbitals of CH_2 hydrogen and 22% is the p-orbital of S. It is of interest to compare the ESR of this compound with that of the oxygen analog. Single crystals of diglycolic acid monohydrate, $HOOC\text{-}CH_2\text{-}O\text{-}CH_2\text{-}COOH \cdot H_2O$ were grown from water and irradiated with ^{60}Co γ-rays. The crystal is monoclinic with a : b : c = 1.324 : 1 : 0.463 and $\beta \approx 90°$. The ESR of irradiated single crystals were measured at 9.04 kmc. (Contractor's abstract)

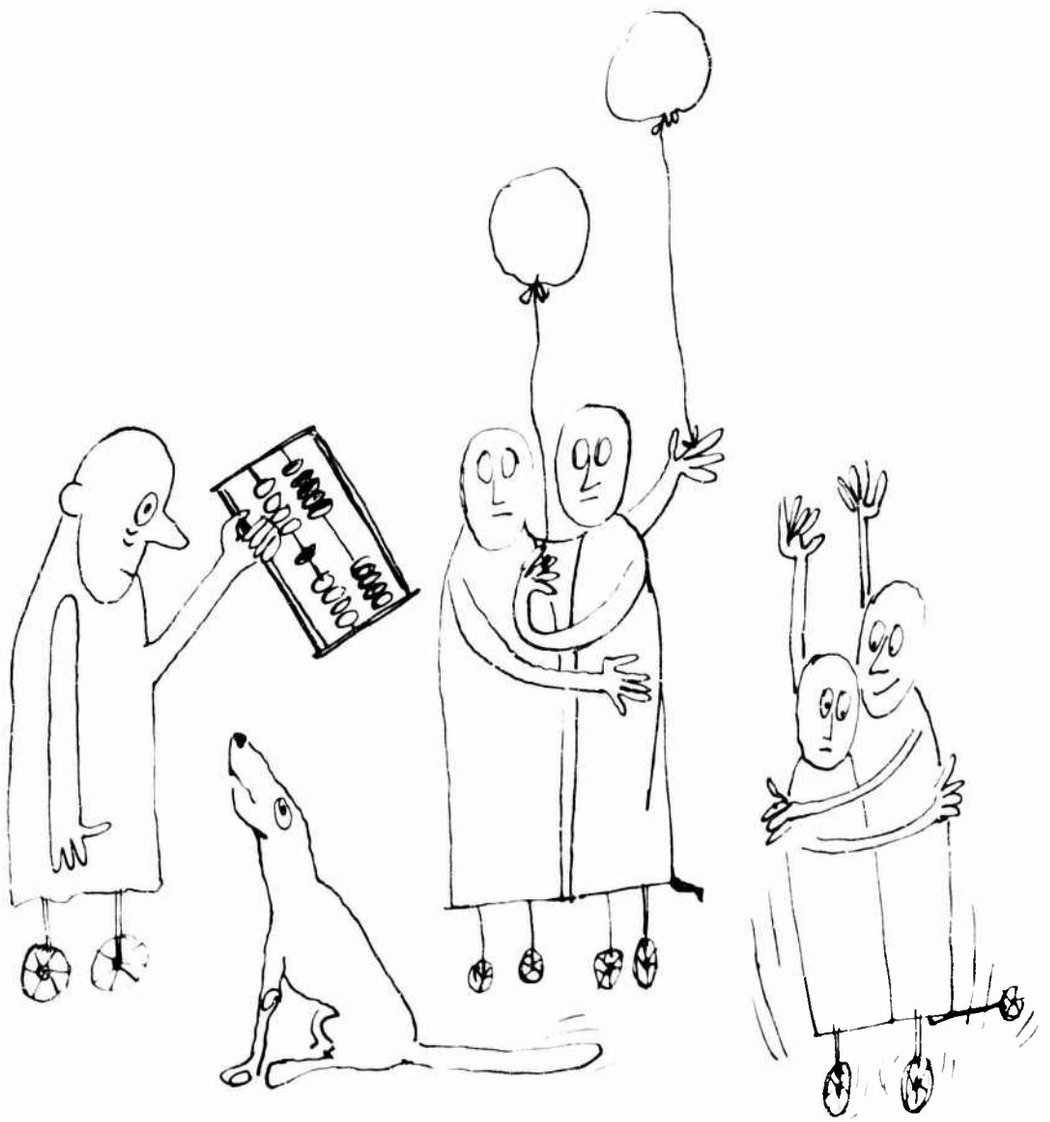
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Duke U. Microwave Lab., Durham, N. C.

ELECTRON-MOLECULE COLLISION CROSS-SECTIONS IN THE BURNED GASES OF A VARIETY OF FUELS, by E. M. Bulewicz and P. J. Padley. [1961] [4]p. incl. table. (Bound with its rept. no. 34, July 1-Sept. 30, 1961) (AF 49(638)765) AD 262001
Unclassified

Also published in Jour. Chem. Phys., v. 36: 2231-2232, Apr. 15, 1962.

In a previous paper (item no. 711, Vol.V) it was shown how the method of cyclotron resonance could be applied to a study of electron-molecule collision cross-sections in low pressure acetylene-oxygen flames. By suitably diluting such flames with hydrogen, carbon monoxide or the rare gases, cross-sections Q_{H_2O} and Q_{CO_2} were found to be $80 \pm 4A^2$ and $37 \pm 2A^2$, respectively in flames at about 2200°K. The relative Q values obtained were considered reliable. It has proved possible to test this conclusion further by extending the measurements of collision frequency to other fuels, using exactly the same apparatus described previously. (Contractor's abstract, modified)



714

Eastern Nazarene Coll. Dept. of Chemistry, Wollaston, Mass.

REACTIONS OF ALUMINUM BOROHYDRIDE, by P. C. Maybury. Final rept. Apr. 20, 1961, 32p. incl. diagrs. tables, refs. (AFOSR-585) (AF 18(603)119) AD 256887 Unclassified

The objective of this research has been to study the nature of the chemical reactivity of aluminum borohydride by means of several isotopic exchange reactions. The similarity of the chemical and physical properties of aluminum borohydride and diborane suggested that borane should play an important role as an intermediate in these reactions and it was hoped that direct evidence could be obtained in support of the existence and nature of this species. The nuclear magnetic resonance spectrum of aluminum borohydride indicates that all 12 hydrogen atoms in the molecule are equivalent and it was expected that further evidence concerned with bond equivalence could be obtained through these studies. It is hoped that a better understanding of the structures and reactivity of aluminum borohydride will help in future studies and applications of this useful and important compound. The report is divided into three separate sections, the first two authored by P. C. Maybury and J. C. Larrabee and the third by L. Taylor and published in Sb. Nauchn. Tr. Pumsk. Politekhn. Inst., No. 10: 105-110, 1961. KINETICS OF THE EXCHANGE REACTION OF $Al(BH_4)_3$ WITH D_2: Preliminary studies indicated a drift in exchange rates as calculated by the exchange law, especially for those runs where the ratio of D_2 to $Al(BH_4)_3$ pressure was large. The assumption was made that the drift was due to the contribution of 2 different mechanisms proceeding at different rates. DEUTERIUM EXCHANGE BETWEEN B_2D_6 AND $Al(BH_4)_3$: The kinetics of the exchange were studied from -70° to 20°C. The orders of reaction were dependent on the relative proportions of B_2D_6 and $Al(BH_4)_3$. A mechanism was 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. Evidence was obtained proving that the B atoms undergo exchange in this reaction by the use of B-10 enriched B_2D_6. THE REACTION OF $Al(BH_4)_3$ WITH NH_3: The $Al(BH_4)_3$-NH_3 reaction product was obtained as a uniform white amorphous appearing powder which dissolved in cold water with slow gas evolution. The solid was ignited with a laboratory burner flame and burned smoothly with a green flame. IR spectroscopy indicated that some B-H bonds remain intact in the ammoniated $Al(BH_4)_3$.

715

Electro-Optical Systems, Inc., Pasadena, Calif.

ELECTRICAL CONDUCTION IN RAPIDLY EXPLODED WIRES, by P. H. Levine, A. V. Tollestrup and F. H. Webb, Jr. [1961] 28p. incl. illus. diagrs. (AFOSR-1363) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)1063 and Army Ordnance Corps under DA 04-495-ORD-1298) Unclassified

A wire exploder capable of vaporizing small wires in times shorter than 10^{-7} sec has been used to study the electrical explosion of wires of various materials and sizes in a variety of environments, with peak specific power levels between 5×10^{12} and 2×10^{14} watts/mol. Simultaneous voltage and current oscillograms with a time resolution of one nanosecond have been obtained, as well as Kerr cell photographs of the wire at different times during the explosion process. From these measurements, the time history of the wire resistance during an explosion is obtained, and its scaling properties are investigated. (Contractor's abstract)

716

Electro-Optical Systems, Inc., Pasadena, Calif.

EXPLODING WIRES AND FILMS (Abstract), by F. H. Webb [Jr.]. [1961] [1]p. (Bound with AFOSR-582; AD 257892) (AF 49(638)1063) Unclassified

Presented at Fourth annual AFOSR Contractors' meeting on Ion and Plasma Acceleration, Beverly Hills, Calif., Apr. 20-21, 1961.

Exploding materials show promise for eventual application in pulsed propulsion systems. Preliminary experiments for a single shot will be directed in which relatively large amounts of metallic vapor or plasma were obtained from electrically exploded thin films up to several hundredths of a gram. Specific impulses in the range 1000 sec to 3000 sec may be obtainable from the explosion process along with higher specific impulses anticipated when magnetic plasma acceleration is employed. It is important to understand the nature of the explosion process, the state of the vapor or plasma after the explosion, the effects of different configurations, confinement techniques and means of coupling to magnetic pressure in order to treat problems of energy transfer and to achieve a high degree of directed kinetic energy.

717

Electro-Optical Systems, Inc., Pasadena, Calif.

THE ELECTRICAL AND OPTICAL PROPERTIES OF RAPIDLY EXPLODED WIRES, by F. H. Webb, Jr.,

H. H. Hilton and others. [1961] [39]p. incl. illus. diagrs. table, refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)1063 and Air Force Systems Command under AF 33(616)8230)
Unclassified

Published in Exploding Wires; Proc. of Second Conf. of the Exploding Wire Phenomenon, Boston, Mass. (Nov. 13-15, 1961), New York, Plenum Press, 1962, p. 37-75.

Results are presented of a series of experiments with wires which are exploded in times less than 10^{-7} sec. The vapor expansion dynamics during the initial conduction phase for exploded silver and copper wires is in agreement with the supersonic model over the range of conditions of this study. The scaled resistivity as a function of energy density for these materials follows a main sequence with a positive energy coefficient of resistivity. The vapor expansion dynamics during the initial conduction phase in molybdenum wires is in agreement with the ablation model until about 2/3 of the latent heat required for vaporization is placed in the material. The scaled resistivity as a function of energy density for molybdenum follows a main sequence with a small positive energy coefficient of scaled resistivity. Above the onset of vaporization the inferred energy coefficient of resistivity decreases with increasing energy input. A classification scheme of exploding wire phenomena is suggested in terms of specific power level for wires thin compared to the initial skin depth.

Enrico Fermi Inst. for Nuclear Studies, Chicago, Ill.
see Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.



718

Florida State U. Dept. of Chemistry, Tallahassee.

SELF-ASSOCIATION CONSTANT OF CHLOROFORM FROM NMR CHEMICAL SHIFTS, by C. F. Jumper, M. T. Emerson, and B. B. Howard. [1961] [2]p. incl. diagr. refs. (AFOSR-1214) (AF 49(638)278) Unclassified

Also published in Jour. Chem. Phys., v. 35: 1911-1912, Nov. 1961.

NMR measurements yielded an association constant of 0.16 (mol fraction)$^{-1}$ in cyclohexane and approximately 0.1 (mol fraction)$^{-1}$ in CCl_4. The shift for chloroform in carbon tetrachloride, as illustrated graphically, is linear with concentration and has a total dilution shift of only 0.022 ppm.

719

Florida State U. [Dept. of Chemistry] Tallahassee.

A MONTE CARLO METHOD FOR NUCLEAR MANY BODY PROBLEMS, by E. W. Schmid. [1961] [16]p. incl. diagr. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)-278 and Office of Naval Research) Unclassified

Published in Nuclear Phys., v. 32: 82-97, Apr. 1962.

A Monte Carlo method is given to solve nuclear many body problems in the frame of Ritz' variational principle. The antisymmetrization and all integrations are performed by a random process. The method is formulated for a 2 cluster system, using oscillator wave functions and hard core forces, but it can be generalized to rather arbitrary forces and wave functions. The ground state energy and rms-radius of the α-particle has been calculated. For the final parameter values, an accuracy in the energy of 10% (2%) was obtained after a calculation time of 40 sec (16 min) with an IBM 7090 computer. The accuracy in the radius is better by a factor of 8. The minimum energy depends on the form of the trial wave function near the hard core. (Contractor's abstract)

720

Florida State U. Dept. of Chemistry, Tallahassee.

ENERGY TRANSFER IN HYDROGEN-BONDED N-HETEROCYCLIC COMPLEXES AND THEIR POSSIBLE ROLE AS ENERGY SINKS, by M. A. El-Bayoumi and M. Kasha. [1961] [2]p. incl. diagrs. (AFOSR-J360) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)712 and Atomic Energy Commission) AD 411057 Unclassified

Also published in Jour. Chem. Phys., v. 34: 2181-2182, June 1961.

The energy transfer results for the acridine-carbazole H-bonded complex is reported. Hydrogen-glass solution (initial concentration of 1 x 10^{-4} mol/l) favors the formation of acridine-carbazole hydrogen-bonded complexes; in contrast, in hydroxylic glass solution (EPA) hydrogen bonding of each solute molecule with the solvent occurs. Strong quenching of carbazole (1 x 10^{-4} mol/l) emission was observed in hydrocarbon-glass solution at a smaller relative concentration of acridine (1 x 10^{-5} mol/l). The quenching was greater than expected even if it assumed that complete association of carbazole with acridine has occurred. Therefore, the emission of some free carbazole molecules is also quenched, which means that the complex is acting as an energy sink.

721

Florida State U. Dept. of Chemistry, Tallahassee.

IONIZATION POTENTIALS OF BENZENE, HEXADEUTEROBENZENE, AND PYRIDINE FROM THEIR OBSERVED RYDBERG SERIES IN THE REGION 600-2000A, by M. F. A. El-Sayed, M. Kasha, and Y. Tanaka. [1960] [2]p. (AFOSR-J361) (AF 49(638)712) AD 408593 Unclassified

Also published in Jour. Chem. Phys., v. 34: 334-335, Jan. 1961.

For abstract see item no. 653, Vol. IV.

722

Florida State U. Dept. of Chemistry, Tallahassee.

EFFECT OF REDUCING THE SYMMETRY ON THE SPECTRA OF BENZENE IN THE 1500-2000A REGION: SPECTRA OF PYRIDINE, PYRIMIDINE, AND PYRAZINE, by M. [F.] A. El-Sayed. [1961] [2]p. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)712 and Harvard U. Chemical Research Fund) Unclassified

Published in Jour. Chem. Phys., v. 36: 552-553, Jan. 15, 1962.

In the 2000A region, the longest wavelength band of the spectrum is found to be at 2009.3, 1913.6, and 1966.3A in pyridine, pyrimidine, and pyrazine, respectively. The corresponding band in benzene is 2042.1A. The pyridine vapor spectrum in the 1600-1800A region shows at least 3 different systems: sharp, diffuse, and continuous. Pyrimidine and pyrazine vapors show very sharp, well-resolved absorption systems in the 1600-1900A region. The diffuse system, in accordance with symmetry expectation and the above assignment could

only be recognized in the pyrimidine spectra (C_{2v} symmetry) but is definitely missing in the pyrazine spectrum (D_{2h} symmetry with center of symmetry). In the latter molecule, the $^1E_{2g}$ level splits into ^1A_g and $^1B_{3g}$, the transition from the ground state to either of which is still symmetry forbidden.

723

Florida State U. [Dept. of Mathematics] Tallahassee.

GENERALIZED FIBONACCI NUMBERS AND ASSOCIATED MATRICES, by E. P. Miles, Jr. [1960] [8]p. (AFOSR-3153) [AF AFOSR-61-12] Unclassified

Also published in Amer. Math. Monthly, v. 67: 745-752, Oct. 1960.

For any integer $k \geq$, the author considers the sequence $f_{0,k}, f_{1,k}, f_{2,k} \ldots$, in which the first k-1 members are 0, the kth number is one, and thereafter every member is the sum of the k members immediately before it. An explicit evaluation and certain other properties of the numbers $f_{j,k}$ are obtained. The case $k = 2$ is that of the ordinary Fibonacci numbers. (Math. Rev. abstract)

724

Florida State U. [Dept. of Mathematics] Tallahassee.

MATRIX SLIDE RULES, by E. P. Miles, Jr. [1960] [4]p. (AFOSR-3154) [AF AFOSR-61-12] Unclassified

Also published in Amer. Math. Monthly, v. 67: 788-791, Oct. 1960.

The author considers a k by ∞ matrix A with columns the vectors C_n, $-\infty < n < +\infty$ whose k elements $C_{1,n}$ ..., $C_{k,n}$ are defined as follows: The k adjacent vectors $C_0, C_1 \ldots, C_{k-1}$ are the successive columns of the identity matrix of order k, and all other $C_{j,n}$ are defined recursively by the relation: $c_{j,n} = \sum_{m=1}^{k} a_m c_{j,n-m}$, $a_k \neq 0$. This means in particular that the vector C_k has elements $c_{j,k} = a_{k-j+1}$, $j = 1, \ldots, k$. Let A_j, $-\infty < j < \infty$, be the k by k submatrix of A consisting of the consecutive column vectors $C_j, C_{j+1}, \ldots, C_{j+k+1}$. Note that $A_0 = I_k$ and A_1 is a nonsingular matrix with characteristic equation: $x^k = \sum_{m=1}^{k} a_m x^{k-m}$. It may be established by induction that $A_j = (A_1)^j$, $-\infty < j < \infty$. It is shown how finite submatrices of A may be used to construct matrix slide rules which are helpful in suggesting numerous problems involving the matrices A_j and providing a quick check for answers to these problems.

725

Florida State U. Dept. of Physics, Tallahassee.

QUASI-FREE NUCLEON-NUCLEON SCATTERING, by T. A. J. Maris. [1958] [8]p. incl. diagrs. [AF 49(638)-427] Unclassified

Published in Nuclear Phys., v. 9: 577-584, Jan. 2, 1959.

A simple approximation is described for the calculation of quasi-free proton-proton scattering using distorted incoming and outgoing waves. The method is applied to Li^7. Results show that in this light nucleus the refraction by the collective nuclear potential does not destroy the strong connection between the angular correlation of the emerging protons and the momentum distribution of the knocked-out proton in the nuclear shell concerned. (Contractor's abstract)

726

[Florida State U. Dept. of Physics, Tallahassee]

LOW-LYING ENERGY LEVELS IN Sc^{41}, by H. S. Plendl and F. E. Steigert. [1959] [5]p. incl. diagrs. table. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)427] and Office of Naval Research) Unclassified

Published in Phys. Rev., v. 116: 1534-1538, Dec. 15, 1959.

The reaction $Ca^{40}(d,n)Sc^{41}$ was studied at 4.15-mev bombarding energy using nuclear emulsions as detectors. Four groups of neutrons were observed with Q values of -0.57, -2.43, -2.64, and -2.65 mev. The observed angular distributions can be fitted with distribution curves obtained from stripping analysis on the basis of $r_0 = 6.0$ fermi and $l_p = 3,1,1,1$, respectively. Two additional groups of questionable assignment were observed at $Q = -1.13$ and -1.41 mev. Neutron groups from reactions on C^{12} and O^{16} were also observed and served to confirm the beam calibration as well as background and other correction methods. (Contractor's abstract)

727

[Florida State U. Dept. of Physics, Tallahassee]

THEORY OF THE PHOTODISINTEGRATION OF THE DEUTERON, by L. D. Pearlstein and A. Klein. [1959] [19]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)-427] and Atomic Energy Commission) Unclassified

Published in Phys. Rev., v. 118: 193-211, Apr. 1, 1960.

By means of a covariant field-theoretic technique, a formally exact expression has been derived for the amplitude for photodisintegration of the deuteron. By expanding the result only in the number of mesons exchanged and by making a series of nonrelativistic approximations, the expression is reduced to one in which the corrections to the conventional dipole matrix element depend only on the amplitude for photomeson production, the renormalized meson-nucleon coupling constant, and the appropriate two nucleon wave functions. The virtual meson effects play a minor role at energies below 100 mev. At higher energies good agreement with the total cross section was obtained by the inclusion of both hard core and tensor force effects in the wave functions. In addition the folded angular distribution could be fitted by using a reasonable extrapolation of the phase shifts in the $^1S_0$ and $^1D_2$ states. (Contractor's abstract)

728

Florida State U. Dept. of Physics, Tallahassee.

STUDY OF NUCLEAR STRUCTURE FROM COULOMB ENERGY DIFFERENCES OF MIRROR LEVELS, by Y. C. Tang and K. Wildermuth. [1960] [3]p. incl. diagr. table. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)427 and Office of Naval Research) Unclassified

Published in Phys. Rev. Ltrs., v. 6: 17-19, Jan. 1961.

By studying the sign and the order of magnitude of the excitation energy difference of mirror levels, information can be obtained about the cluster structure of these levels. Results are presented in tabulated form and it is seen that there is fairly good agreement between calculated and experimental values.

729

Florida State U. Dept. of Physics, Tallahassee.

ANGULAR DISTRIBUTION OF γ RADIATION FOLLOWING $C^{12}(p_1,p_2\gamma)C^{12}$, by M. Nomoto. Mar. 10, 1961 [10]p. incl. diagrs. (Technical rept. no. 2) (AFOSR-784) (AF 49(638)427) AD 613314 Unclassified

Also published in Nuclear Phys., v. 30: 513-519, Feb. 1962.

An analysis is made of the angular distributions of the 4.43-mev γ radiation following $C^{12}(p_1,p_2\gamma)C^{12}$ in the vicinity of the 2 resonance peaks at bombarding energies 5.36 mev and 5.69 mev. It is shown that the angular distributions of this γ radiation are strongly dominated not only by the 2 resonance levels (3/2 + and 5/2 +) in N^{13}, with excitation energies 6.91 mev and 7.42 mev (called C and E respectively), but also by another lower level (5/2 +) with 6.38 mev excitation (called A) and their interference. A better fit between the theory and experimental data is obtained for reduced-width amplitude ratios $\gamma'_{s'_1 l'_1} \gamma'_{s'_2 l'_2} / \gamma_{s_1 l_1} \gamma_{s_2 l_2} = -2.3$ and

$$\gamma''_{s''_1 l''_1} \gamma''_{s''_2 l''_2} / \gamma_{s_1 l_1} \gamma_{s_2 l_2} = -0.32,$$

where no prime, 1 prime and 2 primes are used for the levels C, A and E, respectively, and subscripts 1 and 2 for incoming and outgoing channels, respectively. The relationship $N_2 + N_4 = N_0$ is deduced, if the angular distribution is expressed by $W(\theta) \propto N_0 + N_2 \cos^2\theta + N_4 \cos^4\theta$. Finally, the effects of other neighboring levels in N^{13} are considered. (Contractor's abstract)

730

Florida State U. [Dept. of Physics] Tallahassee.

ONE-MINUTE POSITRON-DECAY ACTIVITY FROM $K^{39}(\alpha,n)Sc^{42}$, by J. W. Nelson, H. S. Plendl, and J. D. Oberholtzer. [1961] [2]p. incl. diagrs. (AFOSR-1057) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)427 and National Science Foundation) Unclassified

Also published in Proc. Rutherford Jubilee, Internat'l. Conf., Manchester (Gt. Brit.) (Sept. 4-8, 1961), London (Gt. Brit.), Heywood and Co., Ltd., p. 819-820.

A 62-sec, 0.51-mev gamma-ray activity observed in the α-particle bombardment of postassium targets is ascribed to the β^+ decay of an isomeric state in Sc^{42} formed by the $K^{39}(\alpha,n)$ reaction. Gamma rays observed in coincidence with the above activity and of the same half-life are interpreted as transitions from the Ca^{42} excited state formed in the β^+ decay to the Ca^{42} ground state. The threshold for this activity occurs at: $E_\alpha = 8.86 \pm 0.04$ mev ($Q = -8.04 \pm 0.04$ mev). (Contractor's abstract)

731

Florida State U. Dept. of Physics, Tallahassee.

ANGULAR DISTRIBUTIONS OF 4.43-MEV GAMMA RADIATION FROM $C^{12}(p,p'\gamma)C^{12}$, by H. S. Adams, J. D. Fox and others. [1961] [5]p. incl. diagrs. tables, refs. (AFOSR-1236) (AF 49(638)427) Unclassified

Also published in Phys. Rev., v. 124: 1899-1903, Dec. 15, 1961.

The yield at 90°, and 32 angular distributions of the 4.43-mev γ-ray from the first-excited state of C^{12} were measured for proton bombarding energies between 5 and 12 mev. The excitation curve for inelastic scattering is characterized by a number of strong resonances, some of which were previously known. In addition, underlying the resonances, there is a monotonically rising background. The angular distributions were fitted by least squares to the expression $W(\theta) = A_0 + A_2P_2(\cos\theta) + A_4P_4(\cos\theta)$. Those obtained in the region of the resonances at $E_p = 5.36$ mev and $E_p = 5.89$ mev can be interpreted by taking into account these 2 resonances with respective characters $\frac{3+}{2}$ and $\frac{5+}{2}$ plus 1 additional state at an excitation energy of 6.38 mev ($\frac{5+}{2}$) in the compound nucleus N^{13} which can be seen only in elastic scattering. A simple direct-reaction model using a nucleon-nucleon interaction accounts very well for 4 angular distributions at higher energies in regions showing no resonant structure. (A preliminary account of this report was given as item no. 667, Vol. IV.) (Contractor's abstract)

732

Florida State U. Dept. of Physics, Tallahassee.

(p,n) REACTION THRESHOLDS IN Ti^{48}, Fe^{56}, AND Sr^{88}, by J. W. Nelson, H. S. Plendl, and R. H. Davis. [1961] [4]p. incl. diagrs. tables, refs. (AFOSR-1676) (AF 49(638)427) Unclassified

Also published in Phys. Rev., v. 125: 2005-2008, Mar. 15, 1962.

The counter-ratio method has been used to determine the ground-state (p,n) reaction threshold in Ti^{48}, Fe^{56}, and Sr^{88} and to locate low-lying excited states in V^{48}, Co^{56}, and Y^{88}. The measured threshold energies are 4.905 mev for Ti^{48}, 5.451 mev for Fe^{56}, and 4.457 mev for Sr^{88}. Additional thresholds were found corresponding to excited states at 0.306, 0.416, 0.514, and 0.752 mev in V^{48}; at 0.159, 0.186, 0.225, and 0.280 mev in Co^{56}; and at 0.391 mev in Y^{88}. The estimated errors in the energy determinations are all ± 10 kev or less. (Contractor's abstract)

733

Florida State U. Dept. of Physics, Tallahassee.

ANNUAL PROGRESS REPORT FOR YEAR 1961, by G. M. Temmer. Final rept. 1961 [104]p. incl. diagrs. tables, refs. (AFOSR-2756) (AF 49(638)427) AD 276635 Unclassified

Results of the Tandem Accelerator Program are presented. Some aspects of the investigation include studies of (p, α) reactions, scattering of α-particles from oxygen, symmetry selection rules for testing nuclear structure and its application to Be^8, and the theory of direct reactions with exchange.

734

Florida State U. Dept. of Physics, Tallahassee.

DETERMINATION OF (p,n) THRESHOLDS FOR Cr^{52} (Abstract), by J. A. Becker and J. D. Fox. [1961] [1]p. (AF 49(638)427) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 47, Feb. 1, 1961.

The thresholds for $Cr^{52}(p,n)Mn^{52}$(5.6-day) and $Cr^{52}(p,n)Mn^{52m}$(21-min) are determined by means of residual activity method. The activity produced in thick Cr_2O_3 targets is detected using a 3-in. x 3-in. NaI(Tl) scintillation spectrometer. The known γ-rays and coincidence sum peaks for the decays were observed. Preliminary data show the 21-min threshold to be at 5.98 ± 0.02 mev, in agreement with radioactivity data, and in disagreement with a previous threshold measurement (see Phys. Rev., v. 58: 929-934, Dec. 1940).

735

Florida State U. Dept. of Physics, Tallahassee.

EXCITATION FUNCTIONS OF THE $Li^7(\alpha,n)B^{10}$ AND $Li^6(\alpha,n)B^9$ REACTIONS (Abstract), by M. K. Mehta, W. E. Hunt and others. [1961] [1]p. (AF 49(638)427) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer Phys. Soc., Series II, v. 6: 226, Apr. 24, 1961.

The neutron yield from the $Li^7(\alpha,n)B^{10}$ reaction has been measured as a function of bombarding energy from threshold at 4.37 to 14.5 mev α-particle energy (lab). Neutrons were detected by 3 paraffin embedded BF_3 counters subtending an angle of about -15° to +15° with respect to the beam direction. Prominent peaks in neutron yield were observed at 5.23, 5.6, 7.05, 8.46, 9.22, 10.09, 12.66, and 13.95 mev (lab) α-particle energy. These correspond to levels in the compound nucleus B^{11} at 12.00, 12.24, 13.16, 14.05, 14.53, 15.09, 16.73, and 17.55 mev, respectively, which compare well with those reported in a previous work (Nuclear Phys., v. 11: 1, 1959). The measured ground state and first excited state thresholds of this reaction are 4.37 and 5.50 mev (lab). A general rise in the neutron yield with indications of many contributing resonances has been observed between 14.5 and 18.0 mev bombarding energy. The observed threshold for the reaction $Li^6(\alpha,n)B^9$ is 6.63 mev (lab) which corresponds to a Q value of -3.98 mev in good agreement with previous work. Energy calibrations are based on an Al(p,n) threshold at 5.800 mev and the estimated error in the present determination is ± 0.02 mev. Neutron yield from the reaction $Li^6(\alpha,n)B^9$ increases by a factor of 10 between 7 and 16 mev bombarding energy of the α-particles.

736

Florida State U. Dept. of Physics, Tallahassee.

STUDY OF THE GAMMA RAY YIELD FROM THE $C^{12}(\alpha,\alpha'\gamma_{4.43})C^{12}$ REACTION (Abstract), by G. E. Mitchell, E. B. Carter, and R. H. Davis. [1961] [1]p. (AF 49(638)427) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 227, Apr. 24, 1961.

The excitation function for $C^{12}(\alpha,\alpha'\gamma_{4.43})C^{12}$ has been measured from 7.3 to 17.0 mev. Gamma rays produced in thin (< 0.1 mg/cm^2, 99% C^{12}) targets were detected with a 3-in. x 3-in. NaI (Tl) crystal. Resonances were observed at bombarding energies of 7.94 (Γ = 120 kev), 8.14 (Γ = 50 kev), 8.95 (Γ = 90 kev), 10.08 (Γ ~ 400 kev), and 10.19 (Γ = 40 kev) mev, where the widths quoted are observed widths. The corresponding excitation energies in O^{16} are 13.10, 13.25, 13.86, 1471, and 14.79 mev. The first 3 levels have been previously studied via N^{15} + p reactions. Above 11 mev bombarding energy, there appear to be many unresolved levels. Most of the angular distributions throughout the region of well resolved resonances show a max in the vicinity of 30° and a minimum at 90°.

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Florida State U. Dept. of Physics, Tallahassee.

(α,n) THRESHOLDS ON C^{12}, Si^{28}, S^{32}, AND S^{34} (Abstract), by J. W. Nelson, E. B. Carter and others. [1961] [1]p. (AF 49(638)427) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 235, Apr. 24, 1961.

Using α particle beams of 1-6 mu amp from the Florida State U. Tandem Van de Graaff accelerator, the following ground state neutron thresholds have been observed: C^{12} 11.484 ± 0.045, Si^{28} 10.00 ± 0.12, S^{32} 9.98 ± 0.07, S^{34} 5.37 ± 0.15 mev. Energies of α particles were determined by magnetic analysis assuming the Al(p,n) threshold to be 5.800 mev. Thick targets were used for all determinations. Annihilation γ rays from positron decay of the product nuclei were measured in the C^{12}, Si^{28}, and S^{32} experiments while a BF_3 proportional counter was used to detect neutrons from S^{34} targets. Indications for excited state thresholds have been observed in Si^{28}, S^{32}, and S^{34}. Analysis of these data in terms of known residual nucleus states will be presented.

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Florida State U. Dept. of Physics, Tallahassee.

EXCITATION FUNCTION OF THE $O^{16}(\alpha,\alpha'\gamma)O^{16}$ REACTION (Abstract), by W. E. Hunt, M. K. Mehta and others. [1961] [1]p. (AF 49(638)427) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 248, Apr. 24, 1961.

Excitation function for the reaction $O^{16}(\alpha,\alpha'\gamma)O^{16}$ has been measured for α-particle bombarding energies (lab) from 10.0 mev to 16.5 mev by observing the yield of the 6.14-mev γ ray and the unresolved 6.92-mev and 7.12-mev γ rays from the 2nd, 3rd, and 4th excited states in O^{16}, respectively, using a 3-in. x 3-in. NaI crystal at 0° with respect to the α beam. Prominent peaks in the yields of 6.14 mev γ ray occur at 11.97, 12.76, 13.27, 14.42, 14.85, 15.73, and 16.07 mev α-particle energy (lab) which correspond to the energy levels in

Ne^{20} at 14.33, 14.96, 15.37, 16.29, 16.63, 17.33, and 17.61 mev, respectively. Peaks in the combined yield of 6.92 and 7.14 γ rays occur at 12.02, 13.51, 12.76, 13.69, 14.53, 14.85, 15.51, add 16.07-mev α-particle energy (lab). These correspond to levels in Ne^{20} at 14.37, 14.76, 14.96, 15.70, 16.37, 17.16, and 17.61 mev. Peaks in the 2 yields do not always occur at the same energy, indicating that the α particles from the same level in compound nucleus Ne^{20} do not always populate all the 3 levels in O^{16}. The levels seen in this work are in good agreement with those seen in yields of α_0, α_*, α_1, α_2, α_3, in the reaction $F^{19}(p,\alpha)O^{16}$ reported earlier.

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Florida State U. Dept. of Physics, Tallahassee.

STUDIES OF (p,α) REACTIONS UP TO 12 MEV (Abstract), by H. S. Adams, J. D. Fox and others. [1961] [1]p. (AF 49(638)427) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 250, Apr. 24, 1961.

The excitation curves and some angular distributions of α-particles from $Al^{27}(p,\alpha)Mg^{24}$ (at least 7 states in Mg^{24}) and $Na^{23}(p,\alpha)Ne^{20}$ (at least 4 groups) are studied. A small Si junction counter was used as a detector. Strong resonances are still observed in the region of 20-mev excitation energy in Si^{28}. This survey is being extended to heavier nuclei.

740

Florida State U. Dept. of Physics, Tallahassee.

PRODUCTION OF AN 18- MEV ALPHA PARTICLE BEAM IN A TANDEM VAN DE GRAAFF ACCELERATOR (Abstract), by E. B. Carter and R. H. Davis. [1961] [1]p. (AF 49(638)427) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 253, Apr. 24, 1961.

An analyzed beam of 8 mμa of He^{++} has been identified by γ-rays the $Be^9(\alpha,n\gamma_{4.43})C^{12}$ reaction, by tracks in Ilford K2 plates of particles scattered from Au foils, and by the $C(\alpha,n)O^{15}$ reaction threshold. A mixture of He and H_2 is normally used in the duoplasmatron ion source, but the importance of H_2 is not clear since significant traces have been found after 4 hr of operation of the unmodified ion source with the H_2 inlet valve turned off. The beam from the negative ion source has a momentum consistent with a He^+ assignment for beam from the duoplasmatron ion source and He^- from the charge exchange canal. The terminal voltage is consistent with a He^- beam in the first half of the tandem accelerator. Hydrogen as a charge exchange gas yields a beam 25% larger than air and 5 times larger than He. Modifications of the ion source to study mixtures of gases will be discussed.

741

Florida State U. [Dept. of Physics] Tallahassee.

CLUSTER MODEL CALCULATION ON THE ENERGY LEVELS OF THE LITHIUM ISOTOPES, by Y. C. Tang. [11]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)427 and Office of Naval Research) Unclassified

Published in Phys. Rev., v. 123: 548-558, July 15, 1961.

A variational procedure is adopted to determine the energies of the levels of the highest space symmetry type in Li^6 and Li^7. The trial wave functions employed take into consideration the existence of cluster structures in those nuclei. With a simple 2-body force, it is shown that the computed energies of the various states are in reasonable agreement with experiment. The $^2F_{5/2}$ level in Li^7, as yet undetermined experimentally, is found to have an excitation energy of about 5.6 mev and a rather large level width. The calculation also indicates that to explain the splitting of levels in those nuclei, a constant 2-body spin-orbit force of the pure neutral form is inadequate. (Contractor's abstract)

742

Florida State U. [Dept. of Physics] Tallahassee.

CLUSTER MODEL CALCULATIONS IN LIGHT NUCLEI, by K. Wildermuth, Y. C. Tang and others. [1961] [2]p. incl. table. [AF 49(638)427] Unclassified

Published in Proc. Rutherford Jubilee Internat'l. Conf., Manchester (Gt. Brit.) (Sept. 4-8, 1961), London (Gt. Brit.), Heywood and Co., Ltd., p. 259-260.

A variational procedure is used to calculate the energies of the various levels in the light nuclei with A = 5,6,7,8. The trial wave functions are chosen according to the prescription of the cluster model. It is found that to produce satisfactory results, it is, in general, necessary to depart from the usual shell model picture. Also, it is found that the 7.47 mev level in Li^7 is definitely a

member of the ^4P multiplet, with the experimentally undetected $F_{5/2}$ level lying at an excitation of about 6 mev. Furthermore, results indicate that the existence of a broad positive parity level at 6.54 mev in Li^7 as indicated by some experiments is highly questionable. (Contractor's abstract)

743

Florida State U. Dept. of Physics, Tallahassee.

$Be^9(p,\alpha)Li^6$ AND $B^{11}(p,\alpha)Be^8$ REACTIONS (Abstract), by H. R. Blieden, G. M. Temmer, and K. L. Warsh. [1961] [1]p. (AF 49(638)427) Unclassified

Presented at meeting of the Amer. Phys. Soc., Chicago, Ill., Nov. 24-25, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 514, Nov. 24, 1961.

The reactions $Be^9(p,\alpha)Li^6$ has been studied for proton energies between 3.5-12 mev with the Tandem accelerator. The charged particles were detected by solid-state counters. The total cross section for α-particle emission is a smooth, monotonically decreasing function of energy. The shape of the angular distribution of α_0, and α_1 obtained between 6 and 11.5 mev changes remarkably little. The α_0 angular distributions show a broad max at θcm ~60°, a min at θcm ~115°, and strong backward peaks in all cases. The α_1 angular distribution has one shallow min at θcm ~65°. At the higher energies, the α_2 angular distribution was also observed. These results will be discussed in terms of the direct and exchange modes of the triton pickup process. The excitation curve for $B^{11}(p,\alpha)Be^8$ shows pronounced structure in contrast to the former reaction. Details of this reaction will also be discussed.

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Florida State U. Dept. of Physics, Tallahassee.

EXCITATION FUNCTION AND ANGULAR DISTRIBUTIONS FOR THE $Li^7(p,\alpha)\alpha$ REACTION (Abstract), by I. G. Han and N. P. Heydenburg. [1961] [1]p. (AF 49-(638)427) Unclassified

Presented at meeting of the Amer. Phys. Soc., Chicago, Ill., Nov. 24-25, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 415, Nov. 24, 1961.

The excitation function for the $Li^7(p,\alpha)\alpha$ reaction has been studied for proton bombarding energies from 2.75-12.0 mev. In addition to the 3-mev resonance peak observed in previous work (Phys. Rev., v. 73: 241, 1948), a prominent peak was observed at 5.6 mev with an asymmetry at the higher energy side indicating an unresolved resonance at about 6.5 mev. Twenty angular distributions have been obtained over this energy range. The angular distributions near the 5.6 mev peak show similar patterns to those near the 3-mev resonance having a maximum at 90° (cm). The resonance at 5.6 mev is probably due to a $J = 2^+$ level in Be^8. The angular distributions from 6.5—7.5 mev also indicate a rather broad resonance at about 6.5 mev. The angular distributions from 9.5—12.0 mev are similar and the yield remains almost constant. Similar work on Li^6 is in progress.

745

Florida State U. Dept. of Physics, Tallahassee.

$C^{12}(\alpha,\alpha_1)C^{12*}$ REACTION FROM 10 TO 19 MEV (Abstract), by G. E. Mitchell, E. B. Carter, and R. H. Davis. [1961] [2]p. (AF 49(638)427) Unclassified

Presented at meeting of the Amer. Phys. Soc., Chicago, Ill., Nov. 24-25, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 415-416, Nov. 24, 1961.

The excitation curves for the reaction $C^{12}(\alpha,\alpha_1)C^{12*}$ (Q = -4.43 mev) have been measured at 6 fixed laboratory angles for the range of bombarding energy 10-19 mev. Considerable structure is observed on all of these excitation functions. Fifteen detailed angular distributions were taken. These angular distributions show qualitatively the direct inelastic diffraction pattern, especially at the higher energies. At 14 mev and below, there are minima at approximately 60° and 120°; above 14 mev, there are minima at about 60°, 90°, and 120°. The back angle behavior is irregular. A qualitative change observed in the character of the angular distributions near 14 mev was also found in the $C^{12}(\alpha,\alpha_1\gamma_{4.43})C^{12}$ reaction.

746

Florida State U. Dept. of Physics, Tallahassee.

EXCITATION CURVES AND ANGULAR DISTRIBUTIONS OF 10- TO 19-Mev ALPHA PARTICLES ELASTICALLY SCATTERED FROM CARBON (Abstract), by E. B. Carter, G. E. Mitchell, and R. H. Davis. [1961] [1]p. (AF 49-(638)427) Unclassified

Presented at meeting of the Amer. Phys. Soc., Chicago, Ill., Nov. 24-25, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 416, Nov. 24, 1961.

Excitation curves from 10- to 19-mev bombarding energy have been taken in about 50 kev steps at 13 angles.

These curves are dominated by several broad anomalie with widths up to 1 mev; in addition, there are about 20 narrow anomalies superimposed. The angular distribution at 11 mev is fit fairly well with the Blair model with cutoff angular momentum equal to 5. The minima in the experimental angular distributions are not as deep as the Blair model predicts. The irregular dependence of the angular distributions on energy may be characterized by listing the energies and the observed number of minima: 11 mev-4 or 5; 11.74 mev-4 or 5; 12.1 mev-6; 12.46 mev-4; 13 mev-4; 14 mev-4; 14.42 mev-4; 14.53 mev-4 or 5; 15 mev-5; 16 mev-5; 17 mev-5 or 6; 17.5 mev-6; 18 mev-7; 18.5 mev-5 or 6; and 19 mev-4.

747

Florida State U. Dept. of Physics, Tallahassee.

ELASTIC SCATTERING OF ALPHA PARTICLES BY O^{16} FROM 10 TO 19 MEV (Abstract), by M. K. Mehta, W. E. Hunt, and R. H. Davis. [1961] [2]p. (AF 49(638)-427) Unclassified

Presented at meeting of the Amer. Phys. Soc., Chicago, Ill., Nov. 24-25, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 439-440, Nov. 24, 1961.

The yield of α particles elastically scattered from O^{16} was measured as a function of α particle bombarding energy in range 10-19 mev. At least 22 resonances are resolved in the excitation curves with observed level widths as large as 0.3 mev. Detailed angular distributions were taken at bombarding energies of 9.92, 11.97, 13.37, 15.20, 17.22, 18.30, and 18.90 mev; the distribution at 18.30 mev is in agreement with that of Correlli, et al (Phys. Rev., v. 116: 1184, 1959). In the vicinity of 18.3 mev, prominent resonance structure was observed and the angular distribution at 17.22 mev is rather different from the distributions at 18.3 mev and 18.9 mev. All of the angular distributions exhibit strong diffraction patterns. The number of maxima and minima increase with increasing energy and all angular distributions exhibit strong backward peaking.

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Florida State U. Dept. of Physics, Tallahassee.

ANGULAR DISTRIBUTIONS OF THE REACTIONS $Al^{27}(p,\alpha_0)Mg^{24}$ AND $Al^{27}(p,\alpha_1)Mg^{24}$ FROM 10 TO 12 MEV (Abstract), by K. L. Warsh, H. R. Blieden, and G. M. Temmer. [1961] [1]p. (AF 49(638)427) Unclassified

Presented at meeting of the Amer. Phys. Soc., Chicago, Ill., Nov. 24-25, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 440, Nov. 24, 1961.

The reactions $Al^{27}(p,\alpha_0)Mg^{24}$ and $Al^{27}(p,\alpha_1)Mg^{24}$ were studied at 10.0, 10.5, 11.0, 11.5, and 12.0 mev. The alphas were detected with junction counters thick enough to stop the alphas but thin enough not to detect the full energy of the protons. The shapes of the angular distributions were observed to change rapidly with beam energy. Some of these show large forward or backward peaking. An excitation curve will be presented; further work is in progress for higher excited states.

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Florida State U. Dept. of Physics, Tallahassee.

EXCITATION FUNCTION OF $O^{16}(p,p'\gamma)$ TO 10.6 MEV (Abstract), by R. F. Sturgeon, Jr., J. A. Becker, and J. D. Fox. [1961] [1]p. (AF 49(638)427) Unclassified

Presented at meeting of the Amer. Phys. Soc., Los Angeles, Calif., Dec. 27-29, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 506, Dec. 27, 1961.

The excitation functions for production of the 6.12 and 6.92 mev γ rays in O^{16} by protons have been measured from thresholds to 10.6 mev. The γ rays were detected at 90° from the beam axis with a 3-crystal scintillation pair spectrometer. A gas target of CO_2 at 6.7 cm Hg pressure was bombarded with proton beams of 2 μa. The yield of the oxygen gamma rays was determined relative to that of the C 4.43 mev γ ray for each run of 200 μcoul. The excitation functions were obtained by normalization to the data of Adams et al on the $C^{12}(p, p'\gamma_{4.43})$ reaction. Resonances were observed at incident proton energies of 6.88, 7.23, 7.43, 7.88, 8.31, 8.86, 9.19, and 9.98 mev.

750

Florida State U. [Dept. of Physics] Tallahassee.

EXCHANGE STRIPPING EFFECTS IN THE REACTION $B^{11}(d,n)C^{12}_{4.43}$, by C. A. Bruns, R. A. Zandis and others. [1961] [10]p. incl. diagrs. tables. (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)427 and Atomic Energy Commission) Unclassified

Published in Nuclear Phys., v. 28: 550-559, Dec. 1961.

Angular distributions for the $B^{11}(d,n)C^{12}_{4.43}$, reaction are presented for bombarding energies of 1.1, 2.5, and 2.8 mev (lab). These distributions are fitted with a 2-mode stripping theory. This theory with all parameters fixed

is used to fit n-γ correlations at 1.1 mev and published data at 2.65 mev. It is suggested that the discrepancies which still remain between theory and experiment may be reconciled by using a distorted wave Born approximation to the 2-mode theory. (Contractor's abstract)

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Florida U. Engineering and Industrial Experiment Station, Gainesville.

EXPERIMENTAL DETERMINATION OF A STATISTICAL REPRESENTATION OF THE NOISE FIELD OF A SUBSONIC AIR JET, by M. R. P. Trubert, H. G. Kizner, and W. A. Nash. Aug. 1961, 15p. incl. illus. diagrs. refs. (Technical note no. 3) (AFOSR-991) (AF 49(638)328) AD 264123 Unclassified

Also published in Developments in Mechanics, Proc. of the Seventh Midwestern Mechanics Conf., Michigan State U. (Sept. 6-8, 1961), New York, Plenum Press, v. 1: 460-483, 1961.

A space-time investigation of the noise field created by a subsonic air jet has been carried out with a model nozzle 1.4 in. in diameter. The random-noise pressure of the jet has been measured at the surface of a rigid plate placed outside the jet boundary. The cross correlation of the random noise has been chosen to represent the statistical properties of the noise field. A set of cross-correlation curves has been obtained experimentally. This investigation presents statistical representations of pressures in an obstructed field, whereas previous studies have pertained only to free fields. (Contractor's abstract)

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Florida U. Engineering and Industrial Experiment Station, Gainesville.

RESPONSE OF AN ELASTIC PLATE TO A DISTRIBUTED RANDOM PRESSURE CHARACTERIZED BY A SEPARABLE CROSS CORRELATION, by W. A. Nash. Sept. 1961, 25p. incl. refs. (Technical note no. 1) (AFOSR-1215) (AF 49(638)328) AD 265640 Unclassified

The technique of generalized harmonic analysis is employed to predict the mean-square response of a thin elastic plate to a random pressure acting normal to the surface of the plate. Damping of the plate is considered, and it is assumed that the pressure is spatially uniform. A general expression is presented for the power spectrum of the response; and, for the special case of a space-time separable pressure cross correlation, the response is evaluated for 2 cases: (a) white noise, and (b) all noise power concentrated at 1 frequency. (Contractor's abstract)

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Franklin Inst. Bartol Research Foundation, Swarthmore, Pa.

DECAY OF Br^{78}, by R. Rikmenspoel and D. M. Van Patter. [1961] [6]p. incl. diagrs. refs. (AFOSR-3012) (AF 49(638)512) Unclassified

Also published in Nuclear Phys., v. 24: 494-499, May 1961.

Br^{78} sources have been produced by proton bombardment of isotopically enriched (97%) thin targets of Se^{78}, in order to investigate the decay scheme of Br^{78}. The $Se^{78}(p,n)Br^{78}$ threshold was measured at 4.40 ± 0.01 mev, using a slow-fast neutron counter arrangement. Annihilation radiation with a half-life of 6.5 ± 0.1 min was observed for bombardments with $E_p \geq 4.40$ mev. Using an anthracene crystal, the end-point of the β^+ spectrum of Br^{78} was measured and was found to be consistent with the value of 2.54 ± 0.01 mev calculated from the $Se^{78}(p,n)$ threshold determination. Measurements of the γ-ray spectrum of Br^{78} indicate a γ-ray of 0.612 ± 0.003 mev, of intensity 0.14 ± 0.015 that of all positons, which is assigned to the known first 2 + state of Se^{78}. Excitation of the known second 2 + state at 1.31 mev is not observed, occurring with $\leq 0.4\%$ of the decays, with log ft ≥ 5.9. The results indicated that the ground state of Br^{78} has spin parity of 1 + . (Contractor's abstract)

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[Franklin Inst.] Bartol Research Foundation, Swarthmore, Pa.

NEW LEVELS IN Ge^{70} (Abstract), by P. N. Trehan, R. Rikmenspoel, and D. M. Van Patter. [1961] [1]p. [AF 49(638)512] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 48, Feb. 1, 1961.

Proton bombardment of thin Ge^{70} targets at $E_p < 5.2$ mev showed 0.175-, 0.67-, 1.04-, 1.71-, and 2.15-mev (± 1%) γ rays in singles spectra and 0.18-, 0.50-, 0.67-, and 1.11-mev γ rays in coincidence with 1.04 mev. The 1.04- and 0.175-mev γ rays arise from known levels at 1.04 (2+) and 1.21 (0+) mev. The prominent γ rays of 0.67 and 1.71 mev are assigned to a new level at 1.71 mev, which is considered as the second 2+ level, both on the basis of systematics and prominence of these γ rays, with a branching ratio (crossover/cascade) = 1.7 ± 0.1. The branching of this level to the 1.21-mev

was found to be < 3%. The 1.11-mev γ ray seen in the coincidence spectra indicates a new level at 2.15 mev with a branching of 0.8 ± 0.3. Excitation curves and angular distributions for some of the prominent γ rays have been measured.

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[Franklin Inst.] Bartol Research Foundation [Swarthmore, Pa.]

(p,p'γ) SPECTRA FOR Ni^{58}, Ni^{60}, AND Ni^{62} (Abstract), by P. N. Trehan and D. M. Van Patter. [1961] [1]p. [AF 49(638)512] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 272, Apr. 24, 1961.

Isotopically enriched targets of Ni^{58} (99.9%), Ni^{60} (99.8%), and Ni^{62} (98.0%) on 8-mil Au backings were bombarded by protons with E_p = 3.4-5.2 mev, and γ-ray spectra with E_γ > 0.6 mev were investigated. In the case of Ni^{58}, only γ rays of 1.01 and 1.45 mev (±1%) were seen. Gamma-rays of 0.83, 0.95, 1.33, 1.79, 2.16, and 2.28 (weak) mev (±1%) were observed from Ni^{60}. The branching ratio of the second 2+ level of Ni^{60} at 2.16 mev has been measured as 0.14 ± 0.02, which differs from earlier radio activity measurements. In the case of Ni^{62}, γ rays of 0.88, 1.17, 1.73, 2.05 (weak) and 2.30 mev (± 1%) were observed. The branching ratio for the 2.05-mev level is estimated as 0.06 ± 0.015. The observation of a prominent 2.30-mev γ ray appears to eliminate the possibility of 0+ for the 2.30-mev level of Ni^{62}. Knowledge of the level schemes of these nickel isotopes indicates that all the γ rays listed should be assigned to the (p, p'γ) reaction. The excitation curves for some prominent γ rays of Ni^{60} and Ni^{62} have been measured.

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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. (AF 49(638)512) Unclassified

Published in Nuclear Phys., v. 27: 467-480, Oct. 1961.

It has been found possible to study the systematic properties of the second 2+ level in medium-weight even nuclei by investigation of γ-radiation from the (p,p'γ) reaction. For the mass region A = 60-80, the present method of observing (p,p'γ) spectra has been successful for nuclei whose (p,n) threshold exceeds about 4 mev. Measurements of the branching ratio of the second 2+ level have been made for Zn^{64}, Zn^{66}, Zn^{68}, Ge^{72}, Se^{76}, and Se^{78}, which are in reasonable agreement with available results from radioactivity. New levels have been found in Ge^{70} at 1.71 ± 0.01 and 2.16 ± 0.01 mev. The 1.71 mev level is considered to be the second 2+ level with a branching (crossover/cascade) of 0.9 ± 0.1. Information concerning the excitation curves for various (p,p'γ) radiation of Zn^{66} and Ge^{70} has been obtained for proton energies in the range of 3.0 to 5.2 mev. (Contractor's abstract)

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[Franklin Inst.] Bartol Research Foundation [Swarthmore, Pa.]

DECAY OF 18-MIN Br^{80} (Abstract), by P. N. Trehan and D. M. Van Patter. [1961] [1]p. [AF 49(638)512] Unclassified

Presented at meeting of the Amer. Phys. Soc., Chicago, Ill., Nov. 24-25, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 428, Nov. 24, 1961.

The decay of Br^{80} was investigated by means of scintillation spectrometry. The 18-min Br^{80} was produced by proton bombardment of 99.4% enriched Se^{80} targets with E_p = 4.0 mev. Gamma rays of energy 0.62, 0.67, 1.26, and 1.33 mev (±1%) were observed in singles spectra, and γ rays of energy 0.64 and 0.71 mev appeared in coincidence with the 0.62-mev γ rays. The 0.62-mev γ ray arises from the known level at 0.62 (2+) mev in Kr^{80}. The 0.64- and 1.26-mev γ rays are assigned to a new level at 1.26 mev in Kr^{80}, and 0.71- and 1.33-mev γ rays are assigned to a second new level at 1.33 mev in Kr^{80}. The level at 1.26 mev is considered to be the second 2+ level, both on the basis of systematics and the log ft value of the beta transition to this level. The 0.67-mev γ ray is assigned to the first 2+ level in Se^{80}. The ratio of 0.62 γ/β+ has been measured as 2.6 ± 0.1, which is used for the evaluation of the log ft values for the transitions to various levels in Se^{80} and Kr^{80}

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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. [AF 49(638)512] Unclassified

Published in Phys. Rev., v. 126: 266-271, Apr. 1, 1962.

Gamma rays with energies of 0. 18 ±0.003, 0.640 ±0.009, 0.67 ± 0.02, 0.710 ± 0.010, 1.258 ± 0.007, and 1.333 ± 0.010 mev have been observed in the decay of 18-min Br^{80}, and their intensities determined. Of these, only the 0.618-mev γ ray has been previously reported. Two new levels are proposed at 1.26 and 1.33 mev in Kr^{80}, and the branching (crossover/cascade) determined for these levels as 0.46 ± 0.08 and 0.14 ± 0.06, respectively. The 0.67-mev γ ray is assigned to the first 2+ state of Se^{80}, whose energy has been determined as 0.667 ± 0.004 mev from (p,p'γ) reaction. Excitation of the second level of Se^{80} at 1.44 mev was not observed. The measured value of 0.62 mev $\gamma/\beta+$ of 2.6 ± 0.1 has been used to evaluate log ft values for the transitions to various levels in Se^{80} and Kr^{80}. The allowed transitions from the 1+ ground state of Br^{80} to the ground state and first 2 levels of both Se^{80} and Kr^{80} are found to be successively hindered, in accord with the empirical rule of Sakai. (Contractor's abstract)

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Franklin Inst. Labs. for Research and Development, Philadelphia, Pa.

A NOTE ON THE EFFECTIVE CONSTANTS OF COMPOSITE MATERIALS, by Z. Hashin and S. Shtrikman. [1961] [6]p. incl. refs. (AFOSR-947) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)159 and Office of Naval Research) Unclassified

Also published in Jour. Franklin Inst., v. 271: 423-426, May 1961.

It is the purpose of this work to find the most restrictive upper and lower bounds on the effective constants that can be obtained in terms of phase constants and fractional volumes, assuming isotropy of the composite material. For reasons of mathematical analogy the results obtained also apply to dielectric, electric conduction, heat conduction and diffusion properties of such materials.

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Franklin Inst. Labs. for Research and Development, Philadelphia, Pa.

MAGNETIC METHOD FOR THE DETERMINATION OF THE ANISOTROPY DISTRIBUTION IN FERROMAGNETIC POWDERS, by P. J. Flanders and S. Shtrikman. Aug. 1961 [16]p. incl. diagrs. refs. (Interim rept. no. 1-A2026-3) (AFOSR-984) (AF 49(638)159) AD 262027 Unclassified

Presented at Internat'l. Conf. on Magnetism and Crystallography, Kyoto (Japan), Sept. 25-30, 1961.

Also published in Jour. Phys. Soc. Japan, v. 17, Suppl. B-I: 673-675, Mar. 1962.

A technique to determine the anisotropy distribution in a ferromagnetic powder consisting of uniaxial particles has been developed which can be used for samples with randomly oriented particles as well as with oriented samples. In principle it eliminates incoherent magnetization reversals. It involves saturating the material in a magnetic field and then making torque measurements at an angle several degrees away from the saturation direction. In these measurements the torque on the specimen as a function of magnetic field is recorded as the field is cycled from zero to a specified field and then reduced to zero. This cycling procedure is continued, gradually increasing the maximum applied field upon subsequent cycles until the magnetic field exceeds the highest anisotropy field of the particles in the distribution. For elongated γ-Fe_2O_3 particles this technique gives length to width distributions which approach those observed by the electron microscope technique. (Contractor's abstract)

761

Franklin Inst. Labs. for Research and Development, Philadelphia, Pa.

MAGNETIC AND STRUCTURAL PROPERTIES OF PRECIPITATING FERROMAGNETIC SYSTEMS, by P. J. Flanders. Final rept. Jan. 1, 1957-Dec. 31, 1961 [8]p. (Rept. no. F-A2026) (AF 49(638)159) Unclassified

Magnetic investigation of the precipitating systems proved to be a sensitive means by which the structural properties of the alloys could be determined. These structural properties could be examined during the earliest stages of anneal with a degree of precision not possible when standard techniques are employed. The experimental torque magnetometer method for the examination of anisotropy and orientation has proved to be a potentially powerful tool and it would be of continued interest and value if applied to other precipitating alloy systems. This technique has applications which extend beyond the study of precipitating alloys into the field of powder ferromagnetism.

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Franklin Inst. [Labs. for Research and Development] Philadelphia, Pa.

EXPERIMENTAL DETERMINATION OF THE ANISOTROPY DISTRIBUTION IN FERROMAGNETIC POWDERS, by P. J. Flanders and S. Shtrikman. [1961] [4]p. incl. diagrs. refs. (AFOSR-4431) (AF 49(638)159) AD 295957 Unclassified

Also published in Jour. Appl. Phys., v. 33: 216-219, Jan. 1962.

A technique to determine the anisotropy distribution in a ferromagnetic powder consisting of uniaxial particles has been developed. This technique can be used for samples with randomly oriented particles as well as with oriented samples. In principle it eliminates incoherent magnetization reversals which led to errors in previous methods. It involves saturating the material in a magnetic field and then making torque measurements at an angle several degrees away from the saturating direction. In these measurements the torque on the specimen as a function of magnetic field is recorded as the field is cycled from zero to a specified field and then reduced to zero. This cycling procedure is continued, gradually increasing the max applied field upon subsequent cycles until the magnetic field exceeds the highest anisotropy field of the particles in the distribution. For elongated γ-Fe_2O_3 particles this technique gives length-to-width distributions which approach those observed by the electron microscope technique. These results are compared to those obtained by remanence measurements which give smaller values of anisotropy constants, indicating the importance of incoherent magnetization reversals, when the remanence is acquired. (Contractor's abstract)

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Franklin Inst. Labs. for Research and Development, Philadelphia, Pa.

REMANENT TORQUE STUDIES IN POLYCRYSTALLINE $BaFe_{12}O_{19}$, by P. J. Flanders and S. Shtrikman. [1961] [2]p. incl. diagrs. table, refs. (AFOSR-4434) (AF 49(638)159) AD 295959 Unclassified

Presented at Seventh Conf. on Magnetism and Magnetic Materials, Phoenix, Ariz., Nov. 13-16, 1961.

Also published in Jour. Appl. Phys., Suppl., v. 33: 1318-1319, Mar. 1962.

Measurements of the anisotropy distribution in $BaFe_{12}O_{19}$ were carried out using the remanent torque technique. Two randomly oriented powder samples with coercive forces of 1500 and 4000 oe were tested. The remanent torque curves for both samples were essentially identical indicating an anisotropy distribution with an average of $2.1 \pm 0.2 \times 10^6$ ergs/cm^3 compared with a value of 3.3×10^6 ergs/cm^3 for single crystal $BaFe_{12}O_{19}$. The origin of this disagreement is unclear but it seems to be associated with splitting into domains. (Contractor's abstract)

764

Franklin Inst. Labs. for Research and Development, Philadelphia, Pa.

NOTE ON A VARIATIONAL APPROACH TO THE THEORY OF COMPOSITE ELASTIC MATERIALS, by Z. Hashin and S. Shtrikman. [1961] [6]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)159] and Office of Naval Research) Unclassified

Published in Jour. Franklin Inst., v. 271: 336-341, Apr. 1961.

This investigation is concerned with the construction of bounds on the moduli that are independent of the statistics, assuming that the compcsite material is isotropic. Results of its application to the case of 2 phase linear elastic and isotropic materials are given.

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Franklin Inst. [Labs. for Research and Development, Philadelphia, Pa.]

COMPARISON OF DISLOCATION PATTERNS IN DEFORMED PURE fcc METALS AND α BRASS (Abstract), by J. T. Fourie, P. R. Strutt, and H. G. F. Wilsdorf. [1961] [1]p. (AF 49(638)162) Unclassified

Presented at meeting of the Amer. Phys. Soc., Monterey, Calif., Mar. 20-23, 1961.

Also published in Bull. Amer. Phys. Soc., Series II, v. 6: 163, Mar. 20, 1961.

Specimens suitable for diffraction electron microscopy have been prepared from deformed single crystals of aluminum and α-brass, the smallest dimension being not less than 10^{-1} cm. In pure fcc metals the majority of dislocations appear as tangles, and many prismatic dislocation loops are found in their vicinity. In contrast, the dislocations in α-brass are straight, and large numbers of them are arranged on single slip planes. The difference in the observed patterns can be construed as evidence that the multiplication mechanism is entirely different for these classes of metals. While the operation of single Frank-Read sources could be invoked for α-brass, the same mechanism could not account for the majority of dislocations produced in pure fcc metals. The underlying cause for the different behavior of dislocations in pure fcc metals and alloys of α-brass type are discussed for the early stages of deformation and specific mechanisms are proposed.

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Franklin Inst. Labs. for Research and Development, Philadelphia, Pa.

A BIBLIOGRAPHY ON GAS-LUBRICATED BEARINGS - REVISED, by A. Peters and E. B. Sciulli, ed. by D. D. Fuller. Oct. 15, 1961, 180p. incl. refs. (Rept. no. I-A2049-16) ([Sponsored jointly by Air Force Office of Scientific Research] and Office of Naval Research under Nonr-234200) AD 246965 Unclassified

This work is an expansion of the bibliography issued in September 1959 (item no. 550, Vol. III) and contains 174 additional references. Wherever possible a resume in English of each reference is included. In most cases the abstracts were taken verbatim from the author, translation being made when required. When necessary or desirable, resumes were prepared or revised. Every effort has been made to make this a comprehensive listing of all references published prior to July 1, 1961, which deal directly or indirectly with gas-lubricated bearings. (Contractor's abstract)

767

Free U. of Brussels (Belgium).

[INFLUENCE OF SERUM ON THE INTERACTION OF SULFAMIDES AND COLORANTS] L'influence du sérum sur l'interaction des sulfamides et des colorants, by E. Lagrange. [1957] [3]p. [AF 61(514)1112] Unclassified

Published in Compt. Rend. Seánces Soc. Biol., v. 151: 2212-2214, Dec. 1957.

Methods for determining the influence of serum on the interaction of sulfamides and dyes are presented. It is also shown that certain systems, notably staphylococcus + fuchsine + sulfathiazol are particularly reactive through paraminobenzoic acid with or without serum.

768

Free U. of Brussels (Belgium).

SUPPRESSION OF ACOUSTIC INPUT BY THALAMIC STIMULATION, by J. E. Desmedt and K. Mechelse. [1958] [4]p. incl. illus. (AFOSR-4892) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(514)1112, Lekime Foundation and Rockefeller Foundation) AD 415107 Unclassified

Also published in Proc. Soc. Exper. Biol. and Med., v. 99: 772-775, 1958.

Electrical responses to clicks were recorded from the ventral cochlear nucleus in curarized cats and the effect thereon of brain stem repetitive stimulation was investigated (stereotaxic method). Clearcut inhibition of the cochlear nucleus response to the click was recorded when a critically-localized region of the posterior diencephalon was stimulated. These and previous results provide the first physiological evidence for a specific extra-reticular descending pathway, presumably enabling higher levels of the nervous system to control acoustic input. (Contractor's abstract)

769

Free U. of Brussels (Belgium).

CORTICOFUGAL PROJECTIONS FROM TEMPORAL LOBE IN CAT AND THEIR POSSIBLE ROLE IN ACOUSTIC DISCRIMINATION, by J. E. Desmedt and K. Mechelse. [1959] [2]p. (AFOSR-J428) (AF 61(514)1112) Unclassified

Presented at meeting of the Physiological Soc., University Coll., London (Gt. Brit.), Mar. 20-21, 1959.

Also published in Jour. Physiol. (London), v. 147: 17P-18P, 1959.

The organization of corticofugal projections from auditory areas and surrounding cortex has been investigated with the Nauta-Gygax method. Special emphasis is placed on the pattern of corticofugal projections terminating in the caudal diencephalon. In view of the evidence that ventral temporal cortex in the cat is at least partially involved in the operation of a specific descending inhibitory pathway controlling cochlear nucleus response to sound, it seems reasonable to suggest that discrimination of acoustic patterns depends on centrifugal modulation of coding processes in auditory afferent relays.

770

Free U. of Brussels (Belgium).

[PROGRESSIVE SENSITIZATION OF A PARTIALLY DENERVATED CORTICAL AREA TO ITS RESIDUAL AFFERENTS] Sensibilisation progressive d'une aire corticale partiellement dénervée à ses afférences résiduelles, by L. Franken and J. E. Desmedt. [1957] 5p. incl. illus. diagrs. (AFOSR-J431) (AF 61(514)1112) AD 407715 Unclassified

Also published in Compt. Rend. Seánces Soc. Biol., v. 151: 2204-2208, Dec. 1957.

The gradual removal of connections in the corpus callosum of the cat leads to an increase in the sensitivity of the remaining fibers of the area. This increase is slow in appearing, being complete only after approximately 2 to 4 mo, a considerably longer period than that required by the spinal cord in similar circumstances.

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Free U. of Brussels (Belgium).

[EVIDENCE SHOWING A FOURTH ACOUSTIC PROJECTION AREA IN THE CEREBRAL CORTEX OF THE CAT] Mise en évidence d'une quatrième aire de projection acoustique dans l'écorce cérébrale du Chat, by J. E. Desmedt and K. Mechelse. [1959] [2]p. (AFOSR-J616) [AF 61(514)1112] AD 416720 Unclassified

Presented at the Twenty-seventh meeting of the Association des Physiologistes de Langue Française, Marseille, June 1-4, 1959.

Also published in Jour. Physiol. (Paris), v. 51: 448-449, 1959.

Evidence is presented for the existence of a fourth projection area in the cerebral cortex of the cat. This area is located between the anterior rhinal fissure and the anterior ectosilvian fissure, in front of the pseudosilvian fissure. It is definitely found outside of the generally accepted boundaries of the first, second and third auditory areas and of the somesthetic areas. The latency of the evoked potential of the fourth acoustic projection area to clicks is from 7 to 12 msec.

772

Free U. of Brussels (Belgium).

EFFERENT OLIVO-COCHLEAR GATING OF ACOUSTIC INPUT AND THE RESULTANT CHANGES IN AUDITORY CORTEX POTENTIALS, by J. E. Desmedt. 1961, 2p. incl. illus. diagr. (AFOSR-J170) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)120 and National Institutes of Health) AD 400432 Unclassified

Presented at meeting of the Physiological Soc., Sept. 28-29, 1962.

Also published in Jour. Physiol. (London), v. 165: 33P-24P, Jan. 1963.

A cat anesthetized with chloralose, immobilized with Flaxedil and with the middle ear muscles cuaterized is studied. Cathode-ray oscillograms of responses to clicks recorded simultaneously at the round window, in the principal division of the superior olive, in the inferior colliculus and in the auditory I area of the cerebral cortex are presented. Forty-two shocks at 400/sec were delivered to the olivo-cochlear bundle through stereotaxic bipolar needles, 20 msec before the testing click. Although OCB activation potentiates the cochlear microphonic potential it effectively suppresses evoked potentials all along the auditory pathway. Pooled data from several cats anesthetized either by pentobarbitone or chloralose are represented graphically. Each point on the graph corresponds to a given parametric set of OCB stimulation and relates equivalent db changes observed in simultaneously recorded auditory nerve and primary cerebral cortex surface-positive potential.

773

Free U. of Brussels (Belgium).

THE PHARMACOLOGY OF A CENTRIFUGAL INHIBITORY PATHWAY IN THE CAT'S ACOUSTIC SYSTEM, by J. E. Desmedt and P. Monaco. [1961] [6]p. incl. illus. diagrs. refs. (AFOSR-J171) (AF 61(052)120) AD 400433 Unclassified

Also published in Proc. of the First Internat'l. Pharmacological meeting, Stockholm (Sweden) (Aug. 22-25, 1961), New York, Pergamon Press, v. 8: 183-188, 1962.

Strychnine and brucine can reduce or suppress the 2 centrifugal effects of stimulation of the Rasmussen bundle on the inner ear, i.e., the inhibition of responses evoked by sound in auditory nerve and cochlear nucleus, and the potentiation of the cochlear microphonic potential. Experiments involving topical application of drugs to the fenestrum rotunda establish this as a genuine effect of the alkaloids. Picrotoxine and metrazol, as well as compound 1757 I.S., do not affect these phenomena. The olivo-cochlear axons presumably liberate the same inhibitory transmitter as the 1 postulated for post-synaptic inhibition in spinal cord. The mechanisms involved are discussed and it is suggested that the preparation used may be useful in further screening and assay of convulsant drugs. (Contractor's abstract)

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Free U. of Brussels (Belgium).

NEUROPHYSIOLOGICAL MECHANISMS IN CEREBRAL AROUSAL, by F. Bremer. [1960] [27]p. incl. illus. refs. (AFOSR-J402) (AF 61(052)120) Unclassified

Also published in Ciba Foundation Symposium on the Nature of Sleep, London (Gt. Brit.) (June 27-29, 1960), Boston, Little, Brown and Co. [1961] p. 30-56.

Convergence and interaction of sensory and reticular impulses on neurones of the cat's visual area characterized the microphysiological observations of Jung. Potential waves recorded from the brain surface have revealed similar interactions. In the evoked potentials of the brain cortex, the interaction of specific and reticular impulses has been shown to result in conflicting processes, a suppressive one and a facilitatory one. Both have their main seat at the cortical level, in a proportion depending on the experimental conditions. The psychophysiological implications of the experimental data are discussed. It is hypothesized that the reticulo-cortical discharges which arouse the brain exert both an intensifying and a differentiating effect on the thalamocortical processes which result in perceptual integration.

775

Free U. of Brussels (Belgium).

NEUROGENIC FACTORS INFLUENCING THE EVOKED POTENTIALS OF THE CEREBRAL CORTEX, by F. Bremer. [1959] [24]p. incl. illus. diagrs. refs. (AFOSR-J403) (AF 61(052)120) Unclassified

Also published in Sensory Communication: Contributions to the Symposium on Principles of Sensory Communication, Endicott House, Massachusetts Inst. of Tech. (July 19-Aug. 1, 1959) [Cambridge] M.I.T. Press, 1961, p. 675-698 (AFOSR-796).

The aim of this report is to survey some of the neurogenic factors that influence the electrical responses evoked in the neocortical gray matter by a brief volley of afferent impulses. Special emphasis has been given to heterosynaptic convergences of specific sensory and unspecific reticular impulses at the thalamic and cortical levels. Like the mono- and polysynaptic reflex responses of spinal motoneurons to single electrical stimuli, the evoked potentials of the cerebral cortex are obviously the artificial product of experiments devised for analytical purposes. Yet the study of the factors of variation of these integrated cortical responses throws light on the physiological properties of the neuronal networks of the brain. By doing so, it represents an approach to the knowledge of the primary neural events, which, initiating an immensely complicated chain of neurophysiological processes, underlie perceptual integration.

776

Free U. of Brussels (Belgium).

[WEDENSKI INHIBITION IN THE CEREBRAL CORTEX] Inhibition de Wedenski dans l'encore cérébrale, by F. Bremer and N. Stoupel. 1960, 2p. (AFOSR-J404) (AF 61(052)120) AD 416715 Unclassified

Also published in Jour. Physiol. (Paris), v. 52: 34-35, 1960.

Electrical responses of the strychninized primary auditory cortex of cat are studied. Clicks presented at 20-50/sec show a falloff of amplitude after the first responses; when a click of different timbre is interpolated, a high-amplitude response occurs. Similarly a transcallosal volley yields an uninhibited response, indicating that when different synapses are employed the same neuron can be activated unless the heterosynaptic volley arrives within the 200-msec refractory period. This may be interpreted as a cortical analog of Wedenski inhibition.

777

Free U. of Brussels (Belgium).

STEREOTAXIC STIMULATION OF EFFERENT PATHWAYS IN THE AUDITORY NERVOUS SYSTEM OF THE CAT] Stimulation stéréotaxique de voies efférentes dans le systeme nerveux auditif du Chat (Démonstration), by J. E. Desmedt and P. Monaco. [1961] [3]p. (AFOSR-J405) (AF 61(052)120) AD 414149 Unclassified

Presented at meeting of the Soc. Belge de Physiologie et Pharmacodynamie, Brussels (Belgium), Apr. 15, 1961.

Also published in Arch. Internat'l. Pharmacodyn. et Ther., v. 132: 492-494, 1961.

Various parametric properties of the auditive nerve system are demonstrated. One notices, therefore, some quantitative changes in the inhibition of auditative responses to the cortex by the systematic change (1) of the frequency of electric shocks in the series preceding the click, (2) of the number of shocks at a chosen frequency and (3) of the interval between the last shock of a series and the click. Several shocks were applied at frequencies up to 50/sec in order to produce the impressions which are dissipated rather slowly in 0.2 to 3 sec according to a regular curve.

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Free U. of Brussels (Belgium).

MODE OF ACTION OF THE EFFERENT OLIVO-COCHLEAR BUNDLE ON THE INNER EAR, by J. E. Desmedt and P. Monaco. [1961] [3]p. incl. diagrs. (AFOSR-J406) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)120 and National Institutes of Neurological Disease and Blindness) Unclassified

Also published in Nature, v. 192: 1263-1265, Dec. 1961.

In experiments on cats (pentobarbitone, chloralose or high spinal section; middle ear muscles stapedius and tensor tympani cauterized; "Flaxedil" infusion) the auditory nerve compound action potential (N_1) evoked by clicks and the cochlear microphonic potential (CM) evoked by tone pips have been recorded through an electrode placed on the round window. Trains of electrical pulses were applied to the crossed olive-cochlear bundle through bipolar stereotaxic electrodes at known intervals before delivery of the testing sound (click or tone pip) to the ear. Effective stimulation of the efferent bundle produces two effects, namely inhibition of the N_1 spike and potentiation of CM. The observations herein suggest that both effects are genuine and that they are simultaneously produced by a chemical transmitter released from the olivo-cochlear axon terminals.

779

Free U. of Brussels (Belgium).

[FROM SENSATION TO ACTION] De la sensation a l'action, by F. Bremer. [1959] [11]p. (AFOSR-J408) (AF 61(052)120) Unclassified

Also published in Bull. Acad. Roy. Belg. Cl. Sci., v. 45: 1148-1158, 1959.

A brief history of some of the problems in neurophysiology is presented. The works of Nernst, Erlanger and Gasser, Fechner and others are discussed.

780

Free U. of Brussels (Belgium).

[NERVOUS REGULATIONS OF CORTICAL ACTIVITY] Les régulations nerveuses de l'activité corticale, by F. Bremer. [1960] [15]p. incl. illus. diagrs. refs. (AFOSR-J409) (AF 61(052)120) Unclassified

Also published in Schweizer Arch. Neurol., Neurochir. und Psychiat., v. 86: 34-48, 1960.

Various aspects of nervous regulations of cortical activity are considered. Topics include reticular-cortical activation and inhibition, and reticular facilitation of evoked cortical potential.

781

Free U. of Brussels (Belgium).

[ANALYSIS OF THE CORTICAL PROCESSES IN AROUSAL] Analyse des Processus corticaux de l'éveil, by F. Bremer. [1960] [10]p. incl. illus. (AFOSR-J410) (AF 61(052)120) Unclassified

Presented at the Moscow Colloquium on Electroencephalography of Higher Nervous Activity, Moscow (USSR), 1960.

Also published in Electroencephalog. and Clin. Neurophysiol., Suppl. 13: 125-136, 1960.

Results indicate that the reduction, in arousal, of the cortical evoked potentials, which is a regular feature of the response provoked by stimuli applied on peripheral receptors is replaced by an increase of the evoked potentials of the same receiving and associative areas when the testing stimulus is applied on the adequate thalamic relay nucleus or on the optic nerve. The same diffuse cortical facilitation follows stimulation of the mesencephalic and the thalamic reticular system. A single reticular shock applied as a conditioning stimulus may exert a powerful facilitation of the response to a subsequent testing stimulus. The oscillographic and some pharmacological characteristics of the phenomenon are described. An explanation is proposed for the 2 contrasting effects of reticular arousal on evoked cortical potentials, and their physiological significance is discussed. The general conclusion of this study is that ascending reticular impulses exert on the cortical neurone population both a sensitizing and an activating effect. (Contractor's abstract, modified)

782

Free U. of Brussels (Belgium).

[OSCILLOGRAPHIC ANALYSIS OF EVOKED POTENTIALS OF CORTICAL RECEPTOR AREAS] Analyse oscillographique des potentiels évoqués de réception corticales, by V. Bonnet. [1961] [8]p. incl. illus. (AFOSR-J411) (AF 61(052)120) Unclassified

Also published in Arch. Internat'l. Physiol. Biochim., v. 69: 609-616, Dec. 1961.

In the cat the recording within the sensory areas of the cortex of responses to sensory stimuli or to electrical excitation of the nerve of corresponding thalamic relay indicated the complex nature of reactionary potential thus observed. Starting with a certain stimulation intensity a negative slow wave of long duration is grafted, in effect, on the descending phase of negative potential. The origins of two waves at the level of the same cortical neurons have been determined from the observed modifications during repeated stimulation and under the influence of Nembutal. Results indicate the slow wave may be attributed to the putting into play of the non-specific transmission nerve system by peripheral or thalamic stimulus.

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Free U. of Brussels (Belgium).

[THE EVOKED POTENTIAL OF THE VISUAL CORTICAL AREA] Le potentiel évoqué de l'aire visuelle corticale, by F. Bremer. [1960] [16]p. incl. illus. refs. (AFOSR-J412) (AF 61(052)120) Unclassified

Also published in Neurophysiologie und Psychophysik des Visuellen Systems, Freiburg (Germany) (Sept. 1960), Berlin (Germany), Springer-Verlag, 1961, p. 335-350.

The response evoked by an electrical stimulus applied on the optic pathway is characterized by a sequence of brief initial transients, preceding the positive negative slow phases, obviously of postsynaptic origin. Spike 1 is the record of the radiation potential. But the nature of spikes 2 and 3 is still a matter of controversy. A significative feature of the spike sequence is the striking dependence of the spacing of its constituting potentials on the temperature of the cortex, a fact which, together with other data, suggests that spikes 2 and 3 contain important intracortical presynaptic components. The complex configuration of the cortical response to a flash of light reflects essentially retinal organization. The various factors that have proved responsible for

correlated changes of retinal, geniculate and cortical reactivity are discussed. Special emphasis is placed on the facilitatory and suppressive processes which are operative during reticular arousal of the brain. (Contractor's abstract)

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Free U. of Brussels (Belgium).

[NEW INVESTIGATIONS ON FACILITATION AND THE INHIBITION OF EVOKED CORTICAL POTENTIALS IN RETICULAR AROUSAL] Nouvelles recherches sur la facilitation et l'inhibition des potentiels évoqués corticaux dans l'éveil réticulaire, by F. Bremer, N. Stoupel, and P. C. Van Reeth. [1960] [19]p. incl. illus. refs. (AFOSR-J414) (AF 61(052)120) Unclassified

Also published in Arch. Ital. Biol., v. 98: 229-247, July 31, 1960.

The aim of this research is two-fold: (1) to define the mechanism of the modifications of the evoked cortical potentials in the cerebral cortex arousal provoked by electrical stimulation of the mesencephalic reticular or thalamic formations or by sensory excitation and (2) to determine, if possible, the functional significance of these modifications.

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Free U. of Brussels (Belgium).

EFFECTS OF ILLUMINATION OF THE EYE ON THE VESTIBULAR RESPONSES IN THE PIGEON, by M. Van Eyck. [1960] [3]p. incl. illus. (AFOSR-J415) (AF 61(052)120) Unclassified

Also published in Acta Oto-laryngol., v. 51: 420-422, Mar. 1960.

Experiments were made on pigeons completely awake after dissipation of light ether anesthesia employed for the neck-muscle dissections or to prepare the labyrinth. A well-fixed head, a mechanical coupling of the light source with the eye during the rotations and also complete darkness avoid the superimposition of optokinetic nystagmus. First it was checked that sudden illumination had no effect on the neck-muscle electromyograms before any stimulation of the canals by rotation. After this check, the combination of rotatory stimulus and light stimulus show the following: (1) Eye illumination of a normal pigeon during a labyrinth stimulation by rotation provokes an amplification of the initial volleys of both the pre- and post-rotatory head nystagmus, if compared with the responses of the same animal without light stimulus; (2) If the light stimulus is only given during the rotation, the post-rotatory nystagmus is unaffected; (3) If a similar experiment is performed on a pigeon with a chronic unilateral labyrinthectomy and showing clearly the phenomenon of compensatory vestibular nystagmus, the light stimulus has just the same effects on this compensatory nystagmus as on a normal nystagmus; and (4) If a light stimulus is given without rotation to a pigeon with an acute unilateral labyrinthectomy in which a small spontaneous nystagmus is green, it is found to amplify and also to accelerate the nystagmic volleys of muscular potentials, the head being immobile.

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Free U. of Brussels (Belgium).

[ELECTROPHYSIOLOGICAL STUDY OF THE CEREBELLO-CEREBRAL RELATIONS IN THE CAT] Etude electrophysiologique des relations cérébello-cérébrales chez le Chat, by N. Stoupel. [1961] [4]p. incl. illus. (AFOSR-J416) (AF 61(052)120) Unclassified

Also published in Compt. Rend. Séances Acad. Sci., v. 253: 2137-2139, Nov. 1961.

The nature of the influence exerted by the neo-cerebellum on the contralateral cerebral cortex is confirmed and defined. The limitation of this influence on motor and somesthetic areas is also discussed.

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Free U. of Brussels (Belgium).

[SUPPRESSION BY STRYCHNINE OF THE CENTRIFUGAL INHIBITORY EFFECT PRODUCED BY THE OLIVO-COCHLEAR FASCICLE] Suppression par la strychnine de l'effet inhibiteur centrifuge exercé par le faisceau olivo-cochleaire, by J. E. Desmedt and P. Monaco. [1960] [5]p. incl. illus. refs. (AFOSR-J418) (AF 61-(052)120) Unclassified

Also published in Arch. Internat'l. Pharmacodyn. et Ther., v. 129: 244-248, 1960.

The centrifugal inhibition of acoustic nerve response to a testing click by the olivo-cochlear bundle in cat is reduced or suppressed by the injection of subconvulsant doses of strychnine. Various controls indicate that this is a specific effect of the alkaloid. Picrotoxic and metrazol have no such effect. The centrifugal olivo-cochlear inhibition thus possesses similar neuropharmacological properties to those of the segmental inhibitions in spinal motoneurons, and it may involve the same (hypothetical) chemical transmitter. (Contractor's abstract)

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Free U. of Brussels (Belgium).

[THE ACTIVATOR RETICULAR SYSTEM] Le système réticulaire activateur, by F. Bremer. [1961] [3]p. incl. refs. (AFOSR-J420) (AF 61(052)120) AD 414186 Unclassified

Presented at Conf. au Colloque sur la neuroleptanalgésie, Ostend (Belgium), Apr. 1961.

Also published in Rev. Agressologie, v. 3: 13-15, 1962.

It is demonstrated that there exists in the reticular formations of the cerebral stem which spreads from the bulbo-pontine to the mesencephalic and extends to the non-specific nerves of the thalamus, a dynamic diffuse mechanism of the diencephalic and cerebral cortex. This is highly sensible to variations of the inner sphere and to those in the surrounding sphere and adjusts the reactivity of the brain which is the immediate physiological condition of consciousness.

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Free U. of Brussels (Belgium).

NEUROPHYSIOLOGICAL MECHANISMS CONTROLLING ACOUSTIC INPUT, by J. E. Desmedt. [1960] [16]p. incl. illus. diagrs. refs. (AFOSR-J422) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)120, Lekime Foundation, and Rockefeller Foundation) Unclassified

Also published in Neural Mechanisms of the Auditory and Vestibular Systems, ed. by G. L. Rasmussen and W. Windle, Springfield, Charles C. Thomas, 1960, p. 152-164.

Neurophysiological mechanisms controlling acoustic input have been studied. Various aspects of the problem are considered including: (1) control of acoustic input in behaving animals, (2) acoustic centrifugal mechanism, and (3) acoustic evoked potentials in thalamus and cortex. The observations summarized in the present paper, though still far from comprehensive, are in good agreement with the evidence presented by Rasmussen, and they suggest that the central mechanisms responsible for the control of acoustic input have a more elaborate organization than hitherto supposed.

790

Free U. of Brussels (Belgium).

CENTRAL REGULATORY MECHANISM: INTRODUCTION, by F. Bremer. [1960] [3]p. (AFOSR-J423) (AF 61(052)120) AD 402694 Unclassified

Also published in Handbook of Physiology: Section I: Neurophysiology; ed. by J. Field, Washington, D. C., Amer. Physiological Soc., v. 2: 1241-1243, 1960.

Various theories which consider the nervous system as an assembly of mechanisms are discussed briefly.

791

Free U. of Brussels (Belgium).

LEADING EDGE EFFECT ON SEPARATED SUPERSONIC FLOWS, by J. J. Ginoux. May 1961 [33]p. incl. illus. diagrs. table. (Technical note no. 1) (AFOSR-1197) (AF 61(052)350) AD 262031 Unclassified

In supersonic tunnel tests with a 2-dimensional backward-facing step model, span-wise perturbations were found in the reattachment region. Studies were made using the same and other similar models. In these later studies, the same 3-dimensional perturbations were detected, into the full thickness of the boundary-layer, after reattachment, both in turbulent and laminar regions of the flow. Their amplitude was a maximum in the transition region. Using a model with a much improved accuracy of manufacture, notably at the leading-edge, it was found that the amplitude of the perturbations was greatly reduced, roughly in proportion to the size of the irregularities of manufacture of the leading-edge itself. It is concluded that the phenomenon is essentially 1 of instability in the 2-dimensional flow, the main triggering action arising from small irregularities in the leading-edge. (Contractor's abstract)

792

Free U. of Brussels (Belgium).

THEORETICAL INVESTIGATION OF EROSIVE BURNING OF SOLID PROPELLANTS, by J. A. Vandenkerckhove. July 1961, 67p. incl. diagrs. table, refs. (Technical rept. no. 2) (AFOSR-1889) (AF 61(052)354) AD 272008 Unclassified

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

After a critical survey of existing theories of erosive burning and of published experimental data, the combustion mechanism of NH_4ClO_4 propellants is discussed and a model of erosive burning of these formulations is proposed. Erosion is assumed to smooth the surface whose burning rate is then controlled by oxidizer regression, no energy being supplied by the main diffusion flame. Furthermore the adiabatic decomposition temperature of the perchlorate is assumed to be obtained at the end of the laminar sublayer whose thickness can be related to mean flow velocity through fluid dynamics. Correlation of test data permits the determination of the transition point. Grain design and motor scale are taken into account through local hydraulics radius. Low pressures, large radii and high burning rates are shown to reduce erosive burning. An attempt is made to explain irregular burning by surface nature and roughness through erosivity. (Contractor's abstract)

793

Free U. of Brussels (Belgium).

TENTATIVE EXPLANATION OF IRREGULAR BURNING IN SOLID PROPELLANT ROCKETS, by J. [A.] Vandenkerckhove. [1961] [2]p. incl. diagrs. [AF 61-(052)354] Unclassified

Published in ARS Jour., v. 31: 1466-1467, Oct. 1961.

Various conditions are presented for the irregular burning of solid propellants. The work of several investigators in this field is summarized.

794

Free U. of Brussels. [Dept. of Chemical Physics] (Belgium).

STATISTICAL AND THERMODYNAMICAL PLASMA PHYSICS. THE APPROACH TO EQUILIBRIUM OF A PLASMA, by R. Balescu. [1961] [4]p. [AF 61(052)-179] Unclassified

Published in Plasma Physics, Accelerators, Thermonuclear Research, v. 2: 169-172, Jan. 1961.

After a short presentation of the general theory of irreversible processes established by Prigogine and Balescu, its application to the problem of long range forces in a plasma is discussed. The diagram technique permits an unambiguous choice of the main contributions to the distribution function. The result is an equation describing the evolution of the distribution function of momenta, which takes rigorously into account the many-body collisions. The latter results from a summation of an infinite number of diagrams, the structure of which is very simple. The successive diagrams involve more and more particles interacting simultaneously. The equation has a formal similarity with the usual Fokker-Planck equation, but the Coulomb interaction between 2 particles is replaced by an effective interaction, which depends on the distribution of all the other particles of the medium. At very low temperatures this effective interaction reduces to a screened Coulomb-Debye potential. The relation of this approach to the previous theories of plasmas (Fokker-Planck equation, Vlasov equation, random phase approximation) can be discussed very clearly by means of the diagrams. (Contractor's abstract)

795

Free U. of Brussels. [Dept. of Chemical Physics] (Belgium).

ON THE MOTION OF A CHARGED PARTICLE, by I. Prigogine. [1961] [5]p. [AF 61(052)179] Unclassified

Published in Plasma Physics, Accelerators, Thermonuclear Research, v. 2: 184-187, Jan. 1961.

The motion of a charged particle, including the effect of its self field is treated in the frame of classical mechanics by the Liouville method. Results are summarized for the following cases: free particle in vacuum, free particle in a black body, and harmonic oscillator. In every case the partial differential equation giving the evolution of the particle phase distribution function is established. (Contractor's abstract)

796

Free U. of Brussels. [Dept. of Chemical Physics] (Belgium).

MAGNETO-RESISTANCE IN SUPERFLUID LIQUID HELIUM, by G. Severne. [1961] [14]p. (AF 61(052)179) Unclassified

Published in Physica, v. 27: 465-478, May 1961.

In solids, the magneto-resistance effect appears as an additional effect, a modification of a pre-existent scattering mechanism. Partially ionized liquid helium II bears a strong formal analogy to a single band solid. However, if the superfluid medium is at zero temperature, and for low ion energies, the intrinsic resistance of the system is zero; the ions experience no friction. It is shown that in the presence of a magnetic field the system becomes dissipative. Thus, in contradistinction to the situation in solids, the magneto-resistance effect in helium II corresponds to the actual creation of a scattering mechanism, and appears as a fundamental phenomenon.

797

Free U. of Brussels. [Dept. of Chemical Physics] (Belgium).

ON THE INITIAL CONDITIONS IN THE THEORY OF IRREVERSIBLE PROCESSES, by J. Philippot. [1961] [7]p. [AF 61(052)179] Unclassified

Published in Physica, v. 27: 490-496, May 1961.

It is the purpose of this note to clarify the physical meaning of the various classes of initial states for which irreversilbe equations have been derived. From the point of view of the ergodic theory it is also interesting to distinguish between a distribution representing a single system and a distribution representing an ensemble of systems. First the "random phase condition" and the diagonal singularity condition used by Van Hove is analyzed and then the properties of the initial distributions used by Prigogine.

796

Free U. of Brussels. [Dept. of Chemical Physics] (Belgium).

ON THE APPROACH TO EQUILIBRIUM IN QUANTUM SYSTEMS, by P. Résibois. [1961] [30]p. incl. diagrs. refs. [AF 61(052)179] Unclassified

Published in Physica, v. 27: 541-570, June 1961.

The diagram technique used by Prigogine and others to study the approach to equilibrium of classical systems is extended to quantum systems. The similarity of the equation of Liouville and von Neumann suggest the study of spatial correlations and the use of the density matrix. It is claimed that the diagram technique can be generalized in ways that are intuitively almost obvious, and that the theory can be formally carried through in the usual limit of an assembly of large volume and number of particles. Almost the only initial assumptions required are that the "reduced variables" e.g., volume and energy/particle should all be finite, and that, initially, all corrections should be restricted to finite ranges.

799

Free U. of Brussels. [Dept. of Chemical Physics] (Belgium).

ON THE KINETICS OF THE APPROACH TO EQUILIBRIUM, by I. Prigogine and P. Résibois. [1961] [16]p. incl. diagrs. refs. [AF 61(052)179] Unclassified

Published in Physica, v. 27: 629-646, July 1961.

The diagram technique developed by Prigogine and Balescu for a classical gas is applied to obtain the solution of the system of equations. The equations obtained are valid to all orders in the coupling constant and for all times. They are non-Markovian for short times, but in the limit of long times they approach the Markovian equations obtained earlier by Henin, Résibois and Andrews. It is shown that the non-Markovian character of the equations does not influence the calculation of the transport coefficients which are completely determined by the asymptotic values of the cross-sections.

800

Free U. of Brussels. [Dept. of Chemical Physics] (Belgium).

ON THE APPROACH TO NON-EQUILIBRIUM STATIONARY STATES AND THE THEORY OF TRANSPORT COEFFICIENTS, by R. Balescu. [1961] [14]p. incl. diagr. refs. [AF 61(052)179] Unclassified

Published in Physica, v. 27: 693-706, July 1961.

A general formula for the time dependent electric current arising from a constant electric field is derived along the line of ideas of Kubo's theory. This formula connects the time dependence of the current to the singularities of the resolvent of Liouville's operator of a classical system. It permits a direct contact with the general theory of approach to equilibrium developed by Prigogine and his coworkers. It constitutes a framework for a diagram expansion of transport coefficients. A proof of the existence of a stationary state and of its stability (to first order in the field) are given. It is rigorously shown that, whereas the approach to the stationary state is in general governed by complicated non-Markoffian equations, the stationary state itself (and thus the calculation of transport coefficients) is always determined by an asymptotic cross section. This implies that transport coefficients can always be calculated from a Markoffian Boltzmann-like equation even in situations in which that equation does not describe properly the approach to the stationary state. (Contractor's abstract)

601

Free U. of Brussels. [Dept. of Chemical Physics] (Belgium).

BINARY COLLISION EXPANSION OF QUANTUM STATISTICAL PAIR PROPAGATOR, by S. Fujita. [1961] [10]p. incl. diagrs. refs. [AF 61(052)179] Unclassified

Published in Physica, v. 27: 930-939, Oct. 1961.

The binary collision expansion of the pair propagator, which is closely related to the grand canonical pair distribution function, is obtained in terms of quantum statistical Feynman-type diagrams. The result may be summarized by stating that the pair propagator can be expanded in a manner in which (1) all interaction lines, representing potentials v of the usual perturbation diagrams, are replaced by sets of ladder diagrams representing binary collision kernels B and (2) whenever a double ladder structure occurs in the diagrams, the statistical factor $(1 \pm f_1)(1 \pm f_2)$ (f being the Bose or the Fermi distribution function) associated with the intermediate lines with momenta P_1 and P_2 should be replaced by $(1 \pm f_1)(1 \pm f_2) - 1$. (Contractor's abstract)

802

Free U. of Brussels. [Dept. of Chemical Physics] (Belgium).

ON THE GENERALIZED BOLTZMANN EQUATION OF A QUANTUM GAS, by S. Fujita. [1961] [17]p. incl. diagrs. refs. [AF 61(052)179] Unclassified

Published in Physica, v. 27: 940-956, Oct. 1961.

The generalized master equation for a quantum gas due

to Résibois is analyzed with the aid of new diagrams, which are intimately related to operator diagrams invented by Prigogine and Résibois. It is shown that part of the equation, which is important for the derivation of generalized Boltzmann equation, has a form analogous to the Pauli equation with the probability of quantum statistical transition between many-body states, the probability being expressible in terms of a matrix A formally identical to the so-called scattering. By use of the technique devised by the author for developing the binary collision expansion of the quantum statistical pair propagator, many-body elements of A are expanded in terms of 2-body elements of A. The generalized Boltzmann equation or the reduced equation for the average occupation number of a single-particle momentum state is derived in the usual manner from the generalized master equation. It is pointed out that the Uehling-Uhlenbeck equation for a hard-sphere Fermi gas is valid only in the lowest order a^2, a being diameter of a hard sphere, at very low temperatures. The new equation valid up to the order $a^2 (a P_F^{h-1}) P_F$ being the Fermi momentum of an ideal Fermi gas and h Planck's constant, is explicitly given in the text. Any higher order corrections could easily be calculated in the framework of the theory. (Contractor's abstract)

803

Free U. of Brussels. [Dept. of Chemical Physics] (Belgium).

RADIATION DAMPING AND EQUATION OF MOTION IN CLASSICAL ELECTRODYNAMICS, by I. Prigogine and F. Henin. [1961] [3]p. incl. diagrs. refs. [AF 61-(052)179] Unclassified

Published in Physica, v. 27: 982-984, Oct. 1961.

Using the Lorentz equation which corresponds to the change of energy through radiation an equation is developed which for slow processes reduces to the Lorentz equation while for rapid processes it avoids some of the usual difficulties. A Hamiltonian description of the system is given and to this Hamiltonian corresponds the Liouville equation

$$\frac{\partial \rho}{\partial t} + iL\rho = 0$$

After considerable manipulation the following equation is obtained in the form

$$ma(t) = eE + \frac{e}{c} v \times H + m\tau_0 \frac{2}{\pi} \int_0^t d\tau \frac{\sin \tau/\tau_0}{\tau/\tau_0} \dot{a}(t-\tau).$$

804

Free U. of Brussels. [Dept. of Chemical Physics] (Belgium).

QUANTUM STATISTICAL DIAGRAM REPRESENTATION IN THE PRESENCE OF BOSE-EINSTEIN DEGENERACY, by S. Fujita. [1961] [9]p. incl. diagrs. refs. [AF 61-(052)179] Unclassified

Published in Physica, v. 27: 1161-1169, Dec. 1961.

A contraction theorem for a product of boson operators averaged over the modified grand canonical ensemble (called as the x-ensemble by Lee and Yang) of free particles is established. The theorem enables one to use the quantum statistical diagram technique for the calculation of statistical mechanical quantities of the degenerate interacting bosons. The diagram technique is illustrated by calculating the grand partition function of hard-sphere bosons above and below the temperature of the Bose-Einstein condensation.

805

Free U. of Brussels. [Dept. of Chemical Physics] (Belgium).

THEORY OF TRANSPORT COEFFICIENTS. I. GENERAL THEORY AND ELECTRICAL CONDUCTIVITY OF ELECTRON-PHONON SYSTEM, by S. Fujita and R. Abe. [1961] [9]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 61-(052)179] and Office of Naval Research) Unclassified

Published in Jour. Math. Phys., v. 3: 350-358, Mar.-Apr. 1962.

A general method is presented for the calculation of static transport coefficients based on Kubo's formulas. Techniques of perturbation expansion, diagram representation, and linked-cluster expansion are used. As an example, the electrical conductivity of an electron-phonon system is calculated with the natural introduction of irreversibility, following the ideas of Van Hove, and Prigogine and his collaborators. Under certain conditions the present method is shown to be equivalent to the conventional method by means of the Boltzmann equation. These conditions are examined and the improvement of the approximation is discussed. (Contractor's abstract)

806

Free U. of Brussels. [Dept. of Chemical Physics] (Belgium).

THEORY OF TRANSPORT COEFFICIENTS. II. VISCOSITY COEFFICIENTS OF QUANTUM GASES OBEYING THE BOLTZMANN STATISTICS, by S. Fujita. [1961] [9]p. incl. diagrs. [AF 61(052)179] Unclassified

Published in Jour. Math. Phys., v. 3: 359-367, Mar.-Apr. 1962.

The viscosity coefficients of a weakly coupled and a dilute quantum gas, both obeying the classical statistics, are calculated using the method developed by Abe and the present author. In this method transport coefficients are calculated from exact formulas due to Kubo with the natural introduction of the irreversibility based on the ideas of Van Hove, Prigogine, and their collaborators. It is shown explicitly that the low-density limit as well as the weak-coupling limit of the viscosity are those which are expected from the conventional calculation via the Boltzmann equation. The nature of these limits is closely related to the 2 well separated time scales — average duration of collision and average time between successive collisions. (Contractor's abstract)

807

Free U. of Brussels. [Dept. of Chemical Physics] (Belgium).

THEORY OF TRANSPORT COEFFICIENTS. III. QUANTUM STATISTICAL SYSTEMS, by S. Fujita. [1961] [5]p. incl. diagrs. refs. [AF 61(052)179] Unclassified

Published in Jour. Math. Phys., v. 3: 1246-1250, Nov.-Dec. 1962.

The electrical conductivity of an electron-phonon system is calculated from Kubo's formula using a perturbation method on the assumptions that the coupling is weak, the system is infinitely large, and that the electrons do not interact between them and obey the Fermi-Dirac statistics and phonons are in thermodynamic equilibrium. The result is identical with that one would obtain from the usually assumed Boltzmann-Bloch equation. The calculation is a logical extension of the previous treatment (item no. 805, Vol. V), where the same problem is treated on the assumption that the electrons obey the Boltzmann statistics. The relation between the present calculation and the derivation of master equation is critically discussed. A brief sketch is given for the calculation of the viscosity coefficient of a dilate quantum statistical gas. (Contractor's abstract)

808

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-1909) [AF EOAR-62-16] AD 289191 Unclassified

Also published in Physica, v. 28: 281-297, Mar. 1962.

The 2 forms of generalized master equation derived by Van Hove and by Prigogine and Résibois are examined with the aid of diagrams. Given the random-phase initial condition they are shown to describe equivalently the exact asymptotic behavior of a diagonal element of the density matrix. Their interrelation is clarified. Both of the equations exhibit non-Markoffian evolution. The way in which they are derived gives valuable hints to the problem in what conditions and in what manner such non-Markoffian equations will be reduced to the usual Markoffian master equations. A few remarks are given on this point. (Contractor's abstract)

809

[Free U. of Brussels. Lab. of Animal Morphology (Belgium)]

ROLE OF SULFHYDRYL AND DISULFIDE GROUPS, by J. Brachet. Summary rept. no. 1, Feb. 1, 1960-Jan. 31, 1961. Feb. 24, 1961 [1]p. (AFOSR-606) (AF 61(052)356) AD 457255 Unclassified

Experiments on the role of sulfhydryl and disulfide groups in morphogenesis have been performed at both the biological and biochemical levels. The main results obtained can be summarized as follows: β-mercaptoethanol inhibits morphogenesis in all the biological systems. Cysteine and glutathione are less inhibitory then β-mercaptoethanol. β-mercaptoethanol, if used at relatively low concentrations, inhibits pigment formation in amphibian embryos. Lipoic acid exerts the same inhibitory effects as β-mercaptoethanol on early embryonic development and on regeneration in Acetabularia. β-mercaptoethanol has little effect on the oxygen consumption, the ATP content and the catheptic activity of amphibian eggs. It does not modify the ATP, DNA and RNA content of the liver of intraperitoneally injected rats and mice.

810

Free U. of Brussels. Lab. of Animal Morphology (Belgium).

[STUDY OF THE EFFECTS OF MERCAPTOETHANOL AND OF DITHIODIGLYCOL ON THE CELLULAR DIVISION OF AMPHIBIAN EGGS] Etude des effets du mercaptoethanol et du dithiodiglycol sur la division cellulaire chez les oeufs d'amphibiens, by S. Limbosch-Rolin and J. Brachet. [1960] [11]p. incl. illus. tables, refs. (AFOSR-2171) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)356, Interuniversity Institute of Nuclear Sciences, National Center of Genetic and Radiobiology, and Rockefeller Foundation) AD 611478 Unclassified

Also published in Exper. Cell Research, v. 24: 120-130, June 1961.

The effects of β-mercaptoethanol, an -SH compound of high reducing capacity, were compared with those of its oxidation product, dithiodiglycol. Both compounds inhibit

cell division in cleaving amphibian eggs. Both compounds cause a regression of the achromatic figure of amphibian eggs, but they have different modes of action. Mercaptoethanol accelerates the regression of the mitotic apparatus, while the dithiodiglycol opposes the regression.

811

Free U. of Brussels. Lab. of Animal Morphology (Belgium).

[SOME BIOCHEMICAL EFFECTS OF BETA MERCAPTOETHANOL ON THE LIVER OF MICE AND RATS] Quelques effets biochimiques du β-mercaptoéthanol sur le foie de souris et de rat, by J. Brachet, M. Cape and others. [1961] [10]p. incl. tables, refs. (AFOSR-2172) (AF 61(052)356) AD 611502
Unclassified

Also published in Biochim. et Biophys. Acta, v. 51: 347-356, 1961.

The effects of β-mercaptoethanol ($HSCH_2$-CH_2OH) on the biochemistry of mouse and rat liver have been studied both in vivo and in vitro. It has been found that intraperitoneal injection of mercaptoethanol has no appreciable effect on the soluble-SH, ATP, DNA and RNA content of the cells. On the other hand, mercaptoethanol exerts a very definite inhibitory effect on the incorporation of labelled amino acids into liver proteins both in vivo and in vitro (30-40% inhibition). Mercaptoethanol, if injected in vivo, does not set free one of the enzymes characteristic of lysosomes, acid phosphatase; there is no liberation either of acid phosphatase when a particulate fraction containing the lysosomes is treated by mercaptoethanol in vitro. (Contractor's abstract)

812

Free U. of Brussels. Lab. of Animal Morphology (Belgium).

[STUDY OF THE BIOCHEMICAL EFFECTS OF MERCAPTOETHANOL] Etude des effets biochimiques du mercaptoéthanol, by M. Decroly, N. Six, and M. Cape. [1961] [2]p. (AFOSR-2173) (AF 61(052)356) AD 611504
Unclassified

Also published in Arch. Internat'l. Physiol. Biochim., v. 69: 381-382, 1961.

The experiments performed revealed an increase in the amount of soluble sulfhydril groups after inj[illegible] of mercaptoethanol. The amount of ATP in the l[illegible] of the animals injected was not affected substantially. Nevertheless, the synthesis of proteins was affected as much in vivo as in vitro; upon observation, in effect, the decrease of the incorporation was of the order of 40%. Finally, the mercaptoethanol does not seem to exercise the effects to the level of that of the lysosomes: there was no liberation of the acid phosphatase, according to the evidence, in the presence of mercaptoethanol, with the experiments that were done in vivo or in vitro.

813

Free U. of Brussels. Lab. of Animal Morphology (Belgium).

[SOME EFFECTS OF BETA MERCAPTOETHANOL AND OF DITHIODIGLYCOL ON REGENERATION] Quelques effets du β-mercaptoéthanol et du dithiodiglycol sur la régénération, by F. Descotils-Heernu, J. Quertier, and J. Brachet. [1961] [20]p. incl. illus. refs. (AFOSR-2174) (AF 61(052)356) AD 611737
Unclassified

Also published in Develop. Biol., v. 3: 277-296, June 1961.

The effects of β-mercaptoethanol and dithiodiglycol (the former containing an -SH group and the latter an -SS- group) on regeneration have been studied in 5 animal species. Mercaptoethanol inhibits regeneration while dithiodiglycol (at those concentrations at which it can be employed) has almost no effect. Mercaptoethylgluconamide, a derivative of mercaptoethanol, cannot penetrate into the cells and it has no noticeable influence on regeneration, except at extremely high concentrations. Mercaptoethanol moderately reduces mitotic activity and basophilia in the blastema. However, it stimulates the synthesis of RNA without acting on DNA synthesis. Dithiodiglycol does not modify mitotic activity, but it increases slightly the basophilia of the regenerating tissue. It also stimulates RNA synthesis. (Contractor's abstract)

814

Free U. of Brussels. Lab. of Animal Morphology (Belgium).

[STUDY OF THE BIOCHEMICAL EFFECTS OF BETA MERCAPTOETHANOL ON THE EGGS OF BATRACHIANS] Etude des effets biochimiques du β-mercaptoéthanol sur les oeufs de Batraciens, by J. Brachet, M. Cape and others. [1961] [20]p. incl. tables, refs. (AFOSR-2175) (AF 61(052)356) AD 611736
Unclassified

Also published in Develop. Biol., v. 3: 424-443, Aug. 1961.

The biochemistry of amphibian eggs treated with mercaptoethanol (M/100) under conditions which completely inhibit morphogenesis has been studied. It has been found that: (1) Mercaptoethanol undergoes a fairly rapid oxidation under the experimental conditions; (2) The acid-soluble -SH groups content increases in mercapto-ethanol-treated embryos; (3) Treatment with

mercaptoethanol leads to a moderate decrease in the oxygen consumption and has no marked effect on the ATP content; (4) The block in development induced by mercaptoethanol cannot be explained on the basis of a stimulation of the catheptic activity; (5) Mercaptoethanol does not immediately inhibit incorporation of thymidine into DNA, of uridine into nuclear nucleic acids, and of leucine into the proteins of the treated embryos. Inhibition of nucleic acid and protein synthesis can be observed when the effects of mercaptoethanol on morphogenesis become irreversible.

815

Free U. of Brussels. [Lab. of Animal Morphology] (Belgium).

[AUTORADIOGRAPHICAL RESEARCH ON THE FORMATION OF PHRAGMOPLAST] Recherches autoradiographiques sur la formation du phragmoplast, by M. J. Olszewska. [1960] [10]p. incl. illus. tables, refs. (AFOSR-2512) (AF 61(052)356) Unclassified

Also published in Protoplasma, v. 53: 387-396, Jan. 20, 1961.

The presence of phragmoplast is connected to the mixing of various radioactive precursors. Phragmoplast is the center of more intense mixing than the surrounding cytoplasm. Proteins, and especially ARN, contained in phragmoplast are synthesized in situ.

816

Free U. of Brussels. Lab. of Animal Morphology (Belgium).

MORPHOGENETIC EFFECTS OF LIPOIC ACID ON AMPHIBIAN EMBRYOS, by J. Brachet. [1961] [2]p. incl. illus. (AFOSR-2514) [AF 61(052)356] Unclassified

Also published in Nature, v. 189: 156-157, Jan. 1961.

It has been found that lipoic acid (5 μgm/ml) and β-mercaptoethanol at low concentrations (M/300 — M/1000) act in an opposite manner to that of β-mercaptoethanol and lipoic acid on tadpoles and planarians when treating embryos of Rana temporaria and Xenopus laevis (gastrulae or neurulae): there is no delay in development, no inhibition of morphogenetic movements, and no microcephaly when these embryonic stages are treated with lipoic acid. On the other hand this substance produces a marked inhibition of tail elongation, whereas the head and the size of the fin are essentially normal. This effect,which seems to be fairly specific of lipoic acid is found in the frog as well as in Xenopus embryos.

817

Free U. of Brussels. [Lab. of Animal Morphology] (Belgium).

THE LIVING CELL, by J. Brachet. [1961] [13]p. incl. illus. (AFOSR-2515) (AF 61(052)356) Unclassified

Also published in Scient. Amer., v. 205: 51-62, Sept. 1961.

The biological functions, chemistry, and reproductive functions of the cell are discussed. The various instruments and techniques of their use in the study of cells are presented in qualitative detail along with illustrations emphasizing the fact that anatomical and chemical views of the cell have now converged to show that it is not a droplet of protoplasm but a highly organized molecular factory.

818

Free U. of Brussels. Lab. of Animal Morphology (Belgium).

DIFFERENTIAL EFFECTS OF β-MERCAPTOETHANOL AND REDUCED GLUTATHIONE ON PROTEIN SYNTHESIS IN A PARTIALLY PURIFIED SYSTEM, by A. Schram and J. Brachet. [1961] [3]p. incl. tables, refs. (AFOSR-3456) [AF 61(052)356] Unclassified

Also published in Biochim. et Biophys. Acta, v. 57: 596-598, 1962.

The inhibitory effect on protein synthesis in whole liver homogenates by β-mercaptoethanol is investigated. It is found that reduced glutathione and mercaptoethanol exert opposite effects on protein synthesis in the partially purified system used in these experiments. It is clear that mercaptoethanol exerts opposite effects in this system and in experiments in vivo.

819

Free U. of Brussels. Lab. of Animal Morphology (Belgium).

[STUDY OF THE ROLE OF SULFHYDRIL GROUPS IN THE MORPHOGENESIS OF THE CHICKEN EMBRYO] Etude du role des groupes sulfhydriles dans la morphogénèse de l'embryon de poulet, by V. Pohl and J. Brachet. [1961] [20]p. incl. illus. tables, refs. (AFOSR-4176) (AF 61(052)356) Unclassified

Also published in Develop. Biol., v. 4: 549-568, June 1962.

β-mercaptoethanol (M/100) and dithiodiglycol (M/1000) inhibit the closure of the neural tube in explanted chick embryos. The effect is at first reversible when the embryos are placed back in normal medium. Alternate treatments with mercaptoethanol and dithioglycol (or

vice versa) have only favorable consequences. Lipoic acid (20-30 μg/ml) also inhibits the closure of the neural tube. Oxaloacetate (1 mg/ml) and succinate (10^{-2} M) initially have a favorable effect, but oxaloacetate soon becomes toxic. ATP (0.1 mg/ml) accelerates the closure of the neural tube, where it increases the number of mitoses. Its addition reverses to a large extent the inhibitory effects of mercaptoethanol, dithiodiglycol and lipoic acid.

820

Free U. of Brussels. Lab. of Animal Morphology (Belgium).

[AUTORADIOGRAPHICAL STUDY OF METABOLISM OF NUCLEIC ACIDS AND OF PROTEINS OF NEURULAS OF BATRACHIANS TREATED WITH β-MERCAPTOETHANOL] Etude autoradiographique du metabolisme des acides nucléiques et des protéines chez neurulas de batraciens traitées au β-mercaptoéthanol, by J. Quertier. [1961] [14]p. incl. illus. refs. (AFOSR-4177) [AF 61(052)356] Unclassified

Also published in Acta Embryol. Morphol. Exper., v. 5: 57-70, 1962.

The incorporation of precursors of nucleic acids and proteins in the study of isolated medullary plates has been subjected to treatment with β-mercaptoethanol, a substance which inhibits the closing of the neural plate. Different times of treatment with mercaptoethanol have been applied; the brief treatments permitting a reversibly complete or at least a partial restoration of the morphogenetic activity and the prolonged treatment has lead to irreversible morphogenetic blockage.

821

Free U. of Brussels. Lab. of Animal Morphology (Belgium).

[THE EFFECTS OF β-MERCAPTOETHANOL ON THE INCORPORATION OF PRECURSORS OF PROTEINS AND OF OPTIMIZATION OF NUCLEIC ACIDS IN THE LIVER AND INTESTINE OF MICE] Les effets du β-mercaptoéthanol sur l'incorporation des précurseurs des protéines et des acides nucléiques dans le foie et l'intestin de souris, by J. Brachet and A. Miraux-Jonckheere. [1961] [9]p. incl. refs. (AFOSR-4240) (AF 61(052)356) Unclassified

Also published in Exper. Cell Research, v. 27: 539-547, Sept. 1962.

The effects are studied by means of an intraperitoneal injection of β-mercaptoethanol (2 mg/20 g body weight) on nucleic acid and protein synthesis in the liver and and intestine of mice. The incorporation of ^{3}H-thymidine, ^{3}H-cytidine and ^{3}H-leucine has been followed by autoradiography. The experiments have shown that β-mercaptoethanol inhibits mitotic activity and incorporation of thymidine into DNA in the intestine. The incorporation of cytidine and that of leucine are also strongly inhibited in the intestine as well as in the liver. The inhibition is of the same order of magnitude for the nucleus and the cytoplasm (except for cytidine, in the case of intestinal nuclei). In the liver, the incorporation of both precursors is higher in the nucleus than in the cytoplasm, while the opposite situation holds for the intestine. The significance of these results is briefly discussed. (Contractor's abstract)

822

Free U. of West Berlin (Germany).

[VOLUME CONDITIONED CHANGES IN THE SODIUM EXCRETION IN THE DOG] Volumenreflektorische Änderung der Natriumausscheidung bein Hund, by K. Pabst and O. H. Gauer. [1959] [3]p. incl. diagrs. (AFOSR-J453) [AF 61(052)31] Unclassified

Also published in Verhandl. Deut. Ges. Kreislaufforsch., v. 25: 263-265, 1959.

Since the magnitude of the blood volume and of the extracellular volume is closely connected with the intake and excretion of sodium chloride, it was postulated that, in addition to the intrathoracic circulatory system, a second system must exist which is responsible for the sodium excretion. To answer this question it is necessary to find a certain form of hydration which causes a tendency to increased sodium excretion. Dogs were first given 400-600 cc of a 0.9% NaCl solution, and then, after anesthetization, were hydrated with a continuous infusion with 3% glucose solution. After diuresis had reached constancy, the animals were forced to breathe thin air so as to reduce pressure in the chest cavity. Under these conditions both water and sodium excretion increased and the Na/K ratio also increased. Consequently the requirements to be satisfied by volume receptors are fulfilled and the assumption of special receptors for the regulation of sodium excretion becomes unnecessary.

823

Free U. of West Berlin (Germany).

[ANTI-DIURESIS AND DIURESIS IN THE RAT AFTER TONEPHIN INJECTION] Antidiurese und Diurese nach kleinen Tonephingaben bei der Ratte, abhängig vom oralen NaCl-Angebot, by E. Witte, H. Reineck, and O. H. Gauer. [1961] [10]p. incl. illus. diagrs. tables, refs. (AFOSR-J454) (AF 61(052)31) Unclassified

Also published in Pflügers Arch. ges. Physiol., v. 274: 262-271, Dec. 1961.

The modified (Vorherr and Friedberg) method of Jeffer's bioassay of ADH was used to measure the influence of 20, 40, and 100μ U highly purified Tonephin, injected intravenously, on the excretion of water, when the rats were hydrated orally with (a) 1% alcohol solution, (b) 0,9% saline and (c) 2,5% saline. Hydration with isotonic saline produced a reduction or even a reversal of the familiar antidiuretic effect of ADH during water hydration. When loading the animals with 2,5% saline a diuretic effect was seen only. These effects cannot be attributed to changes of blood pressure. It seems remarkable that such very minute dosages producing changes of ADH concentration in the blood which are near the normal estimated concentrations of endogenous ADH in human plasma may induce a moderate however regular increase in urine flow, when the animals are hydrated with hypertonic saline. (Contractor's abstract)

824

Free U. of West Berlin (Germany).

[KIDNEY HOMODYNAMICS AND EXCRETORY FUNCTION IN THE KIDNEY DURING DEFINITE CHANGES IN BLOOD VOLUME] Nierenhämodynamik und Ausscheidungsfunktion der Niere unter definierten Änderungen des Blutvolumens, by K. Pabst and O. H. Gauer. [1961] [14]p. incl. diagrs. tables, refs. (AFOSR-J455) (AF 61(052)31) Unclassified

Also published in Pflügers Arch. ges. Physiol., v. 274: 213-226, Dec. 1961.

As a rule oliguria after severe hemorrhage has been attributed to a low filtration rate, due either to a low blood pressure or to a vasoconstriction of the renal vascular flow. However to our knowledge data on the effect of relatively small hemorrhages in unanesthetized animals which are not under stress are not available. Such data alone seem pertinent to the question of normal volume control. Five healthy trained dogs with carotid loops were used in 16 experiments. After due controls approximately 15% of the measured blood volume (Evans Blue) was taken and retransfused 1½ hr later. Urine volume, osmolar concentration, PAH and Inulin clearances, arterial and central venous pressures were recorded. In half the experiments the animals were hydrated with water, in the other half with isotonic saline (20 cc/kg orally followed by continuous infusion). In part of the experiments a correlation of the hemodynamics of the kidney with urine flow could not be excluded. However under saline hydration the oliguria during hemorrhage cannot be attributed to a decrease of filtration rate. Contrary to expectation the U/P ratio increased during hemorrhage 3-4 fold in both series of experiments. These observations can only be due to a reflex effect on the concentrating mechanisms of the kidney (ADH, hemodynamics of the renal medulla). The behavior of central venous pressure suggests that the intrathoracic receptors of the low pressure system may be involved on the afferent side of this reflex. If we interpret the oliguria during hemorrhage and the diuresis with infusion as a volume regulatory measure, we must admit, that volume regulation during moderate deviations from the normal is handled in the first place by the regulation of water excretion, while the behavior of osmotic excretion is non characteristic. (Contractor's abstract)

825

Free U. of West Berlin (Germany).

[CENTRAL VENOUS PRESSURE IN MAN DURING ACUTE ARTERIAL HYPOXIA] Der zentrale Venedruck des Menschen bei akuter arterieller Hypoxie, by H. L. Thron and A. Hintze. [1961] [10]p. incl. diagr. table, refs. (AFOSR-J456) (AF 61(052)31) Unclassified

Also published in Pflügers Arch. ges. Physiol., v. 274: 252-261, Dec. 1961.

In 6 healthy subjects not acclimatized to high altitudes the behavior of central venous pressure was examined, using the method of Gauer and Sieker, during acute arterial hypoxia of 10-24 min duration induced by respiration of gas mixtures containing 8.3-12.3% O_2 in N_2. In only 1 of a total of 13 experiments was there a consistent increase in central venous pressure. In the great majority of the experiments, a tendency towards a slight fall of central venous pressure was observed. These reactions of the central venous pressure were not related to the degree of oxygen lack within the range of hypoxia used. The results are discussed in relation to the constriction of the hand veins observed under severe acute arterial hypoxia. (Contractor's abstract)

826

Free U. of West Berlin (Germany).

[THE EFFECT OF ACUTE ARTERIAL HYPOXIA ON THE VEIN OF THE HAND IN MAN] Das Verhalten der menschlichen Handvenen bei akuter arterieller Hypoxie, by A. Hintze and H. L. Thron. [1961] [25]p. incl. diagrs. table, refs. (AFOSR-J457) (AF 61(052)31) Unclassified

Also published in Pflügers Arch. ges. Physiol., v. 274: 227-251, Dec. 1961.

The behavior of the tone of the capacitance vessels of the hand under the influence of acute hypoxia (breathing of gas mixtures containing 8,1—12,6% O_2 in N_2; in some experiments with the addition of 4% CO_2) was investigated in 13 healthy subjects aged 21-35 yr. The pressure volume characteristic of the capacitance vessels of 1 hand was determined by means of a fast responding plethysmograph combined with venous pressure recording in the same vascular bed. Repeated engorgement of the hand circulation was obtained by inflation of venous occlusion cuffs. The method also allowed the simultaneous determination of the blood flow through the hand. The

results were as follows: (1) There was a consistent decrease in distensibility of the capacitance vessels at low venous pressures. This reaction which must be attributed to a sustained constriction of the hand veins was demonstrable only when breathing gas mixtures of less than 11% O_2 in N_2. With less severe hypoxia there were no clear cut changes in the distensibility of the hand veins. (2) The tone of the resistance vessels of the hand, as judged by blood flow, also showed an increase, which corresponded approximately with that of the capacitance vessels. In individual cases, however, marked differences between the reactivity of the 2 vascular beds were observed. (3) The heart rate increased when breathing the oxygen poor gas mixtures. In contrast to the changes in tone of the hand vascular bed there was a significant increase also with mixtures of 12% O_2 in N_2 and more. (4) Addition of 4% CO_2 to gas mixtures of less than 9.5% O_2 in N_2 resulted in a less severe increase of both heart rate and vascular tone of hand vessels. (Contractor's abstract)

827

Free U. of West Berlin (Germany).

PROPERTIES OF VEINS IN VIVO: INTEGRATED EFFECTS OF THEIR SMOOTH MUSCLE, by O. H. Gauer and H. L. Thron. [1961] [26]p. incl. diagrs. table, refs. (AFOSR-J459) (AF 61(052)31) Unclassified

Presented at Symposium on Vascular Smooth Muscle, Washington, D. C., Nov. 12-15, 1961.

Also published in Physiol. Rev., v. 42, Pt. 2: 283-308, 1962.

Properties of the total circulatory system and of isolated vascular beds were demonstrated which reflect the basic characteristics of passive distensibility and active contractility of the smooth muscle of the walls of the capacity vessels. Due to the very complicated geometry of an undisturbed vascular system, it appears impossible to obtain results comparable to the translucent biophysical analysis of the properties of isolated smooth muscle. On the other hand, they do appear to be of more immediate value to the circulatory physiologist.

828

Free U. of West Berlin (Germany).

DISSOCIATION CROSS SECTION, by G. Ludwig. Final rept. Mar. 1, 1959-June 30, 1961, 6p. (AFOSR-1105) (AF 61(052)217) AD 272392 Unclassified

A discussion of research results from the first technical report concerning dissociation cross sections is treated. The model of the molecule potential used was a square well, and the transition matrix elements within the whole spectrum as well as the influence of the virtual states of the molecule continuum on dissociation is also discussed. The main problem in this research report is the construction of a more realistic H_3-potential.

For the 3 center exchange integrals the Mulliken-Ruedenberg approximation is employed and for the 3 center nuclear attraction integrals the tables by Hirschfelder and Weygandt are used.

829

Free U. of West Berlin (Germany).

THEORETICAL RESEARCH STUDIES OF REACTING PLASMAS, by G. Ludwig. Final rept. June 1, 1959-July 15, 1961. (AFOSR-1441) (AF 61(052)239) Unclassified

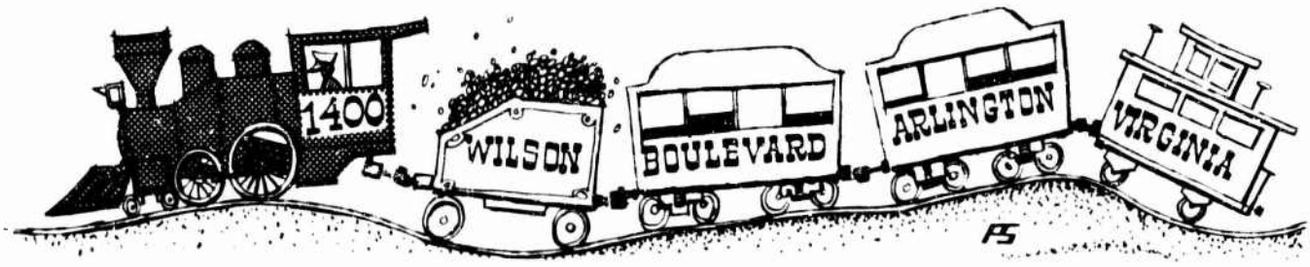
A theoretical study is presented for the derivation of a generalized application of the Boltzmann equation to the time evolution of plasmas. The concept is based upon the kinetic theory of gases which was extended through the use of statistical methods to measurements of particle probability densities.

830

Free U. of West Berlin (Germany).

THE IDEA OF MACROSCOPICAL OBSERVABLES IN CLASSICAL MECHANICS AND A GENERALIZATION OF BOLTZMANN EQUATION [by G. Ludwig]. [1961] 73p. incl. diagrs. refs. (Technical rept. no. 2) (AFOSR-2962) (AF 61(052)239) AD 283523 Unclassified

With the help of generalized Boltzmann densities f_n macroscopical observables are defined and some statements concerning the temporal behavior are given. (Contractor's abstract)



831

Galway U. [Dept. of Chemistry] (Ireland).

THE PROSTHETIC GROUP OF C- PHYCOCYANIN, by C. Ó hEocha and R. F. Lambe. [1961] [2]p. incl. table. (AFOSR-2181) (AF 61(052)409) Unclassified

Also published in Arch. Biochem. and Biophys., v. 93: 459-460, May 1961.

The violinoid prosthetic group (phycocyanobilin) of C-phycocyanin can isomerize to a mesobiliverdin (or to an unidentified bile pigment in the case of Arthrospira phycocyanin), and that it does so most rapidly at low temperature and while still attached to the protein. The results obtained suggest a structural basis for spectral properties of C-phycocyanin and its derivatives which have hitherto proved difficult to interpret.

832

Galway U. Dept. of Chemistry (Ireland).

PHYCOERYTHROBILIN, A PROSTHETIC GROUP OF ALGAL CHROMOPROTEINS, by C. Ó hEocha, P. Ó Carra and D. Carroll. [1961] [1]p. (AFOSR-2182) (AF 61(052)409) Unclassified

Also published in Proc. Biochem. Soc., v. 80: 25, 1961.

Phycoerythrobilin is oxidized by ferric chloride to a mesobiliverdin, and is isomerized by acid to violinoid and urobilinoid pigments. Spectral studies indicate that the number of conjugated double bonds in phycoerythrobilin lies between that of the violinoid and urobilinoid systems.

833

Gaustad Mental Hospital, Oslo (Norway).

DEPTH RECORDING AND ELECTRICAL STIMULATION IN THE HUMAN BRAIN, by C. W. Sem-Jacobsen and A. Torkildsen. [1960] [16]p. incl. illus. diagrs. (Sponsored jointly by Air Force Office of Scientific Research under AF 61(514)1201 and Ford Foundation) Unclassified

Published in Electrical Studies on the Unanesthetized Brain; Symposium, [1960] New York, Harper and Brothers, 1960, p. 275-290.

Development in the technique of stereotactic depth electrography and a preliminary report of the results of electrical stimulation and self-stimulation have been presented. It is hoped that continued work will contribute to further understanding of the complex mechanism of emotional and mental behavior. Extensive studies are, however, necessary to insure valid and correct interpretation. The studies have rendered therapeutic benefits to the epileptic and schizophrenic patients; and with advanced techniques, improved treatment of patients with Parkinson's disease and other brain disorders may be possible. (Contractor's abstract)

834

General Applied Science Labs., Inc. [Westbury] N. Y.

SOUND FIELD DISTRIBUTION ABOUT A JET, by S. Slutsky and J. Tamagno. Dec. 1961 [66]p. incl. diagrs. tables. (Technical rept. no. 259) (AFOSR-1935) (AF 49-(638)194) AD 271007 Unclassified

A mathematical model to study the acoustic field generated by a subsonic jet in the surrounding air at rest was applied to: (1) evaluation of the near field sound intensity radiated by a source in a jet; (2) effectiveness of shielding around a jet, and its influence on sound field directionality; and (3) the effect on the far field of non-uniformity in the jet velocity and temperature profiles. (Contractor's abstract)

835

General Applied Science Labs., Inc., Westbury, N. Y.

A THEORETICAL ANALYSIS OF THE TURBULENT MIXING OF REACTIVE GASES WITH APPLICATION TO THE SUPERSONIC COMBUSTION OF HYDROGEN, by P. A. Libby. June 1961, 42p. incl. diagrs. refs. (Technical rept. no. 242) (AFOSR-752) (AF 49(638)991) AD 288166 Unclassified

Also published in ARS Jour., v. 32: 388-396, Mar. 1962.

The turbulent mixing of an axisymmetric jet of a reactive gas is considered. By assuming a convenient model for the compressible eddy viscosity the momentum equation is reduced to a form amenable to approximate solution. The resulting velocity distribution in both incompressible and compressible flows is compared with experiment and found to be in reasonable agreement therewith. The usual assumptions with respect to chemical behavior, namely either frozen or equilibrium flow, and to unity Lewis numbers and Prandtl number are employed. The theoretical results for chemical equilibrium are compared to experimental data from low speed hydrogen flames and are shown to agree reasonably well therewith. A numerical example of interest in connection with a hypersonic, air-breathing vehicle is carried out in detail. (Contractor's abstract)

836

General Applied Science Labs., Inc. [Westbury] N. Y.

A THEORETICAL INVESTIGATION OF HYDROGEN-AIR REACTIONS. PART I. BEHAVIOR WITH ELABORATE CHEMISTRY, by P. A. Libby, H. S. Pergament,

and M. H. Bloom. Aug. 1961, 52p. incl. diagrs. tables, refs. (Technical rept. no. 250) (AFOSR-1378) (AF 49-(638)991) AD 266515; PB 158977 Unclassified

A study was made of the reaction history of hydrogen-air mixtures under adiabatic, isobaric conditions. An elaborate chemistry was treated with a view toward establishing rather accurate reaction histories. In the future, simplified chemical models will be considered which will permit approximate analyses of the non-equilibrium behavior of hydrogen-air mixtures under flow conditions as, for example, in exhaust nozzles and mixing regions. The results presented for a variety of initial temperatures, pressures and mixture ratios indicate that during the early phases of the reaction the main products achieve close to their equilibrium values with little change in temperature. However, the intermediates, atomic O, atomic H, and the OH radical exceed their equilibrium values. The remaining, major portion of the reaction time involves the decay of these intermediates and the chemical energy release associated therewith. Because of its thermodynamic importance, i.e., its large enthalpy per unit mass, atomic H appears to be the most important intermediate for the reaction considered. (Contractor's abstract)

837

[General Dynamics Corp. Convair Div., San Diego, Calif.]

HIGH-ENERGY X-RAYS DURING SOLAR FLARES, by J. I. Vette and F. G. Casal. [1961] [3]p. incl. diagrs. table. [AF 49(638)561] Unclassified

Published in Phys. Rev. Ltrs., v. 6: 334-336, Apr. 1961.

Measurements are presented which are pertinent to further knowledge of solar phenomena, namely, the detection of high energy x-rays coincident with solar flares. The instrumentation used consists of a NaI scintillation counter which is pointed at the sun by a tracking device described by Shechet. The 2 events observed in this experiment show a decay time slower than the rise time.

838

[General Dynamics Corp. Convair Div., San Diego, Calif.]

OBSERVATIONS OF 26.3 MC/S SOLAR RADIO NOISE DURING AUGUST 1959, by W. C. Erickson. [1961] [8]p. incl. diagrs. (AF 49(638)561) Unclassified

Published in Jour. Geophys. Research, v. 66: 1773-1780, June 1961.

Decameter wavelength observations of the solar noise storm during the latter portion of Aug. 1959 are reported. The data displayed several characteristics not apparent in the observations at shorter wavelengths. Decameter wavelength emission was detected before the meter wavelength emission. Intense decameter wave emission ended on Aug. 25, whereas intense meter wavelength emission persisted until Sept. 3. Observations indicated that the emission was quite uniform. The intense angular scintillations reported by other observers was not detected during this period, but observations tend to confirm the identification of this disturbance as a type I noise storm. Even at decameter wavelengths, the emission region appeared to be of small angular diameter, and low in the corona. (Contractor's abstract, modified)

839

[General Dynamics Corp. Convair Div., San Diego, Calif.]

OCCULTATION OF THE CRAB NEBULA BY THE SOLAR CORONA, by W. C. Erickson and P. Brissenden. [1961] [4]p. incl. diagr. (AF 49(638)561) Unclassified

Published in Astronom. Soc. Pacific, v. 74: 74-77, Feb. 1962.

Observations of the occultation of the Crab Nebula by the solar corona were made in June 1960 at the Clark Lake radio astronomy station at a wavelength of 11.4 m. They are similar to those made in 1959 previously reported. Most of these new observations were again obtained with a fan-beam antenna whose response pattern measures 1.5° east-west and 30° north-south. The radio noise output of this antenna was determined with a comparison radiometer that measured the difference between the antenna noise and the output of a regulated noise source.

840

General Dynamics Corp. Convair Div., Pomona, Calif.

THERMAL STRESSES IN PERFORATED PLATES AND BODIES OF REVOLUTION, by R. D. Sutherland, S. M. Manville and others. June 1961, 100p. incl. diagrs. table, refs. (Rept. no. TM-349-35) (AFOSR-1050) (AF 49(638)592) AD 265537 Unclassified

Methods are derived for the determination of thermal stress in perforated plates and bodies of revolution. The perforated plate problem, being 2-dimensional, is found to be amenable to the complex analysis of Muskhelishvili. The problem of thermal stresses in bodies of revolution is solved in an exact manner by restricting the problem to the aft end of the ogive-shaped body considered. To obtain solutions to the 2-dimensional problems of thermal stresses in perforated plates, the complex analysis of Muskhelishvili is employed with the additional use of conformal mapping. The conformal mapping makes necessary the use of special techniques in order to apply the boundary conditions. Two different examples are presented: (1) thermal stresses in a square plate containing a central circular perforation and (2) thermal stresses in a circular plate containing a central star-shaped perforation. The problem of thermal stresses in ogival bodies of revolution, being a 3-dimensional problem, must be approached in a different manner. To

begin with, a coordinate system is developed based on the classic ogive shape which can approximate a variety of low aerodynamic drag shapes. Thermoelastic and thermoplastic equations are then developed in this coordinate system. The thermoelastic problem is then solved in this system by a combination of stress functions and a numerical technique. Closed form solutions are obtained by considering only the aft end of the ogive. (Contractor's abstract)

841

General Dynamics Corp. Convair Div., San Diego, Calif.

TRANSPORT EQUATIONS FOR PLASMAS IN STRONG EXTERNAL FIELDS, by E. Meeron. Mar. 21, 1961, 9p. (AFOSR-635) (AF 49(638)855) Unclassified

Also published in Phys. Rev., v. 124: 308-310, Oct. 15, 1961.

In this note an outline is provided of the derivative of a hierarchy of closed transport equations in which each successive set yields an approximation valid through successively higher powers of a dimensionless parameter which expresses field force, thus providing a description of precisely those situations in which the existing transport equations are inapplicable. It is shown that higher approximations than the resultant nonlinear Vlasov type equation that is expected from very strong external electric fields in which the motion of each charged particle is assumed to be relatively independent of the individual motions of other particles are readily obtained. Consideration is given to a system of N particles of s kinds, N_i particles of kind i, in a volume V, each carrying a charge $z_i e$. A discussion is also presented on the probable range of validity of the approximation.

842

General Dynamics Corp. Convair Div., San Diego, Calif.

MICROWAVE BREAKDOWN OF THE ATMOSPHERE, by R. Akerib. [1961] [6]p. incl. diagrs. (AFOSR-751) (AF 49(638)855) 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. 1: 988-991, 1962.

The breakdown of air due to a microwave beam has been studied using the theory of Mittleman and Saxon. The threshold proves densities have been derived for attachment limited and for diffusion limited results. The latter are in fair agreement with the results of Platzmann and Solt. The breakdown times have also been derived and are of the order of 10^{-9} sec. (Contractor's abstract)

843

General Dynamics Corp. Convair Div., San Diego, Calif.

MICROWAVE ENERGY TRANSFER MECHANISMS (Unclassified title), by R. Akerib, R. [A.] Pappert, and S. Rand. June 30, 1961, 10p. incl. refs. (Rept. no. ZPh-106) (AFOSR-921) (AF 49(638)855) AD 339115 Secret

844

General Dynamics Corp. Convair Div., San Diego, Calif.

APPROXIMATE CONTINUOUS OPACITY CALCULATIONS FOR POLYELECTRONIC ATOMS AT HIGH TEMPERATURES, by R. A. Pappert and S. S. Penner. June 30, 1961 [19]p. incl. diagrs. (Rept. no. ZPh-106, Appendix 2) (AFOSR-943) (AF 49(638)855) AD 261520 Unclassified

Also published in Jour. Quant. Spectros. and Radiative Transfer, v. 1: 258-268, Dec. 1961.

Approximate formulas derived by Raizer (and modifications thereof) for the Rosseland and Planck mean absorption coefficients in high-temperature gases have been compared with Armstrong's results for nitrogen at 5 and 20 ev for densities varying between $\sim 5 \times 10^{20}$ cm^{-3} and $\sim 5 \times 10^{15}$ cm^{-3}. Comparison has also been made with results obtained by Bernstein and Dyson for the Rosseland mean of fluorine at 10 ev in the density range $\sim 10^{21}$ cm^{-3} to 10^{18} cm^{-3}. The modified Raizer formulas are consistently better approximations than the expressions obtained by Raizer and agree within about a factor of 2 with the results derived from numerical calculations. (Contractor's abstract)

845

General Dynamics Corp. Convair Div., San Diego, Calif.

ATMOSPHERIC BREAKDOWN, by R. Akerib and K. A. Brueckner. June 30, 1961, 22p. incl. diagrs. (Rept. no. ZPh-106, Appendix 1) (AF 49(638)855) AD 261519 Unclassified

The propagation of a microwave beam of high energy through the atmosphere is treated in connection with the problem of the breakdown of the atmosphere. A density of a few electrons is first considered. Under the influence of the field, these electrons are accelerated and, in colliding with the various atoms, pick up sufficient energy to undergo an ionizing collision with an atom. This process continues until the density of electrons is sufficiently high to reflect the microwave beam. Ionization is thus the basic process of the buildup of density of electrons. The story, however, is not so simple. A number of electron loss mechanisms are present; e.g., diffusion, attachment, and recombination processes. These

processes are not all important simultaneously. In Section II, a simple theory of breakdown is described which is applied to attachment-controlled, diffusion-controlled breakdown. Sections III and IV discuss breakdown times and the case of pulsed radiation. In Section V, a short discussion is presented of the theory. (Contractor's abstract)

846

General Dynamics Corp. Convair Div., San Diego, Calif.

NON-LINEAR SOLUTIONS OF FOKKER-PLANCK EQUATIONS, by N. Edmonson, Jr. and T. Summers. June 30, 1961, 25p. incl. diagrs. (Rept. no. ZPh-106, Appendix 3) (AF 49(638)855) AD 261521
Unclassified

Mathematical statements of the presumed nature of the interaction between a plasma and electromagnetic waves are re-examined for possible methods of exploiting the effects of nonlinear terms in the heretofore linearized versions of magnetohydrodynamic equations. A procedure is studied for orthogonal polynomial expansion of the velocity dependence of the particle distribution functions. The procedure consists of substituting the expansion into the transport equation whose result yields an infinite set of linked equations for the coefficients of the expansion. The set of equations to be studied consists of a finite number of the linked equations combined with the electromagnetic field equations. The important assumptions made are: (1) the plasma is fully ionized, (2) the ions have a Maxwellian distribution, (3) electron-electron interactions can be ignored, (4) electron-ion interactions may be described by the Fokker-Planck collision terms used by Grad (Comm. on Pure and Applied Math., v. 2: 325, v. 3: 331, 1949). The proposed solution method contains implicitly the assumptions that (5) the electron distribution is in some sense close to a Maxwellian distribution, (6) coefficients of third (products of velocity components taken 3 at a time) and higher order terms can be ignored.

847

General Dynamics Corp. Convair Div., San Diego, Calif.

COUPLING AND ENERGY TRANSFER OF RADIO-FREQUENCY ENERGY TO A CONDUCTING SURFACE (Unclassified title), by K. A. Brueckner. June 30, 1961, 21p. (Rept. no. ZPh-106, Appendix 5) (AF 49(638)855) AD 324631
Secret

848

General Dynamics Corp. Convair Div., San Diego, Calif.

CORRELATION FUNCTIONS IN PLASMA, by I. Oppenheim. June 30, 1961, 9p. (Rept. no. ZPh-106, Appendix 6) (AF 49(638)855) AD 261616
Unclassified

The correlation function between the potential at point a and the potential at point b in a fully ionized plasma is computed. The correlation function is shown to be a long-range function of the distance between points a and b. This result has significance in the treatment of the interaction of radiation with a plasma because of its effect on transport properties in a plasma. (Contractor's abstract)

849

General Dynamics Corp. Convair Div., San Diego, Calif.

INDIRECT EXPONENTIAL COUPLING IN THE CLASSICAL MANY-BODY PROBLEMS, by E. Meeron. June 30, 1961 [7]p. incl. refs. (Rept. no. ZPh-106, Appendix 7) (AF 49(638)855) AD 414140 Unclassified

Also published in Phys. Rev., v. 126: 883-886, May 1, 1962.

The usual coupling procedure consists of multiplying the interparticle potential $U_n(r^n)$, by a coupling parameter λ and then expanding thermodynamic functions in powers of λ. The Kirkwood variation of this procedure couples only one particle of the system, resulting in an integro-differential equation for distribution functions, which also can be expanded in powers of the coupling parameter. These expansions converge only for weakly coupled systems. If the Ursell f bonds are coupled instead of the direct interaction potentials, we can expand certain thermodynamic functions in powers of the exponential coupling parameters. Integrodifferential equations for distribution functions are derived, and it is seen that distribution functions are given by ratios of two practically finite polynomials in the exponential coupling parameters. The coefficients in these polynomials are finite even for strongly singular (e.g. hard sphere) potentials. The method provides a well-defined expansion parameter for the Kirkwood-Saltzburg hierarchy and appears related to the f-bond chain summation and nodal expansion methods. Present and possible future applications include: theory of fused salts and electrolytes, theory of ferroelectricity, ion pairing in semiconductors, equation of state of the high-temperature electron gas, and problems of phase transitions. The possibility of applying exponential coupling to quantum-mechanical systems is noted.

850

General Dynamics Corp. Convair Div., San Diego, Calif.

ENERGY TRANSFER MECHANISMS AT PLASMA RESONANCE (Unclassified title), by W. M. Leavens. July 1961, 10p. incl. diagrs. (Rept. no. ZPh-106, Appendix 4) (AF 49(638)855) AD 324630
Secret

851

[General Dynamics Corp. Convair Div., San Diego, Calif.]

COEFFICIENT OF DYNAMIC FRICTION FOR SLOW IONS, by S. Rand. [1961] [8]p. incl. diagrs. refs. [AF 49(638)855] Unclassified

Published in Phys. Fluids, v. 4: 1251-1258, Oct. 1961.

The coefficient of dynamic friction for a subsonic ion is determined, in a phenomenological manner, by requiring that the drag force acting on a test particle in a plasma be identical with the drag force on a field particle. The drag coefficient is determined in both a fully ionized gas and in a specialized partially ionized gas. The effect on collisions between ions and neutral particles on the drag force is considered. It is found that, with some rather special conditions, the stopping power on a charged particle traversing a plasma may be reduced when the density of neutral particles is increased.

852

[General Dynamics Corp.] General Atomic Div., San Diego, Calif.

CHEMICAL REACTIONS USING FREE RADICAL BEAMS (Abstract), by W. L. Fite, H. Harrison, and R. T. Brackmann. [1961] [1]p. [AF 49(638)301] Unclassified

Presented at Second AFOSR Contractors' meeting on Chemical Kinetics of Propulsion, Illinois Inst. of Tech. Armour Research Foundation, Chicago, Ill., Sept. 11-12, 1961. (AFOSR-1417; AD 265513)

In attempting to extend crossed-beam experiments for the measurement of 2-body, gas-phase chemical reaction cross sections from cases involving alkali metals (which may be detected by surface ionization) to the general case where detection is made mass spectrometrically, a number of important successes have been achieved. Foremost has been the systematic increase in signal-to-noise ratio by 5 orders of magnitude since the First AFOSR Contractors' meeting (item no. 707, Vol. IV). Accompanying this improvement, a number of spurious signals have been made evident, but the identification and elimination of unwanted effects has generally proceeded satisfactorily. It is believed that the gas-phase 2-body reaction $H + D_2 \rightarrow HD + D$ has been observed for which tentative values of the cross-section range from 4×10^{-20} cm^2 to 1×10^{-18} cm^2. The prognosis appears good for measurements of the other 2 reactions to which most attention has been directed, $H + O_3 \rightarrow OH + O_2$ and $D + Cl_2 \rightarrow DCl + Cl$, for which some experimental limits have been established.

853

General Electric Co. Flight Propulsion Lab. Dept., Cincinnati, Ohio.

HIGH TEMPERATURE HEAT TRANSFER TO CYLINDERS, by J. F. Cassidy, M. L. Ghai, and J. W. Reid. Final rept. Mar. 1, 1959-May 29, 1961 [71]p. incl. illus. diagrs. refs. (AFOSR-872) (AF 49(638)243) AD 260372 Unclassified

A combined analytical-experimental program was performed to provide basic knowledge of heat transfer from gases at high temperatures. The principal objective of this program was to obtain information regarding the forced convective heat transfer process associated with the transition flow region in a tubular test section. The experiments were conducted in a test stand which utilized the high temperature nitrogen gas flow discharge from an electrothermal generator. The results, describing the forced convection heat transfer phenomenon in a transition flow, are presented. They quantitatively describe the Nusselt number variation with the Reynold's number and the pipe L/D ratio. The typical transition relation, $\frac{Nu}{Pr^{1/3}_{R.N.}} (\frac{\mu s}{\mu b})^{0.14}$ was plotted vs Reynolds number for various L/D ratios. A theoretical investigation of the laminar boundary layer in an electrical conducting fluid, for an arbitrarily applied magnetic field was performed. New advances in high temperature thermometry have also been made under this program. These resulted from the development and use of a tungsten-tungsten rhenium thermocouple system. Improved probe calibration methods have demonstrated the probe's temperature and pressure measurement capabilities in gaseous temperatures as high as 5600°F. (Contractor's abstract)

854

General Electric Co. Flight Propulsion Lab. Dept., Cincinnati, Ohio.

VISCOUS MAGNETOHYDRODYNAMIC BOUNDARY LAYER, by A. Sherman. [1960] [6]p. incl. diagrs. (AFOSR-1679) [AF 49(638)243] Unclassified

Published in Phys. Fluids, v. 4: 552-557, May 1961.

The behavior of the Blasius boundary layer, for a fluid of constant electrical conductivity, in the presence of a non-uniform magnetic field is studied. Distortion of the applied field due to currents flowing in the fluid is neglected; that is, the magnetic Reynolds number is assumed to be zero. Since the fluid is of uniform conductivity, the influence of the pressure distribution, caused by the interaction between the magnetic field and the inviscid flow, on the boundary layer is taken into account along with the Lorentz body force within the layer itself. The nonlinear boundary layer equations are solved by the method of power series expansion utilizing the Görtler variables. Particular attention is given to the case in which the

nonuniform field is established in a constant height channel. The boundary layer, then, is assumed to begin at some position along 1 wall, and grow in the downstream direction. For purposes of computation, the problem is further specialized to treat the case in which the nonuniform field is generated by a current-carrying wire imbedded in 1 wall of the channel and aligned normal to the flow. The results of a calculation, for 1 choice of the relevant nondimensional parameters, show that the reduction in skin friction is sufficient to separate the boundary layer. (Contractor's abstract)

855

General Electric Co. Flight Propulsion Lab. Dept., Cincinnati, Ohio.

OBSERVED EMISSIVITIES OF ROCKET COMBUSTION GASES, by D. E. Robison and S. J. Van Grouw. Final rept. Dec. 1961, 12[illegible]p. incl. illus. diagrs. tables, refs. (AFOSR-1904) (AF 49(638)413) AD 269387 Unclassified

The total and the spectral intensity of the radiation emitted by rocket combustion products at high pressure was studied. Spectral and total radiation data are presented for 3 rocket propellant systems: HNO_3 and HN_3; N_2O_4 and NH_3; and N_2O_4 and N_2H_4. Each of the combinations contained H_2O as the principal radiating gas.

The measurements were made at a nominal combustion pressure of 700 psia. Emissivity correlations and methods of estimating the temperature of the combustion gases are developed. A technique is given for obtaining direct observation of high temperature gases inside the combustion chamber of a small rocket motor.

856

General Electric Co. General Electric Research Lab., Schenectady, N. Y.

ENERGY PARAMETERS IN ADSORPTION, by G. Ehrlich. [1961] [5]p. (AFOSR-2921) [AF 49(638)791] AD 435178 Unclassified

Also published in Jour. Chem. Phys., v. 36: 1499-1503, Mar. 1962.

The energy quantities for chemisorbing systems derived from calorimetry, isotherms, rate studies, and steady state measurements are analyzed. It is shown that if equilibration of the adsorbed layer occurs rapidly before evaporation (as it does for most metals) and the kinetic processes are properly identified, then the energy parameters deduced from thermodynamic and kinetic measurements are comparable. (Contractor's abstract)

857

General Electric Co. General Electric Research Lab., Schenectady, N. Y.

OBSERVATIONS ON INDIVIDUAL ADSORBED ATOMS (Abstract), by G. Ehrlich and F. G. Hudda. [1961] [1]p. (AF 49(638)791) Unclassified

Presented at meeting of the Amer. Phys. Soc., Monterey, Calif., Mar. 20-23, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 168, Mar. 20, 1961.

The interactions of nitrogen with a tungsten surface have been studied in Müller's field ion microscope, with a resolution of less than 5A. Adsorption at 300°K results in a nonuniform distribution of adatoms with the highest concentration in the jogged regions between the 100 and 111 zones. During the initial stages the more closely packed planes, such as (110) and (211), remain devoid of gas. This distribution is dictated by the kinetics of the dissociation step and not by variation in the binding energy of adatoms. At 300°K the adatoms appear fixed in place; extensive rearrangement is only observed at T > 400°K. The configuration of surface atoms from which a nitrogen atom has moved on heating is identical with that prior to adsorption, indicating that no permanent perturbation of the lattice occurs. At 300°K adsorption of nitrogen is not observed on pairs of nearest neighbor sites. Instead, adatoms are separated by several lattice spacings. This suggests that in the dissociation of the molecule vibrationally excited adatoms are formed which can migrate before decaying to their groundstate.

858

General Electric Co. General Electric Research Lab., Schenectady, N. Y.

ADSORPTION KINETICS ON THE ATOMIC LEVEL (Abstract), by G. Ehrlich and F. G. Hudda. [1961] [1]p. [AF 49(638)791] Unclassified

Published in Abstracts of Scientific Papers presented at Eighteenth Internat'l. Cong. of Pure and Applied Chemistry, Montreal (Canada) (Aug. 1961), Toronto U. Press, 1961, p. 155.

Adsorption processes on a tungsten surface have been examined in the low-temperature field ion microscope with a resolution of less than 5A. Nitrogen interacting at room temperature with a surface formed by field desorption appears in the microscope as brightly emitting spots of somewhat larger diameter than a tungsten atom. The distribution of these over the different crystallographic regions is not uniform: the low index planes, such as (110) and (211), remain unchanged, and the highest concentration appears in the region between the 111 and 100 zone lines, in which lattice steps are heavily kinked. At T = 300°K the adsorbed material proves to be

immobile, and this nonuniformity therefore stems from differences in the kinetics of adsorption on different planes. However, at T > 400°K the emitting spots around (111) move over the surface. Examination of the original adsorption sites reveals no change in the lattice structure and establishes that these emission spots correspond to adatoms. From the spacing of adatoms after adsorption at T = 300°K it can be shown that in the dissociation process vibrationally excited atoms are found.

859

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. [AF 49(638)791] Unclassified

Published in Jour. Chem. Phys., v. 35: 2165-2167, Dec. 1961.

Changes in the electrical resistance of high-area, evaporated metal films after adsorption of gases have been attributed to a long-range effect of the adsorbed material. It is shown that the experimental findings do not demand this interpretation, and that contributions to the observed resistance increases may arise from any of the following: (1) A localized resistance change at necks in the film, (2) Changes in surface stress on adsorption, (3) A decrease in the rate of electron tunneling across gaps in the film with an increase in the work function. The last mechanism appears most likely, and experiments to establish these effects quantitatively are outlined. (Contractor's abstract)

860

General Electric Co. General Electric Research Lab., Schenectady N. Y.

SEMICONDUCTING COMPOUNDS; PROCEEDINGS OF THE CONFERENCE, Schenectady, N. Y., June 14-16, 1961. New York, W. A. Benjamin, Inc., 1961 [241]p. incl. illus. diagrs. tables, refs. (AFOSR-2010) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)997 and General Electric Research Lab.) Unclassified

Also published in Jour. Appl. Phys. Suppl., v. 32: 2063-2304, Oct. 1961.

The aim of this conference was to summarize both experimental and theoretical results in various classes of compounds and to synthesize physical ideas common to these compounds. Emphasis was placed on 3-5 and 2-6 compounds with some discussion of the lead compounds and oxides. This was thought to be the first conference devoted exclusively to papers and discussion on the physics of semiconducting compounds It was restricted to fundamental physical properties, such as band structure, transport, optical galvanomagnetic, and resonance phenomena. The proceedings seem to constitute a fairly complete and impressive summary of present knowledge and understanding of compound semiconductors.

861

General Electric Co. Space Sciences Lab., Philadelphia, Pa.

THE GENERALIZED INVERSE PROBLEM OF ORBIT COMPUTATION, by V. G. Szebehely. [1961] [21]p. incl. diagr. (AFOSR-435) (AF 49(638)814) AD 611517 Unclassified

Also published in Space Research II; Proc. Second Internat'l. Space Science Symposium, Florence (Italy) (Apr. 10-14, 1961), Amsterdam, North-Holland Publishing Co., 1961, p. 318-338.

The basic problem of celestial mechanics—finding the motion for given initial conditions in a given force field—is inverted by asking for force fields which result in either a specific orbit or which allow to obtain a closed form solution of the equations of motion. The first case leads to a generalized concept of guidance and thrust programs, while the second opens the way to finding new closed form solutions for slightly modified n-body (n > 2) gravitational fields. The problem discussed in this paper is a generalization in purpose and in method of the classical problem of orbit determination in celestial mechanics. It allows the determination of classes of functions which either furnish optimization opportunities of the guidance problem (first case) or furnish overall field modifications which allow closed form solutions (second case) applicable to perturbation calculations as reference orbits with predetermined approximations. Establishing new reference orbits for perturbations and formulating a concise and systematic method of guidance analysis are the 2 main results presented in the paper. (Contractor's abstract)

862

General Electric Co. Space Sciences Lab., Philadelphia, Pa.

PROCEEDINGS OF THE FIRST INTERNATIONAL SYMPOSIUM ON ANALYTICAL ASTRODYNAMICS, California U., Los Angeles, June 27-29, 1961, 91p. incl. refs. (AFOSR-885) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)814, California U., and General Electric Co.) AD 258659 Unclassified

The aim of this symposium was to facilitate interchange of ideas between all scientists whose work is directly or indirectly connected with applied celestial mechanics. Since the purpose of the papers presented was to stimulate discussions, the speakers not only described the results of new research, as is customary in technical society meetings, but also discussed published work and

possible approaches to new problems. In view of this, these proceedings consist of abstracts authors submitted to the appropriate journals for publication. The papers were divided into the following categories: earth satellites, critical inclination, interplanetary trajectories, optimization problems, orbit determination, miscellaneous physical problems, and miscellaneous analytical problems.

863

General Electric Co. Space Sciences Lab., Philadelphia, Pa.

INFLUENCE OF TENSOR CONDUCTIVITY ON CURRENT DISTRIBUTION IN A MHD GENERATOR, by H. Hurwitz, Jr., R. W. Kilb, and G. W. Sutton. [1960] [12]p. incl. diagrs. [AF 49(638)914] Unclassified

Published in Jour. Appl. Phys., v. 32: 205-216, Feb. 1961.

Magnetohydrodynamic generators may operate under conditions such that the product of electron cyclotron frequency and mean collision time is not small compared to unity. Accordingly the electrical conductivity is a tensor rather than a scalar quantity. The influence of tensor conductivity on the electrical current distribution has been investigated in 2 idealized situations, 1 pertaining to the entrance and exit regions of the generator and the other pertaining to the region near segmented electrodes. The calculations predict modifications of the internal impedance of the generator which can be described in terms of increases in the effective duct length and width. (Contractor's abstract)

864

General Electric Co. Space Sciences Lab., Philadelphia, Pa.

HALL EFFECTS IN A LORENTZ GAS, by G. W. Sutton. Jan. 10, 1961, 13p. (AFOSR-462) (AF 49(638)914) AD 276648 Unclassified

Also published in Phys. Fluids, v. 4: 1273-1276, Oct. 1961.

For a Lorentz gas, expressions are derived for the direct and transverse electron electrical conductivities for an arbitrary inverse-power interaction force with the heavy particles. The results are compared to the simple kinetic model for the electron motion. The simplified equation is not general for small magnetic fields but is correct for large magnetic fields. For inverse powers greater than 3, the error is less than 15%. (Contractor's abstract)

865

General Electric Co. Space Sciences Lab., Philadelphia, Pa.

THE COMBINED EFFECT OF TENSOR CONDUCTIVITY AND VISCOSITY ON AN MHD GENERATOR WITH SEGMENTED ELECTRODES, by A. Sherman and G. W. Sutton. June 1961, 14p. incl. diagrs. (Rept. no. R61SD-100) (AFOSR-687) (AF 49(638)914) AD 260366 Unclassified

Also published in Proc. Fourth Biennial Gas Dynamics Symposium on Magnetohydrodynamics, Northwestern U., Evanston, Ill. (Aug. 23-25, 1961), Evanston, Northwestern U. Press, 1962, p. 173-183. (AFOSR-2787)

An investigation of the combined influence of tensor conductivity, fluid viscosity and segmented electrodes was carried out for an MHD generator. A solution for the flow field, and induced magnetic field was obtained in closed form by assuming an incompressible, constant properties fluid, and 2-dimensional flow. Calculations are presented which show the influence of the product of electron cyclotron frequency and electron mean free time, Hartmann number, and generator loading parameter on the flow. (Contractor's abstract)

866

General Electric Co. Space Sciences Lab., Philadelphia, Pa.

DETERMINATION OF THE LONGITUDINAL VARIATION OF MHD CHANNEL CROSS-SECTION FOR MAXIMUM POWER, by H. Yeh. June 1961 [18]p. incl. diagrs. (Rept. no. R61SD066) (AFOSR-1030) (AF 49(638)914) AD 438717 Unclassified

This analysis is based on the 1-dimensional inviscid flow equations of an ionized gas (whose electrical conductivity is in general a function of pressure and temperature) flowing through a channel for the purpose of the extraction of electrical power. The problem is: given the inlet conditions and a fixed channel length, what should be the distribution of channel cross-sectional area (and hence of all other gas properties) in order to extract maximum power? This variational problem is solved in the present report by means of a computation procedure based on the method of steepest descent. After the procedure is formulated for the general case, a simplification is obtained if the conductivity is assumed to vary with temperature only according to a power law. In order to test this method, a sample calculation of the first variation is obtained, using the constant-velocity distribution as the zero-th approximation. Further calculations required for the complete solution can likewise be performed in a straightforward manner. (Contractor's abstract)

867

General Electric Co. Space Sciences Lab., Philadelphia, Pa.

VELOCITY PROFILES AND EFFICIENCY OF MHD GENERATORS WITH SEGMENTED ELECTRODES, by H. Yeh and G. W. Sutton. Sept. 15, 1961, 30p. incl. diagrs. (Rept. no. R61SD150) (AFOSR-1595) (AF 49-(638)914) AD 266275 Unclassified

The 2-dimensional problem of an infinitely long magnetohydrodynamic generator with segmented electrodes of finite length was solved for constant properties, including the Hall effect. First, it was shown that the non-uniform current distribution does not affect the velocity profile, which is therefore parabolic for laminar flow. Second, the generator efficiency (not including friction) is exactly equal to the generator loading factor even for a non-uniform velocity. In these investigations it was assumed that opposite pairs of electrodes have no mutual influence. This assumption has been verified when the Hall effect is absent even when the electrode pitch is equal to channel width. (Contractor's abstract)

868

General Electric Co. Space Sciences Lab., Philadelphia, Pa.

END EFFECTS IN INVISCID FLOW IN A MAGNETO-HYDRODYNAMIC CHANNEL, by G. W. Sutton and A. W. Carlson. [1961] [12]p. incl. diagrs. table. (AFOSR-3402) (AF 49(638)914) Unclassified

Also published in Jour. Fluid Mech., v. 11: 121-132, Aug. 1961.

The flow of an inviscid, incompressible electrical conducting fluid in a channel of constant rectangular cross-section is considered, when the flow enters a region which contains a magnetic field transverse to the flow and electrodes on opposite sides of the channel. This geometry is typical of a dc induction pump or magnetohydrodynamic generator. The conducting fluid external to the magnetic field acts as a shunt and produces a non-uniform electric potential field and hence a non-uniform Lorentz force on the fluid, and causes the fluid velocity profile to be distorted. These effects are calculated theoretically for small magnetic Reynolds number and small magnetic interaction parameter. It is found that the velocity at the centre-line of the channel is retarded and at the walls the velocity is accelerated. The fractional change of velocity at the wall is equal to approximately 0.44 times a modified magnetic interaction parameter. (Contractor's abstract)

869

General Electric Co. [Space Sciences Lab.] Philadelphia, Pa.

MAGNETOHYDRODYNAMIC RESULTS FOR HIGHLY DISSOCIATED AND IONIZED AIR PLASMA PRODUCED BY HYPERSONIC SHOCK WAVES (Abstract), by H. T. Nagamatsu and R. E. Sheer, Jr. [1961] [1]p. [AF 49-(638)914] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 21, Feb. 1, 1961.

An investigation of air plasma moving through a constant (2300 gauss) transverse magnetic field was conducted in a shock tube. As the plasma traveled through the field, an electromotive force was produced in the plasma. Two diametrically opposite, 1/2-in. diam, copper electrodes were used to measure this potential. The shock Mach number varied from 10 to 32 with corresponding equilibrium plasma temperatures from 3600 to 11,000°K. At Mach number 30 the observed potential across the electrodes, with a 1-meg external load, was 236 v, which agreed with the theoretical value, but at lower Mach numbers the observed potentials were much lower than theory. By varying the external load for a shock Mach number of 30, the current from the plasma varied from nearly zero to 115 amp. This high current was extracted from the copper electrodes at nearly room temperature. The observed potential decreased linearly with increasing current indicating a nearly constant plasma resistance. For this resistance the electrical conductivity was calculated and was much less than the theoretical prediction. The maximum power extracted from the plasma was 7.8 kw with an external load of 1.85 ohms.

870

General Electric Co. Space Sciences Lab., Philadelphia, Pa.

FUNDAMENTALS OF MHD FLOW (Abstract), by G. W. Sutton. [1961] [1]p. (Bound with AFOSR-582; AD 257892) (AF 49(638)914) Unclassified

Presented at Fourth annual AFOSR Contractors' meeting on Ion and Plasma Acceleration, Beverly Hills, Calif., Apr. 20-21, 1961.

Several important theoretical problems associated with the steady flow of an electrically conducting fluid in a rectangular channel with mutually perpendicular magnetic and electric fields have been investigated. The results are applicable to both MHD electrical power generators and accelerators. The first problem considers the generation of vorticity by the magnetic field at the entrance to the channel. The coupled inviscid linearized momentum and electric field equations were solved by means of an expansion in power of the magnetic interaction parameter. It was found that the fractional change in velocity profile is greatest at the wall, amounting to 44% of the magnetic interaction parameter. Since the Hall effect will not be negligible in an MHD generator or accelerator, complete expressions were derived for the tensor conductivity from the kinetic theory of gases for

an inverse power interaction force. It was found that simpler expressions may be used within an accuracy of 15% (provided the scalar conductivity is calculated correctly) except if electron-ion collisions dominate, in which case the error is much larger. Work has been initiated on the entrance effects into a channel with segmented electrodes and tensor conductivity. It has been found that if the magnetic field extends appreciably downstream of the inlet region, the electrical characteristics of the channel are independent of the Hall effect. The problem of channel flow with both viscosity and tensor conductivity has been solved for segmented electrodes considering the flow to be laminar and fluid properties to be constant. The result is that the electrical characteristics are not effected by either viscosity or the Hall effect; but the friction is increased by both effects, which decreases the efficiency. In addition it has been found that a transverse pressure gradient will develop.

871

General Electric Co. [Space Sciences Lab.] Philadelphia, Pa.

THERMAL DIFFUSION RATIO IN DISSOCIATED AIR, by S. M. Scala. [1961] [3]p. incl. diagrs. refs. (AFOSR-1494) (AF 49(638)931) AD 285619 Unclassified

Also published in ARS Jour., v. 31: 1441-1443, Oct. 1961.

Although the mechanism of thermal diffusion has usually been neglected in studies of the diffusion process in the hypersonic laminar boundary layer, it has been found that thermal diffusion can be important for non-equilibrium viscous flow. The mechanism of thermal diffusion is reviewed and in particular, a number of approximations to the thermal diffusion ratio in binary mixture dissociated air are presented.

872

General Mills, Inc., Minneapolis, Minn

ALPHA AND BETA GRAIN BOUNDARIES IN INDIUM ANTIMONIDE, by R. K. Mueller and R. L. Jacobson. [1961] [5]p. incl. illus. diagrs. table, refs. (AFOSR-1466) (AF 49(638)628) Unclassified

Also published in Jour. Appl. Phys., v. 33: 2341-2345, July 1962.

Grain boundaries in indium antimonide with misfit angles of 6° have been prepared which, according to the dislocation model for grain boundaries, consist of rows of alpha or beta dislocations. Current flow across these boundaries in n- and p-type material has been studied. Alpha boundaries were found to present a barrier to current flow in n- and p-type material, beta boundaries only in p-type material. This indicates for alpha dislocations donor behavior in p-type material, acceptor behavior in n-type material, and for beta-dislocations donor characteristics. A theoretical model for the boundary states is proposed. (Contractor's abstract)

873

General Motors Corp. Allison Div., Indianapolis, Ind.

GENERALIZED ELECTROMAGNETIC FIELD OF THE RAIL TYPE ACCELERATOR, by D. L. Clingman and T. L. Rosebrock. June 1961, 12p. incl. diagrs. (Engineering rept. no. 2186) (AFOSR-1279) (AF 49(638)864) AD 436084 Unclassified

Descriptive equations have been derived for the 3-dimensional electromagnetic field of the rail type plasma accelerator, including parallel and nonparallel rail elements. Special cases treated include: (1) finite length parallel rails, 3-dimensional field; (2) finite length parallel rails, 2-dimensional field in the plane of the rails; (3) finite length parallel rails, 2-dimensional field in the plane midway between the rails and normal to the plane of the rails; (4) finite length nonparallel rails, 3-dimensional field; (5) finite length nonparallel rails, 2-dimensional field in the plane of the rails; (6) finite length nonparallel rails, 2-dimensional field in the plane midway between the rails and normal to the plane of the rails. The assumptions of line currents and a filamentary discharge are made. (Contractor's abstract)

874

General Motors Corp. Allison Div., Indianapolis, Ind.

ANALYSIS OF ENERGY EFFICIENCY OF RAIL ACCELERATORS, by G. M. Palmer. July 1961, 24p. incl. diagrs. refs. (Engineering rept. no. 2252) (AFOSR-1631) (AF 49(638)864) AD 267221 Unclassified

Application of possible energy loss mechanisms to the rail accelerator problem has shown how large amounts of energy could be consumed and not become available as axial kinetic energy. Axial kinetic energy vs specific impulse plots indicate that a specific impulse of 10,000 sec would require a kinetic energy of 40 joules. For the conditions considered, radial kinetic energy and the plasma formation and heat energy are negligible by comparison. Thus, an efficiency of 10 to 20% based on absorbed energy is implied depending upon emissivity up to a 50% reduction. The range of efficiency is in good agreement with experimental results. Two of the mechanisms considered, Joullian heating of the rails and radio frequency electromagnetic radiation, were found completely negligible. Although the relative energy contained in radial motion at the velocities considered is small compared to the thermal radiation energy losses, a reduction in radial velocity has a corresponding effect on the radiation by reducing the radiating surface area for a given time interval. A marked improvement in efficiency could be realized by utilizing a cold plasma so that losses based on temperature could be reduced.

875

General Motors Corp. Allison Div., Indianapolis, Ind.

STUDY OF RAIL-TYPE ELECTROMAGNETIC ACCELERATOR (Abstract), by T. L. Rosebrock. [1961] [1]p. (Bound with AFOSR-582; AD 257892) (AF 49(638)864) Unclassified

Presented at Fourth annual AFOSR Contractors' meeting on Ion and Plasma Acceleration, Beverly Hills, Calif., Apr. 20-21, 1961.

Theoretical and experimental studies were made of a pulsed rail-type electromagnetic accelerator employing an exploding-wire propellant charge. The dimensionless governing equations of the idealized accelerator circuit with filamentary discharge were derived and solved on the analogue computer. Several studies of the discharge process have been conducted including: (1) a study of the time-variation of plasma conductivity and temperature, (2) calculated mass-velocity distribution of a plasma expanding in a magnetic field, and (3) generalized electromagnetic field equations for the accelerator. An experimental accelerator circuit has been fabricated consisting of a 2000-joule capacitor coaxially coupled through a low inductance vacuum spark gap to the accelerator mounted in a 1 ft diam x 4 ft length plastic vacuum chamber. Principle measurements have included: (1) momentum, obtained with a ballistic pendulum which can completely surround the accelerator; (2) plasma front velocity, obtained with a photomultiplier system; (3) time records of current and voltage; and (4) mass distribution, obtained by spectroscopic analysis of plasma deposits on targets surrounding the discharge. Momentum measurements and plasma deposition patterns validate theoretical predictions of large losses in undirected kinetic energy.

876

Genoa U. [Neurosurgical Clinic] (Italy).

INDUCTION OF SLEEP IN CATS BY ELECTRICAL STIMULATION OF THE BRAIN STEM RETICULAR FORMATION (Abstract), by E. Favale, A. Guissani, and G. F. Rossi. [1961] [1]p. (AFOSR-3449) (AF 61(052)-461) Unclassified

Presented at Second Internat'l. Cong. of Neurological Surgery, Washington, D. C., Oct. 14-20, 1961.

Also published in Excerpta Medica, Internat'l. Cong. Series No. 36, 1961.

The induction of light and deep sleep described is possible only if proper parameters of stimulation are employed and if the stimulation is performed on a proper EEG and behavioral background. Low frequency pulses and a background of relaxed wakefulness are essential for the induction of light sleep; high frequency pulses applied during the intermediate sleep are essential for the precipitation of deep sleep.

877

Genoa U. [Neurosurgical Clinic] (Italy).

BLOOD PRESSURE DURING NATURAL SLEEP IN CATS, by G. F. Rossi, E. Favale and others. [1961] [1]p. (AFOSR-3450) (AF 61(052)461) Unclassified

Presented at Fifth Internat'l. Cong. of Electroencephalography and Clinical Neurophysiology, Rome (Italy), Sept. 7-13, 1961.

Also published in Excerpta Medica, Internat'l. Cong. Series No. 37, 1961.

The behavior of the blood pressure during sleep strongly supports previous findings indicating that it is during the episodes characterized by EEG desynchronization and muscular hypotonia that sleep reaches its maximal depth. In addition, the relation between EEG desynchronization, EMG flattening, blood pressure fall and depth of sleep suggests that all these phenomena are produced by a common neural mechanism.

877A

Genoa U. Neurosurgical Clinic (Italy).

RESEARCHES ON THE NERVOUS MECHANISMS UNDERLYING DEEP SLEEP IN THE CAT, by G. F. Rossi, E. Favale and others. [1961] [23]p. incl. diagrs. refs. (AF 61(052)461) Unclassified

Published in Arch. Ital. Biol., v. 99: 270-292, July 1961.

The present study is devoted to the neural mechanisms underlying the deep sleep episodes characterized by complete postural relaxation and EEG desynchronization. Unanesthetized, free moving cats carrying chronically implanted electrodes for EEG and EMG recording and for electrical stimulation of peripheral and central nervous structures were used. (1) The EEG, EMG and behavioral criteria followed for the valuation of the depth of sleep are described. (2) Low rate electrical stimulation of the thalamic and reticular EEG synchronizing systems is ineffective during deep sleep. (3) The intravenous injection on thiopental sodium during sensory arousal, leaves the EMG silence unaffected but induces EEG synchronization. Low rate electrical stimulation of the thalamic recruiting system becomes once more effective following the injection of barbiturate. (4) High rate electrical stimulation of the brain stem reticular formation, which is followed by arousal when it is performed during light sleep, may lead to central and peripheral episodes of deep sleep if it is performed during the intermediate stage of sleep. (5) On the basis of these results the hypothesis is made that: (a) the EEG desynchronization that characterizes the deep sleep episodes results from the functional depression of the subcortical systems which are responsible for EEG synchronization-(b) this depression is due to the influence of an inhibitory mechanism which becomes active at the onset of the episodes of deep sleep; (c) this inhibitory mechanism is

probably responsible for the appearance of deep sleep itself. (6) The possible relations of these findings with those obtained by other authors, and the general conclusions drawn from them on the mechanisms underlying sleep are discussed. (Contractor's abstract)

878

George Washington U., Washington, D. C.

EXPERIMENTS IN INDIA ON "VOLUNTARY" CONTROL OF THE HEART AND PULSE, by M. A. Wenger, B. K. Bagchi, and B. K. Anand. [1961] [7]p. incl. diagrs. table. (Sponsored jointly by Air Force Office of Scientific Research, under AF 18(600)1180, Indian Council of Medical Research, Institute of Mental Health under M-788, Rackham Foundation, and Rockefeller Foundation) Unclassified

Published in Circulation, v. 24: 1319-1325, Dec. 1961.

The authors investigated 4 practitioners of Yoga in respect to control of the heart and pulse. Two claimed to stop the heart. One formerly made this claim but only demonstrated his method. The method for the first 3 was similar, involving retention of breath and considerable muscular tension in the abdomen and thorax, with closed glottis. It was concluded that venous return to the heart was retarded but that the heart was not stopped, although heart and radial pulse sounds weakened or disappeared. The fourth subject, with different intervening mechanisms also presumably under striated muscle control, did markedly slow his heart. The data indicate strong increase in vagal tone of unknown origin.

879

George Washington U. [School of Psychiatry] Washington, D. C.

A TEST OF MILIEU EFFECTS WITH SOME OF PIAGET'S TASKS, by J. J. Goodnow. [1961] [68]p. incl. diagrs. tables, refs. (AFOSR-1801) (AF 49(638)682) AD 611288 Unclassified

Approximately 500 European and Chinese boys between the ages of 10 and 13 were given four Piaget tasks (combinatorial reasoning, conservation of space, weight and volume), and Raven's Progressive Matrices (generally regarded as an intelligence test). Among the Chinese boys education varied from little or none to full schooling. Similarities across milieus were more striking than differences: there was an odd lack of relationship between the combinatorial task (closely tied to Matrices performance) and the conservation tasks (no such tie); replication of Geneva results was fair to good; the differences occurring suggest a need for a closer look at the concept stability of reasoning and at the expected inter-relationships among various tasks.

880

Georgetown U. Dept. of Physics, Washington, D. C.

THEORETICAL VIBRATIONAL ENERGY LEVELS OF H_2 ASSOCIATED WITH VARIOUS LC STO MO CONFIGURATION COMBINATIONS (Abstract), by G. M. Leies. [1961] [1]p. [AF AFOSR-60-1] Unclassified

Published in Symposium on Molecular Structure and Spectroscopy, Ohio State U., Columbus, June 12-16, 1961, p. 28-29.

Also published in Spectrochim. Acta, v. 17: 1103, Oct. 1961.

Vibrational energy levels G_v and first differences ΔG_v have been determined for 11 different theoretical potential curves of the H_2 ground electronic state. These potential curves were previously determined by McLean et al using LC STO MO wave functions with configuration interaction. Values of G_v and ΔG_v have been calculated for each potential curve through the use of the WBK approximation. Since each wave function differs from the preceding one by the addition of one more configuration, a comparison of the ΔG_v curves provides a measure of the influence of each configuration on the shape of the ΔG_v curve. The effects of each configuration on the vibrational levels will be discussed. The ΔG_v curves group into 2 distinct families. All wave functions including the $(\sigma_u 1s\sigma_u 1s')$ configuration have rapidly converging vibrational levels at high quantum number v, characteristic of the experimental levels. Those wave functions which exclude $(\sigma_u 1s\sigma_u 1s')$ show ΔG_v curves which have a positive curvature at all values of v for which calculations have been made.

881

Georgetown U. Dept. of Physics, Washington, D. C.

VIBRATIONAL ENERGY LEVELS OF IONIC MOLECULES BOUND BY CLASSICAL FORCES (Abstract), by E. J. Finn. [1961] [1]p. [AF AFOSR-60-1] Unclassified

Published in Symposium on Molecular Structure and Spectroscopy, Ohio State U., Columbus, June 12-16, 1961, p. 34-35.

Also published in Spectrochim. Acta, v. 17: 1109, Oct. 1961.

Theoretical energy levels of LiI, NaCl, and InF (chosen as representative diatomic ionic molecules) have been calculated up to vibrational quantum number v = 10,000. Two classical vibrational potentials were studied for each molecule. The first potential consisted of the

Coulombic attraction term and a nuclear repulsion term, while the second added a polarizability term to the first. The vibrational energy levels were computed with an IBM 704 program, using a first-order WKB approximation. Analysis of the data shows that at very low v ($v < 30$) a power series adequately represents the energy levels, while at very high values of v ($v \to \infty$) the energy levels approach H atom-like energies corresponding to a 1/r Coulombic potential. Further, the first energy difference curves show positive curvature at all v for all cases. Formulae will be presented that accurately yield the vibrational energies and first differences at all v.

882

Georgetown U. Dept. of Physics, Washington, D. C.

EMPIRICAL FUNCTIONS FOR VIBRATIONAL ENERGY DIFFERENCES OF H_2 (Abstract), by M. Shafi and C. L. Beckel. [1961] [1]p. (AF AFOSR-60-1) Unclassified

Published in Symposium on Molecular Structure and Spectroscopy, Ohio State U., Columbus, June 12-16, 1961, p. 40-41.

Also published in Spectrochim. Acta, v. 17: 1114, Oct. 1961.

A number of analytic functions other than power series have been used to represent the vibrational differences of the ground state of H_2. The best of these functions are presented and the roles that the concepts of covalency and ionicity played in their choice are discussed. Several of the functions give significantly better results than can be obtained with a power series. The best formulae indicate the existence of an unobserved $v = 15$ level.

883

Georgetown U. Dept. of Physics, Washington, D. C.

ROTATION-VIBRATION ENERGY LEVELS OF A DIATOMIC MOLECULE (Abstract), by C. L. Beckel. [1961] [1]p. [AF AFOSR-60-1] Unclassified

Published in Symposium on Molecular Structure and Spectroscopy, Ohio State U., Columbus, June 12-16, 1961, p. 53.

Also published in Spectroschim. Acta, v. 17: 1126, Oct. 1961.

It appears that Dunham's theoretical work on the energy levels of a rotating vibrator is in error in the second order when applied to diatomic molecules. The reason for this is that Dunham treated the one-dimensional problem whereas molecules undergo radial motion. The 2 cases require use of different effective potentials in the WBK integrals. A description will be given of the adjustment of Dunham's work to handle the radial problem. This adjustment alters the spectroscopic coefficients by new terms of the same magnitude as the second-order corrections listed by Dunham. One new result is that a radial harmonic oscillator has vibrational levels which are not quite equidistant and a minimum not exactly at $v = -1/2$. The new terms increase the zero point energy of H_2 by 15 cm^{-1}. The significance of this with regard to recent experimental and theoretical determinations of the H_2 dissociation energy will be discussed. Other numerical examples of the new corrections will be presented.

884

[Georgetown U. Medical Center, Washington, D. C.]

PREPARING PSYCHOPHYSIOLOGIC ANALOG INFORMATION FOR THE DIGITAL COMPUTER, by H. Zimmer. [1960] [4]p. incl. diagr. (AFOSR-679) (AF 49(638)487) Unclassified

Also published in Behav. Sci., v. 6: 161-164, Apr. 1961.

The preparation of psychophysiologic analog information for the digital computer basically requires 2 approaches: (a) the condensation and integration of data by analog equipment prior to its conversion into digital format, and (b) a full digital description of the psychophysiologic variable, with subsequent data reduction through appropriate digital computer programming. Detailed descriptions of the apparatus used in the preparation of the analog information are given.

885

[Georgetown U. Medical Center, Washington, D. C.]

A FREE RESPONSE APPROACH TO THE STUDY OF PERSON COGNITION, by L. Beach and M. Wertheimer. [1960] [8]p. incl. tables, refs. (In cooperation with Colorado U., Boulder) [AF 49(638)487] Unclassified

Published in Jour. Abnorm. and Social Psychol., v. 62: 367-374, Mar. 1961.

In person perception experiments subjects (Ss) have often been required to make judgments about other people (Os) on dimensions that may not be applicable or relevant from the S's point of view. The results of such studies are, consequently, difficult to interpret. It has been argued that fixed scale research should be preceded by free response—content analysis studies to aid in decisions as to which scales or dimensions are appropriate for the Ss, the Os, and the situation involved. In an attempt to show that dimension use does differ for different Ss and Os, Ss were asked to describe persons they knew who fit the specifications of classes of Os designated by E. These descriptions were then content analyzed.

The findings serve to support the contention that the dimension used in judgments of other peopel are a function of the Ss doing the judging, the Os being judged, the situation, and the interaction among these variables. It was concluded that a prior free response—content analysis approach like the present one might well be considered logically and methodologically prior to the study of how independent variables affect ratings along fixed predetermined scales.

886

Georgia Inst. of Tech. Engineering Experiment Station, Atlanta.

MASS SPECTROGRAPHIC IDENTIFICATION OF THE ION OBSERVED IN HYDROGEN MOBILITY EXPERIMENTS, by W. S. Barnes, D. W. Martin, and E. W. McDaniel. [1961] [2]p. (AFOSR-626) [AF 18(600)1524] AD 255602 Unclassified

Also published in Phys. Rev. Ltrs., v. 6: 110-111, Feb. 1961.

In studies of hydrogen, the 3 known species (H^+, H_2^+, and H_3^+) are all observed at very low drift-tube pressures, p, and for short drift distances, d. The H_3^+ ion is by far the most abundant throughout the range covered. As pd is increased, the abundances of H^+ and H_2^+ relative to that of H_3^+ diminish, the H_2^+ abundance falling off more rapidly than that of H^+. Taking into account the increasing ion losses due to diffusion recombination, etc., it appears that the H_3^+ population increases mainly at the expense of H_2^+.

887

Georgia Inst. of Tech. Engineering Experiment Station, Atlanta.

COLLISION PHENOMENA OF PLASMA PHYSICS, by E. W. McDaniel. 1961, 1v. incl. diagrs. tables, refs. (AFOSR-649) (AF 18(600)1524) Unclassified

Plasma phenomena are treated both classically and quantum mechanistically. Transport phenomena and atomic collisions are widely discussed; detailed descriptions of experimental methods and large amounts of data which have proved useful as reference material are included.

888

Georgia Inst. of Tech. Engineering Experiment Station, Atlanta.

MOBILITY AND CLUSTERING OF NEGATIVE IONS AND MASS-SPECTROGRAPHIC STUDY OF ION-MOLECULE REACTIONS OCCURRING AT THERMAL ENERGIES UNDER GAS KINETIC CONDITIONS, by E. W. McDaniel and D. W. Martin. Final summary rept. Aug. 1, 1955-Mar. 31, 1961 [11]p. incl. refs. (Technical status rept. no. 23) (AFOSR-826) (AF 18(600)1524) AD 256481 Unclassified

Investigations were made to obtain an identification of the negative ion observed in mobility experiments involving oxygen and oxygen mixtures: SO_2, SF_6 and HCl. The mobilities of the negative ions at room temperature are measured by means of a direct observation of the transit times of the ions over a given distance in a weak electric field. Attempts to observe clusters were made by examining the ions in helium and lithium. With helium it was found that appreciable clustering never occurred because of the high ionization potential which made charge transfer to essentially any collision partner energetically favorable. Preliminary studies of hydrogen mobility revealed that the only ion that will normally be present during experiments in hydrogen-ion mobility is H_3^+.

889

Georgia Inst. of Tech. Engineering Experiment Station, Atlanta.

X-RAY STUDIES OF DAUPHINÉ TWINNING IN QUARTZ (Abstract), by J. H. Koenig and R. A. Young. [1961] [1]p. (Technical rept. no. 8) [AF 49(638)624] Unclassified

Presented at meeting of the Georgia Academy of Sciences, Apr. 28, 1961.

Dauphiné twinning, which amounts to an 180° rotation of the twin about the c-axis, cannot be observed by ordinary polarizing-optics methods. Specular reflection from properly etched surfaces may show up twin boundaries which intersect the surface of the crystal. Certain x-ray reflections are affected, some profoundly, by the presence of these twins whether or not they either intersect the surface or are of macroscopic size. An x-ray method making use of this effect has been employed in a preliminary study of several aspects of the occurrence of Dauphiné twinning. The method will be described. Some of the effects on Dauphiné twinning of thermal cycling will be discussed and evidence for the possible occurrence of microscopic or submicroscopic twinning will be presented. The significance of such twinning behavior to piezoelectric applications and to crystal structure studies will be mentioned.

890

Georgia Inst. of Tech. Engineering Experiment Station, Atlanta.

DRIFT TUBE-MASS SPECTROMETER FOR STUDIES

OF LOW-ENERGY ION-MOLECULE REACTIONS, by E. W. McDaniel, D. W. Martin, and W. S. Barnes. [1960] [6]p. incl. illus. diagrs. refs. (AFOSR-2874) (AF 49(638)1064) Unclassified

Also published in Rev. Scient. Instr., v. 33: 2-7, Jan. 1962.

Apparatus has been developed for the mass spectrographic study of ion-molecule reactions occurring under gas-kinetic conditions. Ions are produced by electron bombardment inside a long drift tube containing gas at a pressure of up to about 0.7 torr. The ions diffuse down the drift tube under the influence of a weak electric field. A sample of the ion population at the end of the drift tube is extracted through a two-stage, field-free differential pumping section and passed into a 60° magnetic deflection mass spectrometer. The number of ion-molecule collisions in the drift tube may be varied over a wide range by changing the source position and/or the gas pressure. Information concerning the nature and probability of the reactions occurring is revealed by the resulting changes in the ionic mass spectrum. (Contractor's abstract)

891

Georgia Inst. of Tech. Engineering Experiment Station, Atlanta.

ON THE POSSIBLE OCCURRENCE OF H_3^+ IN INTERSTELLAR SPACE, by D. W. Martin, E. W. McDaniel and M. L. Meeks. June 13, 1961 [2]p. (AFOSR-J89) (AF 49(638)1064) AD 400067 Unclassified

Also published in Astrophys. Jour., v. 134: 1012-1013, Nov. 1961.

The possibilities for detection of the molecular ion H_2^+ by radioastronomical techniques have recently received considerable attention, and theoretical predictions of the spectrum have been made by Mizushima and Burke. Recent work on ion-molecule reactions indicates that the molecular ion H_3^+ may also be expected in interstellar space. In fact, with the presence of quantities of molecular hydrogen, H_2^+ will react to form H_3^+.

892

Giannini Controls Corp. Astromechanics Research Div. [Malvern, Pa.]

DECAY-DAMPING RELATIONSHIPS FOR HIGHLY COUPLED SYSTEMS WITH MANY DEGREES OF FREEDOM, by A. G. Fonda. Aug. 1961, 33p. incl. diagrs. (Technical note no. 02-001) (AFOSR-131?) (AF 49(638)1015) AD 265167 Unclassified

A mathematical study is made of the decay-damping relationships in aerodynamic theory. Basic concepts of aeroelasticity are developed with respect to air speed, flutter, and modal displacement under supersonic conditions. Limited application is made of the first-order piston theory.

893

Giannini Scientific Corp. [Santa Ana, Calif.]

NOTE ON THE AXISYMMETRY OF AN ELECTRODELESS DISCHARGE, by H. G. Loos and R. P. Treat. Aug. 1961 [5]p. incl. diagr. (AFOSR-1520) (AF 49(638)1014) AD 269854 Unclassified

The vacuum electric field in a configuration is strongly non-axisymmetric, but the polarization of the gas inside the coil completely compensates the non-axisymmetric component, leaving an axisymmetric field. (Contractor's abstract)

894

Giannini Scientific Corp. [Santa Ana, Calif.]

INITIAL BREAKDOWN OF GASES IN ELECTRODELESS DISCHARGES, by H. G. Loos. Final rept. Sept. 1961, 7p. (AFOSR-1521) (AF 49(638)1014) AD 271424 Unclassified

The configuration studied in the theoretical work consists of a long cylindrical gas column subjected to a strong, fast rising axial magnetic field which is initially zero; the gas is assumed weakly preionized. Experiments have been performed with a toroidal and a cylindrical configuration.

895

Giannini Scientific Corp. [Santa Ana, Calif.]

IONIZATION IN AN ELECTRODELESS DISCHARGE. PART II, by R. P. Treat. Sept. 1961 [35]p. incl. illus. diagrs. (AFOSR-1522) (AF 49(638)1014) AD 271423 Unclassified

The breakdown of a gas in an electrodeless discharge is studied. The configuration consists of a long cylindrical gas column subjected to a strong, fast rising axial magnetic field. The investigation showed that when losses are by free electron diffusion and electric fields due to charge separation are negligible, appreciable multiplication of electrons takes place in an interval of time 2tc (the cut-off time for ionization) when the magnetic field is nearly zero. The voltage around the discharge tube that produces a given multiplication of electrons in the time interval 2tc (the cut-off time for ionization) is determined. This voltage is compared with experimentally observed breakdown voltages in argon and hydrogen. (Contractor's abstract)

896

Giannini Scientific Corp. [Santa Ana, Calif.]

IONIZATION EXPERIMENT ON AN ELECTRODELESS DISCHARGE IN A CYLINDRICAL COIL, by H. G. Loos and R. P. Treat. Aug. 1961 [28]p. incl. illus. diagrs. (AFOSR-1523) (AF 49(638)1014) AD 270989 Unclassified

The breakdown of argon and air was studied for an electrodeless discharge in a straight cylindrical coil. No evidence of deviation from axisymmetry of the discharge due to the coil junction was found. A luminous sheet was formed in all discharges, including the ones with marginal voltages. Simultaneous smear pictures and oscillograms support the assumption that the luminous sheet is a current sheet. (Contractor's abstract)

897

Giannini Scientific Corp. [Santa Ana, Calif.]

IONIZATION EXPERIMENT OF AN ELECTRODELESS DISCHARGE WITH TOROIDAL GEOMETRY, by J. E. Chambers, H. G. Loos and others. Aug. 1961 [42]p. incl. illus. diagrs. (AFOSR-1825) (AF 49(638)1014) AD 269857 Unclassified

Measurements were made concerning the initial breakdown of a gas subjected to an electrodeless discharge in a toroidal geometry with the magnetic field in the longitudinal direction. The current through a ring conductor embracing the toroidal discharge tube established the rotational transform required for plasma equilibrium. Smear photographs of the discharge were made, looking through the discharge tube in a plane which passes through the torus axis. Simultaneous measurements of light intensity and of the magnetic field in the gas show that the initial breakdown occurs at a time when the magnetic field is zero. The data allow an interpretation in which the plasma has the form of a shell. Marginal breakdown conditions have been measured. (Contractor's abstract)

898

Göteborg U. [Dept. of Biology] (Sweden).

THE BIOCHEMICAL RELATIONSHIP BETWEEN NEURON AND ITS OLIGODENDROGLIA. MOLECULAR CHANGES IN THE RNA OF NERVE AND GLIA CELLS DURING LEARNING AND DURING EXPERIMENTALLY INCREASED RNA AND PROTEIN SYNTHESIS, by H. Hydén. Apr. 30, 1961, 11p. incl. tables, refs. (AFOSR-1104) (AF 61(052)248) AD 262035 Unclassified

Fresh, isolated nerve cells or oligodendroglia have been analyzed with respect to RNA nucleotides, protein, respiratory enzyme activities, anaerobic glycolysis and ATP-ase activity. The amount of RNA nucleotides and protein has been expressed as $\mu\mu$g/cell. Several new methods for the $\mu\mu$g-range are described. The biochemical composition and enzyme activities were found to differ considerably in the nerve cell compared with its glia. Quantitative as well as qualitative differences could be produced by stimulation even down to the molecular level. They were found to be inversely related in the 2 types of cells of the neuron-glia complex. Evidence is presented that the nerve cell and the glia constitute a metabolic symbiosis. From an energetic point of view they form a coupled system. Based on these findings, the results are presented from a study of changes during learning experiments in rats. (Contractor's abstract)

899

Göteborg U. Dept. of Biology (Sweden).

EXPERIMENTALLY INDUCED CHANGES IN THE BASE COMPOSITION OF THE RIBONUCLEIC ACIDS OF ISOLATED NERVE CELLS AND THEIR OLIGODENDROGLIA CELLS, by E. Egyházi and H. Hydén. [1960] [8]p. incl. illus. diagrs. tables, refs. (AFOSR-2119) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)248, National Multiple Sclerosis Society, and Swedish Medical Research Council) AD 612854 Unclassified

Also published in Jour. Biophys. and Biochem. Cytol. v. 10: 403-410, July 1961.

The effect of tricyano-amino-propene, a dimer of malononitrile, on the base composition of the RNA in isolated Deiters' nerve cells and their oligodendroglial cells has been studied using a microelectrophoretic method. Tri-a-p in a dose of 20 mg/kg has the effect of increasing the RNA and protein content per nerve cell by 25% and decreasing the glia RNA by 45%. The RNA base composition of the nerve cells from the control animals differs from that of their glial cells. The guanine of the nerve cell is significantly higher than that of the glia, but the content of cytosine is higher in the glia than in the RNA of nerve cell. The cytosine of nerve cells decreased significantly after tri-a-p administration. In the glial cells the cytosine showed a 20% increase, and the guanine a 25% decrease. Tri-a-p sharpened the difference in RNA composition already existing between the control nerve cells and their glial cells by almost 300% for the guanine and by 400% for the cytosine. The chemical and functional relationship between the nerve cell and its oligodendroglial cells is discussed. (Contractor's abstract)

900

Göteborg U. [Dept. of Biology] (Sweden).

ADENOSINE TRIPHOSPHATE LEVELS AND ADENOSINE TRIPHOSPHATASE IN NEURONS, GLIA AND NEURONAL MEMBRANES OF THE VESTIBULAR NUCLEUS, by J. Cummins and H. Hydén. [1961] [13]p. incl. illus. diagrs. tables, refs. (AFOSR-J468) (Sponsored jointly by Air

Force Office of Scientific Research under AF 61(052)-248, National Institute of Mental Health, and National Multiple Sclerosis Foundation) Unclassified

Also published in Biochim. et Biophys. Acta, v. 60: 271-283, July 1962.

Hydrolysis of radioactive ATP by isolated neurons and equal volumes of glia were studied. Glia without homogenization gave a rate of 1.7 μμ mol per sample/h indicating an "ecto"-ATPase; this value was 50% lower near the capillaries. The intact neuron gave no ATPase activity, however, on homogenization the activity was 1.0 μμ mol of ATP hydrolyzed per h. The pH dependence of the ATP hydrolysis by the neuron was broad with a maximum at pH 7.4, with glia it was sharper with a maximum about pH 8.0. The luciferin-luciferase system was used to measure ATP and the amount of ATP found was 123 μμg for the neuron and 5 μμg for glia. The cell wall of the neuron was isolated. This membrane preparation gave an "endo"-ATPase activity of 0.14 μμ mol of ATP hydrolyzed in either sucrose plus Mg^{2+} or Na^{+} plus Mg^{+2}. The rate was doubled when K^{+} was added to Na^{+} plus Mg^{2+} and completely inhibited by ouabain. These results emphasize the importance of this system in "active transport" and indicate that K^{+} and Na^{+} transport is coupled. (Contractor's abstract)

901

Göteborg U. Dept. of Pharmacology (Sweden).

A METHOD FOR THE DETERMINATION OF NORMETANEPHRINE IN BRAIN, by A. Carlsson and M. Lindqvist. [1961] [4]p. incl. diagr. (AFOSR-4329) (Sponsored jointly by Air Force Office of Scientific Research under [AF EOAR-61-44] and Swedish Medical Research Council) Unclassified

Also published in Acta Physiol. Scand., v. 54: 83-86, 1962.

Brain tissue is extracted with perchloric acid. The extract is neutralized and passed through a Dowex 50 column. Elution is performed by means of a carbonate-bicarbonate buffer, pH 10. Utilizing the principles of the trihydroxyindole method the normetanephrine of the eluate is converted into a strongly fluorescent compound. Fluorescence is measured in a spectrophotofluorometer. Results are satisfactory with respect to reproducibility, recovery, and specificity. (Contractor's abstract)

902

Göteborg U. Dept. of Pharmacology (Sweden).

A Mg^{++}-ATP DEPENDENT STORAGE MECHANISM IN THE AMINE GRANULES OF THE ADRENAL MEDULLA, by A. Carlsson, N.-A. Hillarp, and B. Waldeck. [1961] [7]p. incl. diagrs. refs. (AFOSR-4330) (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: 47-53, 1962.

The amine granules of the adrenal medulla take up and concentrate adrenalin and dopamine in vitro at low external concentrations of the added amines. The storage mechanism is activated by ATP and Mg^{++} and is blocked by some tranquillizers, especially reserpine, at low concentrations. It is also inhibited by 4 adrenergic blocking agents, dibenamine, phenoxybenzamine, dihydroergotamine and 3,4-dichloroisopropylnoradrenalin. (Contractor's abstract)

903

Göteborg U. Dept. of Pharmacology (Sweden).

FORMATION OF PHENOLIC ACIDS IN BRAIN AFTER ADMINISTRATION OF 3,4-DIHYDROXYPHENYLALANINE, by A. Carlsson and N.-A. Hillarp. [1961] [6]p. incl. tables, refs. (AFOSR-4331) (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. 55: 95-100, 1962.

When L-DOPA (100 mg/kg body wt) was given intravenously to rabbits large amounts of first 3,4-dihydroxyphenylacetic acid (DOPAC) and then homovanillic acid rapidly accumulated in the brain stem. The data suggest that the dopamine formed in the brain from the administered DOPA first reaches sites of monoamine oxidase. The DOPAC thus formed then reaches sites of catechol-O-methyl transferase. The data also suggest that the accumulated phenolic acids do not easily escape from the brain to the blood. (Contractor's abstract)

904

Göteborg U. Dept. of Pharmacology (Sweden).

HISTOCHEMICAL LOCALIZATION AT THE CELLULAR LEVEL OF HYPOTHALAMIC NORADRENALINE, by A. Carlsson, B. Falck and others. [1961] [2]p. (AFOSR-4332) (AF EOAR-61-44) Unclassified

Also published in Acta Physiol. Scand., v. 54: 385-386, 1962.

There is evidence that NA in the hypothalamus is accumulated in what appears to be synaptic nerve terminals. This amine may consequently serve as a synaptic transmitter in the brain. Another interesting finding is that there seems to be a local accumulation of NA (or possibly DA) in the median eminence where the hypophysial porta system arises.

905

Göteborg U. Dept. of Pharmacology (Sweden).

IN-VIVO DECARBOXYLATION OF α-METHYL DOPA AND α-METHYL METATYROSINE, by A. Carlsson and M. Lindqvist. [1961] [8]p. incl. illus. diagrs. refs. (AFOSR-4333) (Sponsored jointly by Air Force Office of Scientific Research under [AF EOAR-61-44] and the Swedish Medical Research Council) Unclassified

Also published in Acta Physiol. Scand., v. 54: 87-94, 1962.

α-Methyl DOPA (DOPA = 3, -dihydroxyphenylalanine) and α-methyl metatyrosine were injected to mice (400 mg/kg intraperitoneally). The former amino acid was also injected to rabbits (200 mg/kg intravenously). At varying intervals after the injection the brains were examined for monoamines (5-hydroxytryptamine, noradrenaline, dopamine, and α-methyl analogues). A transient decrease in 5-hydroxytryptamine and dopamine and a prolonged and more marked decrease in noradrenaline were observed. The α-methyl amino acids were found to undergo decarboxylation and subsequent β-hydroxylation in vivo. The drop in noradrenaline and dopamine levels in brain caused by the α-methyl amino acids appears to be largely due to displacement by these decarboxylation products, which may possibly also take over the functions of the physiological amines. (Contractor's abstract)

906

Göteborg U. Dept. of Pharmacology (Sweden).

FLUORESCENCE OF CATECHOL AMINES AND RELATED COMPOUNDS CONDENSED WITH FORMALDEHYDE, by B. Falck, N.-A. Hillarp and others. [1961] [7]p. incl. diagr. tables, refs. (AFOSR-4335) (Sponsored jointly by Air Force Office of Scientific Research under [AF EOAR-61-44], National Institutes of Health, and Swedish Medical Research Council) Unclassified

Also published in Jour. Histochem. and Cytochem., v. 10: 348-354, May 1962.

The reaction under mild conditions between formaldehyde and phenylalanine and phenylethylamine derivatives has been studied. When the amines included in a dried protein film were exposed to formaldehyde vapor a very intense green to yellow fluorescence was given only by those that as well as being primary amines also have hydroxyl groups at the 3 and 4 positons (3,4-dihydroxyphenylalanine, dopamine, noradrenaline). The 3-OH group seems to be essential for the reaction. The catechol amines, which are secondary amines (adrenaline, epinine), gave a much weaker fluorescence that developed more slowly. The results obtained on further examination of the reaction favor the view that the amines primarily condense with formaldehyde to 1,2,3, 4-tetrahydroisoquinolines which are involved in a secondary reaction to become highly fluorescent and at the same time insoluble. This secondary reaction may be a binding to protein, an oxidation with the formation of double bonds in the heterocyclic ring, or both. (Contractor's abstract)

907

Göttingen U. Inst. of Physiology (Germany).

[ON A RHYTHMIC BREATHING STIMULATION SUBSTRATE IN THE RHOMBENCEPHALON OF THE CAT] Über ein Substrat atmungsrhytmischer Erregungsbildung im Rautenhirn der Katze, by R. von Baumgarten, K. Balthasar and H. P. Koepchen. [1959] [25]p. incl. illus. diagrs. refs. (AF 61(514)1265) Unclassified

Published in Pflügers Arch. ges. Physiol., v. 270: 504-528, Mar. 1960.

In 38 histologically controlled microrecordings of inspiratory neurons of the cat the previously marked recording point was situated within a group uniquely of large nerve cells in the rhombencephalon, 1-3 mm rostral and 2-3 mm lateral to the obex. These cells form a 2 mm long band-like structure immediately ventrolateral to the tractus solitarius. Because of their well-defined position and specific function it seems to be justified to regard them as an "inspiratory nucleus". Homologous cell-formations are also to be found in dogs, rabbits, monkeys, and in man. It has been shown that afferent vagal fibers run to the inspiratory nerve cells. This was seen in experiments in which the vagus nerve was stimulated with electric shocks and its lung stretch receptors through lung inflation, as well as in investigations of degeneration following the severance of some vagal rootlets. Retrograde degenerations of inspiratory nerve cells following vagotomy could not be found. Therefore there is no evidence that these cells are vagal motoneurones. On the other hand, alterations of the inspiratory nerve cells of both sides were observed in cats and monkeys, following unilateral hemisection of the spinal cord at the level of C2. They seemed to be retrograde degenerations, thus it may be suggested that efferent axons coming from the inspiratory nerve cells descend, partially crossed, partially uncrossed, to spinal levels. Intracellular microrecordings of the inspiratory neurons showed, beside action potentials, also repolarization potentials, pacemaker potentials, miniature potentials and a slow "respiratory potential" lasting throughout the discharging period. The discharging threshold (firing level) rose markedly and continuously reaching a maximum at the end of the discharging period. As a new working hypothesis, it is suggested that the inherent rhythmicity of breathing rests, among other things, on 2 independent mechanisms: The end of each inspiratory period is caused by the excessive height of the discharging threshold, whereas the beginning of the period depends more on the cessation of inhibiting discharges which come from the reciprocally innervated expiratory neurons. (Contractor's abstract)

908

Göttingen U. Inst. of Physiology (Germany).

[CONTRIBUTIONS ON THE TECHNIQUE OF THE EXTRA- AND INTRACELLULAR, AS WELL AS THE STEREOTAXIC MICROELECTRODES IN THE BRAIN] Beitrag zur Technik der extra- und intracellulären, sowie der stereotaktischen Mikroableitung in Gehirn, by R. von Baumgarten, E. Kanzow and others. [1960] [ ] incl. illus. refs. (AF 61(514)1265) Unclassified

Published in Pflügers Arch. ges. Physiol., v. 271: 245-256, May 1960.

A method for preparation of glass insulated and sharpened platinum-wire-microelectrodes is outlined. Some experiences of the laboratory in preparing and using capillary microelectrodes are given. A method for avoiding brain pulsation during intracellular recording is reported. A headsupport with a microdrive especially adapted for microrecording and a new apparatus for stereotaxic microrecording are described. A new method for marking the site of recording with capillary or metallic electrodes is suggested. It is based on the photographic reduction of silver at small metallic deposits in the tissue. A critical consideration is given to the interpretation possibilities of microrecording in the brain.

909

Göttingen U. [Inst. of Physiology] (Germany).

INTRACELLULAR POTENTIALS FROM RESPIRATORY NEURONES IN BRAIN-STEM OF CAT AND MECHANISM OF RHYTHMIC RESPIRATION, by G. C. Salmoiraghi and R. von Baumgarten. [1960] [16]p. incl. illus. diagrs. refs. (AF 61(514)1265) Unclassified

Published in Jour. Neurophysiol., v. 24: 203-218, Mar. 1961.

The potential level at which action potentials were produced by 7 inspiratory and 1 expiratory neurones successfully penetrated was not the same throughout the burst of action potentials but shifted in the direction of depolarization as the burst progressed. Since temporal summation of synaptic potentials was the cause of each spike, the observed shift of the firing level implies that the excitability of respiratory neurones became less as the burst progressed. It is suggested that such a limiting factor plays a major role in periodically bringing the discharge of the neurone to an end. Rhythmicity would appear to result from the interplay of 3 factors: (1) self-reexciting and (2) self-limiting mechanisms within the inspiratory and the expiratory networks of neurones, and (3) reciprocal innervation of the 2 networks.

910

Göttingen U. Inst. of Physiology (Germany).

[ON THE TERMINAL REGION OF THE AFFERENT, CARDIOVASCULAR FIBERS OF THE VAGUS NERVE IN THE RHOMBENCEPHALON OF THE CAT] Über ein Endigungsgebiet afferenter, kardiovasculärer Fasern des Nervus vagus im Rautenhirn der Katze, by K. Hellner and R. von Baumgarten. [1961] [12]p. incl. illus. diagrs. refs. (AF 61(514)1265) Unclassified

Published in Pflügers Arch. ges. Physiol., v. 273: 223-234, June 1961.

A systematic exploration with microelectrodes of the cat rhombencephalon has been made to localize neurons discharging in sunchrony with various phases of the heart beat. One to 3 mm rostral to the obex and 1 mm lateral to the edge of the fourth ventricle a point was found where such action potentials were especially common. The depth and exact position of the microelectrode tip was indicated by making a small electrolytic lesion. The recording points were found to lie within the sensory nucleus of the vagus dorsal or dorsolateral to the tractus solitarius. Three types of burst discharges were noted within the region indicated: shortly after the R wave of the electrocardiogram, during the P wave and during the T wave. This corresponds to the 3 types of activity which have been found in vagal neurons. A variety of reasons have been advanced for believing that the action potentials are recorded postsynaptically. Evoked potentials were recorded selectively in the same region when the vagus was stimulated. These evoked potentials were not able to follow stimuli over 100/sec. Stimulation at the same point with the same microelectrode lowered the blood pressure and slowed the heart. It is concluded that the cardiovascular vagal afferents terminate in this region of the medulla and that neurons there are fired with approximately the same rhythms as the vagal afferent fibers. (Contractor's abstract)

911

Göttingen U. [Inst. of Physiology] (Germany).

EFFECT OF AUTONOMIC AFFERENT IMPULSES ON BRAINSTEM NEURONS, by R. von Baumgarten. Final technical rept. Sept. 30, 1961 [49]p. incl. illus. diagrs. table, refs. (AFOSR-2011) (AF 61(052)14) AD 272254 Unclassified

Methods were developed for production of sharpened platinum-wire electrodes with glass isolation; and for recording from moving tissue. A new stereotaxic machine is introduced which allows changing arbitrarily the point of drillhole on the skull and the direction of approach with the electrode for a given target. A technique for the large exposure of the rootlets of the ninth and tenth cranial nerves and a new method for histological

determination of the site of the tip of micropipettes in tissue are presented. The usefulness of different kinds of microelectrodes for different purposes is discussed. Analysis of recordings from single filaments of the vagal rootlets has shown that cardiac and respiratory afferent activity enters the brain at different levels. Chronic degeneration experiments with transsection of caudal (respiratory) rootlets of the vagus nerve showed terminal degeneration in a region rostrolateral to the obex and ventral to the tractus solitarius. Intracellular records of respiratory nerve cells in the medulla oblongata of cats were obtained. The rhombencephalon was explored for impulses correlated with heart beats.

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

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

Gustaf Werner Inst. of Nuclear Chemistry (Sweden)
see Uppsala U. Gustaf Werner Inst. of Nuclear Chemistry (Sweden).



Hamilton Coll., Ont. (Canada).
see McMaster U. Hamilton Coll., Ont. (Canada).

912

Harvard U. [Cruft Lab.] Cambridge, Mass.

A STUDY OF NATURAL CONVECTION ABOVE A LINE FIRE, by S.-L. Lee and H. W. Emmons. [1961] [16]p. incl. illus. diagrs. table. (AFOSR-1958) (AF 49-(638)29) Unclassified

Also published in Jour. Fluid Mech., v. 11: 353-368, Nov. 1961.

In the theoretical treatment, a turbulent plume above a steady 2-dimensional finite source of heated fluid in a uniform ambient fluid is investigated. By the use of the lateral entrainment assumption, a quadrature solution has been obtained for each of 2 separate ranges of a source Froude number, $F > 1$ or $F < 1$. In neither of these cases can the finite width line source be accurately represented by an equivalent mathematical line source at a lower level. Only the special case, $F = 1$, can be so represented and its solution is discussed. In the experimental treatment, hot gases, resulting from the burning of a liquid fuel in a long channel burner, are driven upwards by buoyancy and gradually cooled down by the entrainment of ambient air. The average temperature along lines parallel to the channel burner was measured by a piece of resistance wire. For the case of a non-luminous diffusion flame, the effective radiation loss to the surroundings was assumed to be negligible, and, by a comparison of the energy flux supplied from the fuel and the energy flux contained in the plume, the characteristic turbulence entrainment coefficient is determined. By the alternate use of either an absorbing or a reflecting surface for the table-top surrounding a luminous flame, a measurement was made of the energy radiated from the flame that was intercepted by the fire surroundings and subsequently returned to the buoyancy plume by heating the ingested air. These measurements agree with available estimates computed from such data. The experimental results relating to the behavior of the convection plume agree closely with the theoretical predictions in all cases.

913

Harvard U. [Cruft Lab.] Cambridge, Mass.

GEOMETRICAL CONSIDERATIONS IN THE BURNING OF LIQUID DROPS, by D. G. Udelson. [1961] [10]p. incl. illus. diagrs. (AFOSR-2994) (AF 49(638)29) AD 438559 Unclassified

Also published in Combustion and Flame, v. 6: 93-102, June 1962.

Previous experimental work has demonstrated the existence of 2 regimes of burning on liquid fuel spheres placed in a moving air stream: envelope flames and wake flames. In this study, a third regime of burning is distinguished wherein a flame is stabilized in the boundary layer at the side of a liquid sphere. The angular position which the side flame assumes when measured from the forward stagnation point of the sphere is shown to increase with free stream air velocity. It is also demonstrated that the angular position depends on the sphere size as well as on the orientation of the air flow with respect to the gravity force thus proving natural convection to be an important factor. Boundary layer theory is employed and provides a quantitative basis for the above phenomena. (Contractor's abstract)

914

Harvard U. Cruft Lab., Cambridge, Mass.

A STUDY OF THE OPTIMAL CONTROL OF DYNAMIC SYSTEMS, by Y.-C. Ho. Feb. 10, 1961 [103]p. incl. diagrs. refs. (Technical rept. no. 335) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186616) AD 261851 Unclassified

The problem of controlling the behavior of a general dynamic system subject to various physical constraints is studied. The class of dynamic systems considered is assumed to obey the linear vector differential equation $\dot{x} = Fx + Du$, $x(0) = c$, where x is an n-vector called the state vector, F is a nxn matrix of constant elements, D is a nxr matrix of constant elements, and u is an r-vector called the control vector. The constraints stipulated are, (1) $u(t) = u(iT)$ for $iT \leq t < (i + 1)T$ and (2) $|u(t)| \leq 1$ for $t \geq 0$, i.e., the control vector is constrained to be piecewise constant and amplitude limited. The determination of u(t) subject to (2) or (3) or both such that the state vector x(t) attains the value zero in minimum time or the integral of some measure of the vector is a minimum over a period of time, is of interest. A well-known example of this class of problems is the so-called bang-bang control problem. (Contractor's abstract)

915

Harvard U. Cruft Lab., Cambridge, Mass.

THE ANALYSIS OF A SECOND-ORDER LINEAR DIFFERENTIAL EQUATION WITH EXPONENTIALLY VARYING GAIN, by T. S. Baker and K. S. Narendra. Mar. 15, 1961 [28]p. incl. diagrs. (Technical rept. no. 334) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186616) AD 258891 Unclassified

The behavior of a second-order differential equation with exponentially varying gain is analyzed. When a system has a certain type of time varying gain it may be possible to approximate it by a function of the form $(B^2 e^{-2\alpha t} + 1)$. In other situations it may be practical to introduce just such a variation to obtain desirable transient characteristics. The step response of the equation

$$\frac{d^2\theta(t)}{dt^2} + 2\zeta\frac{d\theta(t)}{dt} + (B^2e^{-2\alpha t} + 1)\theta(t) = (B^2e^{-2\alpha t} + 1)f(t)$$

is obtained analytically by means of an analog computer in terms of the system parameters. Solutions for time varying gain and with constant maximum overshoot are discussed. It is concluded that the major difficulty in discussing this system is that there are too many parameters to keep track of. Hence, for $\zeta = 1$, $\zeta = 2$, the overshoot shall not exceed 50% if the special case of $a = 2$ is considered. For the fastest initial time response, B should be adjusted to give the response with the maximum overshoot, $\theta_m = 1.5$.

916

Harvard U. Cruft Lab., Cambridge, Mass.

FINAL VALUE CONTROL PROBLEMS AND THE METHOD OF CONSTRAINED DESCENT, by Y.-C. Ho. Apr. 10, 1961, 5p. (Technical rept. no. 340) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186616) AD 258557 Unclassified

The solution of the vector matrix equation, $Ax = b$ subject to the constraint $L^- \leq x \leq L^+$ where $L^+ \geq 0$, $L^- \leq 0$, and $L^+ - L^- > 0$ is discussed, where A is an r x n matrix, b is an r vector, L^+, L^-, and x are n vectors. Such problems often arise in the consideration of final value control systems. In such case, b is visualized as the vector representing the desired final state of the system: x, the control to be applied at successive control intervals 1, ..., n; A, the matrix of influence coefficients which represent the effect of the components of x on the final state of the system; L^+ and L^-, the limits for the control vector x, reflecting practical constraints for allowable variations of x. Examples as to how such problems arise in detail have been described by others. Solutions to the above mentioned problem may be nonexistent or infinite in number. The purpose here is to illustrate a systematic way of solving such a problem which does not require advanced knowledge concerning the existence of solutions. (Contractor's abstract)

917

Harvard U. Cruft Lab., Cambridge, Mass.

APPLICATION OF MATRIX METHODS TO THE OPTIMUM SYNTHESIS OF MULTIVARIABLE SYSTEMS SUBJECT TO CONSTRAINTS, by K. S. Narendra and R. M. Goldwyn. June 15, 1961 [23]p. incl. diagrs. (Technical rept. no. 342) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186616) AD 263428 Unclassified

Matrix methods are used to extend well-known concepts in single variable systems to the case of systems with several inputs and outputs. The analysis of such multivariable systems, when subjected to random inputs, is considered in the time and frequency domains. Constraints are set up in terms of bandwidth and saturation—as logical extensions of the single variable case—for multivariable systems, and the physical significance of such constraints is discussed. Using the matrix relations obtained, a vector integral equation of the Wiener-Hopf type is derived by minimizing a generalized mean square error. The effect of constraints on the minimization procedure is studied using variational methods. (Contractor's abstract)

918

Harvard U. Cruft Lab., Cambridge, Mass.

MATCHED FILTERS AND INTERSYMBOL INTERFERENCE, by D. W. Tufts. July 20, 1961 [19]p. (Technical rept. no. 345) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186616) AD 263882 Unclassified

This analysis was conducted to shape a new tool for the design of synchronous, pulse-transmission links. This is accomplished by combining the viewpoints which led to the formulation of 2 tools of proven worth in communication theory-the matched filter and Nyquist's methods for pulse shaping and transmission line equalization. (Contractor's abstract)

919

Harvard U. Cruft Lab., Cambridge, Mass.

ON COMPUTING MINIMA BY THE PENALTY FUNCTION APPROACH, by Y.-C. Ho. Nov. 10, 1961 [21]p. incl. diagrs. (Technical rept. no. 347) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186616) AD 269057 Unclassified

There has been considerable interest in the computational solution of problems of optimal control or programming. This problem may be stated as follows: Minimize $x_0(t_1)$ subject to either (1) $x_i(t_1) = c_i$, $i = 1,2,...,n$ or (2) $x_j(\tau_k) \leq 0$, $j = 1,...,n$, $k = 1,2,...,K$ or both equation 1 and equation 2. The effectiveness of the penalty function approach as a computational tool for solving minimization problems is discussed. The effectiveness of this method as compared to that of gradient projection when applied to problems with equality constraints as side conditions, is yet to be determined. The penalty function method is not applicable in practice to problems with inequality side conditions because a systematic procedure to assure its convergence to approximately the true minimum is lacking at present. All proposed solutions to this

problem seem to, of necessity, involve the eventual determination of the vector g which represents the correct multipliers to the problem.

920

Harvard U. [Cruft Lab.] Cambridge, Mass.

CROSS-RELAXATION IN MASERS, by N. Bloembergen and P. S. Pershan. [1961] [14]p. incl. diagrs. refs. [Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186616] Unclassified

Presented at Second Internat'l. Conf. on Quantum Electronics, Berkeley, Calif., Mar. 23-25, 1961.

Published in Advances in Quantum Electronics, New York, Columbia U. Press, 1961, p. 373-387.

Recent papers on the basic physical processes are reviewed. The implications for the operation of solid-state masers are then discussed. Various cross-relaxation processes involving higher excited states such as exchange pockets of Cr^{+3} ion pairs in ruby or optical levels are also discussed.

921

Harvard U. [Cruft Lab.] Cambridge, Mass.

LINEAR EFFECT OF APPLIED ELECTRIC FIELD ON NUCLEAR QUADRUPOLE RESONANCE, by J. Armstrong, N. Bloembergen, and D. Gill. [1961] [4]p. incl. diagr. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [Nonr-186616]) Unclassified

Published in Phys. Rev. Ltrs., v. 7: 11-14, July 1, 1961.

The second moments of the Cl^{35} resonances in polycrystalline $NaClO_3$ were found to increase linearly with the strength of an applied static electric field, up to the max field used (17 kv/cm). The interpretation is the same as given by T. Kushida and K. Saiki (Phys. Rev. Ltrs., v. 7: 9-10, July 1, 1961) and is based on a linear variation of the electric field gradient at the position of the nuclei with the externally applied electric field, if these positions lack inversion symmetry. Suggestions are made for the related experiments, including the induction of nuclear spin transitions by a radiofrequency electric field.

922

Harvard U. [Cruft Lab.] Cambridge, Mass.

LINEAR EFFECT OF APPLIED ELECTRIC FIELD ON MAGNETIC HYPERFINE INTERACTION, by N. Bloembergen. [1961] [3]p. incl. table. [Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186616] Unclassified

Published in Phys. Rev. Ltrs., v. 7: 90-92, Aug. 1, 1961.

A general theoretical discussion is given and specific calculations are made for MnF_2 which show that an effect should be observable for a field of 10^4 v/cm. Experiments are being carried out.

923

Harvard U. [Cruft Lab.] Cambridge, Mass.

PRESSURE DEPENDENCE OF THE MICROWAVE RESONANCE PROPERTIES OF SOME SPINEL AND GARNET FERRITES, by I. P. Kaminow and R. V. Jones. [1961] [8]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. 123: 1122-1129, Aug. 15, 1961.

The anisotropy fields, g values, and linewidths of yttrium, erbium, and ytterbium iron garnets (YIG, ErIG, and YbIG); $MgFe_2O_4$ with variable distribution of Mg^{+2} ions; and $Ni_{1-z}Co_zFe_2O_4$ with variable z = 0, 0.05, and 0.10, were measured at X-band and room temperature as functions of hydrostatic pressure to 10^4 kg/cm^2. The pressure dependence of magnetization was measured using magnetostatic mode methods in the narrow linewidth materials, YIG and $MgFe_2O_4$. The complexity of the crystal structure and magnetic interactions makes any quantitative interpretation very difficult. However, the observations can be understood qualitatively in terms of the volume dependence of the crystalline fields and the exchange interactions. In the case ErIG, the volume dependence of the ferric-rare-earth exchange constant is calculated; and, in the case of nickel cobalt ferrite, a simple explanation is given for the observed volume dependence of the Co^{+2} anisotropy. The contribution of thermal lattice vibrations to the linewidth in YIG is discussed, and the possibility of the anisotropic spin-orbit interaction is considered.

924

Harvard U. [Cruft Lab.] Cambridge, Mass.

ELECTRICALLY INDUCED SHIFT OF THE F^{19} RESONANCE FREQUENCY IN MnF_2, by P. S. Pershan and N. Bloembergen. [1961] [3]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [Nonr-186616]) Unclassified

Published in Phys. Rev. Ltrs., v. 7: 165-167, Sept. 1, 1961.

The shift theoretically predicted (Phys. Rev. Ltrs., v. 7: 90-92, Aug. 1, 1961) was observed, amounting to $\Delta\nu_E$ = 5 kc/sec for each of the four F^{19} nuclei in the unit cell, if E = 10^4 v/cm is applied in the [100] direction. This is an order of magnitude smaller than the theoretical estimate and various reasons for the discrepancy are given. A possible application to the investigation of antiferromagnetic domain walls is discussed.

925

Harvard U. [Cruft Lab.] Cambridge, Mass.

THEORY OF THE VARIATION OF THE NUCLEAR QUADRUPOLE INTERACTION IN COVALENT BONDS WITH APPLIED ELECTRIC FIELD, by N. Bloembergen. [1961] [2]p. [Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186616] Unclassified

Published in Jour. Chem. Phys., v. 35: 1131-1132, Sept. 1961.

A theory of the shift in the pure quadrupole resonance frequency with applied electric field for covalent bonds is presented. A linear effect is predicted for nuclei not at a center of symmetry. The specific case of the Cl resonance in p-dichlorobenzene is discussed in detail. The electric field frequency shift is caused by changes in sp hybridization, ionic character and length of the bond, which are calculated by the Ritz procedure. The predicted shift is 870 c/sec for an external field along C-Cl of 10^4 v/cm.

926

Harvard U. [Cruft Lab.] Cambridge, Mass.

LINEAR EFFECT OF ELECTRIC FIELD ON THE Cl^{35} QUADRUPOLE INTERACTION IN PARADICHLOROBENZENE, by J. Armstrong, N. Bloembergen, and D. Gill. [1961] [2]p. incl. diagr. table. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [Nonr-186616]) Unclassified

Published in Jour. Chem. Phys., v. 35: 1132-1133, Sept. 1961.

Observations of the broadening of the Cl^{35} pure quadrupole resonance in polycrystalline p-dichlorobenzene in fields up to 23.8 kv/cm at 77°K. A linear relation between second moment and field squared is observed corresponding to 500 ± 60 c/sec (see item no. 925, Vol. V). This is 3 times as large as in (ionic) NaCl. This stark effect may give additional information about chemical bonds.

927

Harvard U. [Cruft Lab.] Cambridge, Mass.

ABSENCE OF ANTIFERROMAGNETIC DOMAIN WALLS IN MnF_2, by P. S. Pershan. [1961] [2]p. incl. diagrs. [Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186616] Unclassified

Published in Phys. Rev. Ltrs., v. 7: 280-281, Oct. 1, 1961.

The electrically induced shift of the nuclear F^{19} nuclear resonance frequency of an MnF_2 crystal was measured to show that no antiferromagnetic walls exist.

928

Harvard U. [Cruft Lab.] Cambridge, Mass.

REACTANCES ASSOCIATED WITH A CLASS OF NEGATIVE RESISTANCES, by J. S. T. Huang and A. A. Pandiscio. [1961] [7]p. incl. diagrs. table. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186616) Unclassified

Published in Jour. Electronics and Control, v. 12: 265-271, Apr. 1962.

For those classes of negative resistance devices which can be cast into appropriate feedback models, knowledge of the loop gain is sufficient to determine the negative resistance and its associated reactance utilizing Bode's active immittance relations (1945). Even when the external stray elements are taken into account, it is shown that a shunt capacitance is always associated with a voltage controlled and a series inductance with a current controlled negative resistance. (Contractor's abstract)

929

Harvard U. Cruft Lab., Cambridge, Mass.

RADIO WAVE PROPAGATION, by H. R. Mimno. Sept. 20, 1960 [18]p. incl. refs. (Technical rept. no.

326) (Sponsored jointly by Air Force [Office of Scientific Research], Office of Naval Research, and Signal Corps under Nonr-186617) AD 28369'. Unclassified

The history of this project is summarized. A list of 27 technical reports written in connection with this contract is given. A total of 50 progress reports were produced from Oct. 1, 1945 to Jan. 1, 1959.

930

Harvard U. Cruft Lab., Cambridge, Mass.

THE TRANSIENT RESPONSE OF LINEAR ANTENNAS AND LOOPS, by R. W. P. King and H. J. Schmitt. Mar. 30, 1961 [14]p. incl. diagrs. (Technical rept. no. 338) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186632) AD 259650 Unclassified

The transient response of straight wires and circular loops when short pulses are applied is studied experimentally and theoretically. It is shown that the initial response is always that of an infinitely long antenna at a frequency near the upper limit of the frequencies contained in the pulse provided this is sufficiently short so that the first reflection from the end of the wire or loop is not superimposed on it. (Contractor's abstract)

931

Harvard U. Cruft Lab., Cambridge, Mass.

ON THE BORN-LERTES ROTATION EFFECTS, by W. F. Pickard. Apr. 10, 1961 [24]p. incl. diagrs. refs. (Technical rept. no. 339) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186632) AD 258556 Unclassified

A unified theoretical treatment of the Born-Lertes rotational effect is presented for the special case of a system of 2 concentric cylinders. It is shown that both the Born and the Lertes effects arise naturally from the concepts of dielectric loss and effective conductivity. A typical theoretical curve is given for the variation of the torque with frequency. (Contractor's abstract)

932

Harvard U. Cruft Lab., Cambridge, Mass.

THE ELECTRICAL PUMPING OF DIELECTRIC LIQUIDS, by W. Pickard. Dec. 1, 1961, 1v. incl. diagrs. refs. (Technical rept. no. 350) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186632) AD 274913 Unclassified

The problem of the pumping of dielectric fluids by the action of electric fields is considered both theoretically and experimentally. The existing theory of co-field effects is revised and extended; a qualitative theory is developed for cross-field effects. A number of original experiments are described for both the co- and cross-field cases; for example, the pressures generated in a cross-field pump are studied as a function of fluid temperature and rate of fluid flow. It is concluded that co-field pumping is due to the emission of ions from the electrodes and that cross-field pumping is a result of Sumoto type phenomena at fluid interfaces and of co-field effects in the fringing fields of the pump. (Contractor's abstract)

933

Harvard U. Dept. of Chemistry, Cambridge, Mass.

THE MOLECULAR AND CRYSTAL STRUCTURE OF HYDROGEN CYANIDE TETRAMER (DIAMINOMALEONITRILE), by B. R. Penfold and W. N. Lipscomb. [1961] [8]p. incl. diagrs. tables, refs. (AFOSR-1125) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)809] and National Institutes of Health) AD 259965 Unclassified

Also published in Acta Cryst., v. 14: 589-597, June 1961.

A 3-dimensional crystal structure analysis of hydrogen cyanide tetramer has led to a location of all atoms with average standard deviations of 0.0025A for C and N atoms and 0.04A for hydrogens. The diaminomaleonitrile structure is proved. In its crystal setting the molecule has no symmetry. The 2 amino groups have different configurations, 1 being planar and 1 tetrahedral with both being involved in intermolecular N-H. . .N hydrogen bonds. An analysis is made of the anisotropic nature of the atomic thermal vibrations. Molecular orbital calculations have been made for this molecule and for tetracyanoethylene leading to π bond orders for all bonds. Order/length relationships for the C-C bonds are discussed. (Contractor's abstract)

934

[Harvard U. Dept. of Chemistry, Cambridge, Mass.]

THE CRYSTAL AND MOLECULAR STRUCTURE OF CELLOBIOSE, by R. A. Jacobson, J. A. Wunderlich, and W. N. Lipscomb. [1961] [10]p. incl. diagrs. tables, refs. (AFOSR-1126) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)809] and National Institutes of Health) AD 259966 Unclassified

Also published in Acta Cryst., v. 14: 598-607, June 1961.

The structure of β-cellobiose has been determined by 3-dimensional Patterson superposition techniques, in which an improved sharpening procedure based on the gradient of the electron density function was used to increase resolution. The 1:4 linking of the 2 'chair'

β-glucopyranose residues is confirmed. The molecule has an internal hydrogen bond, O'_3-H:···O_5 of length 2.80A, and C-O-C angles within the rings of 117° and 115°, significantly greater than the tetrahedral angle. It is of interest in connection with the proposed structures of forms of cellulose that the molecule has the bent conformation with the glucose residues somewhat twisted relative to one another, and that the isolated molecule would not have a 2-fold axis. All OH hydrogens seem to be involved in the hydrogen bonding scheme in the crystal. (Contractor's abstract)

935

[Harvard U. Dept. of Mathematics, Cambridge, Mass.]

RAMIFIED COVERINGS OF RIEMANN SURFACES, by D. H. Husemoller. [1961] [8]p. [AF 18(600)1461] Unclassified

Published in Duke Math. Jour., v. 29: 167-174, Mar. 1962.

A. Hurwitz (Math. Ann., v. 39: 1-61, 1891) introduced the general idea of describing a ramified covering by its associated unramified covering and investigated the case of coverings of simply connected surfaces. This paper develops a precise setting for the general classification of ramified coverings. This is then applied to the determination of all finite coverings of compact surfaces and bordered surfaces of genus strictly greater than zero. The Hurwitz relation for the genera of a covering of a compact surface is generalized to bordered surfaces.

936

Harvard U. [Dept. of Mathematics, Cambridge, Mass.]

ON BLOCKS OF REPRESENTATIONS OF FINITE GROUPS, by R. Brauer. [1961] [3]p. (AFOSR-64-0071) (AF 49(638)287) AD 431078 Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 47: 1888-1890, Dec. 1961.

Further results, needed for the application of the theory to an investigation of the structure of groups of even order, are given. Suppose G is a finite group and p a fixed prime. The irreducible characters of G are distributed into disjoint sets, the p-blocks of G. Let G^0 be the set of p-regular elements of G and χ_μ^0 the restriction of the character χ_μ to G^0. If B is a fixed block, the functions χ_μ^0 with $\chi_\mu \in B$ generate a Z-module, a basis for which is called a basic set for B. It is shown that for a given p-block of defect d, a basic set can be chosen so that the Cartan invariants are bounded above by a number depending only on p^d. Among other results, it is shown that given p^d, there are only a finite number of types of p-blocks of defect d.

937

Harvard U. [Dept. of Mathematics, Cambridge, Mass.]

INVESTIGATION ON GROUPS OF EVEN ORDER. I, by R. Brauer. [1961] [3]p. (AFOSR-64-0072) (AF 49(638)-287) AD 431167 Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 47: 1891-1893, Dec. 1961.

This paper builds on the results of a previous paper (item no. 936, Vol. V) to study groups of even order. One of the principal group-theoretical conclusions is as follows: Let H be an abelian 2-group of order $2^n \geq 8$ which has no direct factor which is elementary abelian of type (2,2,2). Then there exist only finitely many simple groups G with H as their 2-Sylow subgroup.

938

Harvard U. [Dept. of Mathematics, Cambridge, Mass.]

ON DIFFERENTIALS IN FUNCTION FIELDS, by O. Zariski and P. Falb. [1961] [15]p. (AFOSR-1788) (AF 49(638)494) AD 428467 Unclassified

Also published in Amer. Jour. Math., v. 83: 542-556, July 1961.

It is concerned mainly with finding a suitable definition of the v-value v(dx) of a differential dx on a curve C, for a valuation v. The difficulty arises when the ground field k is imperfect (although the field K = k(C) is assumed to be separably generated), and is usually overcome by means of the repartitions, and by an artificial definition of the differentials. The definition proposed is as follows: (1) write $k = k_1(u_1, \ldots, u_\rho)$, where $\{u_1, \ldots, u_\rho\}$ is a subset of a p-basis of k over k^p such that the defining ideal of C has a basis consisting of polynomials in $k^p[u, X]$ (the X's are the coordinates of the affine space); k_1 must contain k^p, and the u's must form a p-basis of k over k_1; (2) call "differential" an element of the dual of the K-module of the derivations in K with k_1 as constant field; (3) at a place v of K over k, consider "uniformizing parameters" $\xi_1, \ldots \xi_{\rho+1}$ such that there are derivations D_i with the property $D_i R_v \subseteq R_v$, $D_i \xi_j = \delta_{ij}$; (4) set $v(dx) = v(A)$ if $dx \wedge du_1 \wedge \ldots \wedge du_\rho = A\, d\xi_1 \wedge \ldots d\xi_{\rho+1}$. With this definition, which is independent of k_1 and of the ξ's and u's, it is shown that the

v-value of dx is related in the customary manner to the different; it is therefore a "good" definition for use in the Riemann-Roch theorem.

939

[Harvard U. Dept. of Mathematics, Cambridge, Mass.]

[THE SOLUTION OF A SINGULARITY OF AN EMBEDDED ALGEBRAIC SET. NOTE I.] La risoluzione delle singolarità delle superficie algebriche immerse. Nota I, by O. Zariski. [1961] [6]p. (AFOSR-3315) (AF 49(638)494) Unclassified

Also published in Atti Accad. Naz. Lincei, Rend. Classe Sci. Fis. Mat. e Nat., v. 31: 97-102, Sept.-Oct. 1961.

See the following abstract (item no. 940, Vol. V).

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[Harvard U. Dept. of Mathematics, Cambridge, Mass.]

[THE SOLUTION OF A SINGULARITY OF AN EMBEDDED ALGEBRAIC SET. NOTE II.] La risoluzione delle singolarità delle superficie algebriche immerse. Nota II, by O. Zariski. [1961] [4]p. (AFOSR-3315A) (AF 49(638)494) Unclassified

Also published in Atti Accad. Naz. Lincei, Rend. Classe Sci. Fis. Mat. e Nat., v. 31: 177-180, Nov. 1961.

A simple demonstration is given of the following theorem: If F is an algebraic surface substituted in a nonsingular variable V of dimension 3, F can be transformed into a nonsingular surface which is the average of a set of transformations of an ambient variable. It defines the average of the discriminant, the locus of the critical curve of a singular point P of F, and says that P is "isolable" if it is the singular point of this curve. The singular "isolable" points that do not satisfy any singular curve of F, and certain points (in name only) of singular curves of F, of a point boundary, wherein the critical curve has a double point of distinct tangents, follow at points where this curve has a simple point (i.e., simple points or singular, non-isolable ones). The previous note (see item no. 939, Vol. V) shows how to resolve the singular curves of F.

941

Harvard U. Dept. of Mathematics, Cambridge, Mass.

CURVATURE PROPERTIES OF TEICHMÜLLER'S SPACE, by L. V. Ahlfors. [1961] [16]p. (AFOSR-8) [AF 49(638)574] AD 256013 Unclassified

Also published in Jour. Anal. Math. (Jerusalem), v. 9: 161-176, 1961.

Using integral representations of the Beltrami differentials and quadratic differentials associated with compact surfaces of a given genus $g > 1$, a number of formulae bearing on the structure of the Teichmüller space T_g is obtained. A Riemannian metric on T_g is examined and explicit expressions are obtained for the derivatives of the coefficients g_{ij}. This leads first to a direct proof that the metric is Kahlerian, and then to a demonstration that the Ricci curvatures and the curvatures of holomorphic sections are negative. It follows that the scalar curvature at each point, being the sum of Ricci curvatures, is also negative. (Math. Rev. abstract)

942

Harvard U. [Dept. of Mathematics, Cambridge, Mass.]

A NEW GENERALIZATION OF JENSEN'S THEOREM ON THE ZEROS OF THE DERIVATIVE OF A POLYNOMIAL, by J. L. Walsh. [1961] [6]p. (AFOSR-62) (AF 49(638)574 and AF 49(638)845) AD 256038 Unclassified

Also published in Amer. Math. Monthly, v. 68: 978-983, Dec. 1961.

Generalizations (A) and (B) are established and discussed for the following theorem, which is itself a generalization of Jensen's theorem: Let p(z) be a real polynomial not identically constant all of whose zeros have real parts in the interval $\alpha \leq x \leq \beta$ of the axis of reals, and let γ be a real point not interior to that interval and not having an abscissa equal to that of a nonreal zero of p(z). Let $\Gamma(z_k)$ denote the circle through the conjugate pair $(z_k, \bar{z}_k)$ of nonreal zeros tangent to the line γz_k at z_k. Then all nonreal zeros of the derivative $p'(z)$ lie in the closed interiors of the circles $\Gamma(z_k)$. Generalizations are: (A) Let r(z) be a real rational function but identically constant all of whose finite zeros lie in the half-plane $x > 0$ and all of whose finite poles lie in the half-plane $x > 0$, except that $z = 0$ may be a zero or a pole. Let a circle $\Gamma(z_k)$ be drawn with center on the axis of reals passing through each conjugate pair $(z_k, \bar{z}_k)$ of zeros and of poles, where $\Gamma(z_k)$ is tangent at z_k to the line $0z_k$. Then all nonreal zeros of $r'(z)$ lie in the closed interiors of the $\Gamma(z_k)$. (B) Let p(z) be a real polynomial all of whose zeros lie in the closed interior of the circle whose diam is the segment $\alpha\beta$ of the axis of reals, and let all the nonreal zeros lie interior to that circle. For each pair $(z_k, \bar{z}_k)$ of conjugate imaginary zeros of p(z) let Γ_k be the circle tangent at z_k and $\bar{z}_k$ to the respective circles $\alpha z_k \beta$ and $\alpha \bar{z}_k \beta$. Then all nonreal zeros of $p'(z)$ lie in the closed interiors of the Γ_k. A nonreal point z_0 on a circumference Γ_k but not a multiple zero of p(z) and not on or within a second circle

Γ_j cannot be a zero of p'(z) unless p(z) has precisely three distinct zeros, one at α or β.

943

Harvard U. Dept. of Mathematics, Cambridge, Mass.

DEGREE OF POLYNOMIAL APPROXIMATION TO AN ANALYTIC FUNCTION AS MEASURED BY A SURFACE INTEGRAL, by J. L. Walsh. [1961] [7]p. (AFOSR-63) (AF 49(638)574 and (AF 49(638)845) AD 256015 Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 48: 26-32, Jan. 1962.

Let C be an analytic Jordan curve with interior D. Walsh and Russel (see item no. HAR.05:010, Vol. II or Trans. Amer. Math. Soc., v. 92: 355-370, 1959) have found the connection between the best polynomial approximation on C in the sense of $\int_C |f(z) - p_n(z)|^p dz$, $p > 1$, and integrated Lipschitz conditions satisfied by the derivatives of f on C. The present note is concerned with approximation in the sense of (1) $\iint_D |f(z) - p_n(z)|^p dz$, $p > 1$. By definition, the class $L_p(k, \alpha)$, $p > 1$, $k = 0, 1, 2, \ldots$, $0 < \alpha < 1$, consists of those functions in H^p such that $\int_{-\pi}^{\pi} |f^{(k)}(e^{i\theta}) - f^{(k)}(e^{i(\theta+\delta)})|^p d\theta \leq A|\delta|^{p\alpha}$. This function class can be transplanted to D by conformal transformation. The main result is a constructive characterization of the (transplanted) class $L_p(k, \alpha)$: A function f(z) holomorphic in D belongs to $L_p(k, \alpha)$ if and only if there exist polynomials $p_n(z)$ of degree n such that (1) does not exceed $M/n^{k+\alpha+1/p}$, M being independent on n, z. The proof follows from the corresponding result of Walsh and Russell through the inequality $\iint_{|z|<1} |P(z)|^p d\sigma \leq \frac{1}{np+2} \int_{-\pi}^{\pi} |P(e^{i\theta})|^p d\theta$, valid for polynomials P(z), which connects the norms. There are equally satisfactory results for the case when $\alpha = 1$, as well as when $k = -1$, involving instead of $L_p(k, \alpha)$ a function class defined through an integrated modulus of smoothness. Finally, 2 theorems concerning approximation by bounded analytic functions are stated.

944

Harvard U. [Dept. of Mathematics] Cambridge, Mass.

GRUNSKY INEQUALITIES AND COEFFICIENTS OF BOUNDED SCHLICHT FUNCTIONS, by V. Singh. Apr. 1961 [32]p. incl. refs. (AFOSR-550) (AF 49(638)574) AD 256016 Unclassified

Also published in Ann. Acad. Scient. Fennicae, Series A. I., No. 310, 1962, 22p.

Let D be a plane finitely connected domain whose boundaries are closed Jordan curves C_ν and let f(z) be a regular analytic function in D whose coefficients in power series expansion about a point $\zeta \in D$ are b_ν. Grunsky had given a set of necessary and sufficient conditions, depending upon b_ν, so that f(z) may be extended as a schlicht function in D. In the present report, Grunsky's conditions have been extended to the case when f(z) has the additional restriction of being bounded. i.e., $|f(z)| < 1$, $z \in D$. These conditions have then been used to get distortion theorems and coefficient inequalities for bounded schlicht functions in $|z| < 1$ and in $|z| > 1$. (Contractor's abstract)

945

Harvard U. [Dept. of Mathematics] Cambridge, Mass.

APPROXIMATION BY BOUNDED ANALYTIC FUNCTIONS TO FUNCTIONS REPRESENTED BY DIRICHLET SERIES, by J. P. Evans and J. L. Walsh. [1960] [9]p. (AFOSR-552) (AF 49(638)574 and AF 49(638)845) AD 256017 Unclassified

Also published in Proc. Amer. Math. Soc., v. 12: 875-879, Dec. 1961.

Results on approximation to a function f(z) which is analytic on a closed point set $\bar{R}_0$ by functions analytic and bounded in a region R_1 which contains $\bar{R}_0$ and whose boundary C_1 has points in common with $\bar{R}_0$ have been established by the authors [Walsh and Evans, Arch. Math., v. 5: 191-196, 1954]. Here the study of the problem is continued under the assumption that there be exactly one common point A of the boundaries C_0 and C_1, which are required to be Jordan curves, and that f(z) no longer need be analytic at A. A new method is employed, the use of Dirichlet series. Let $w = \theta(z)$, $z = x(w)$ map conformally R_1 onto Re $w > u_1$ and C_0 onto Re $w = u_0$, $u_1 < 0 > u_0$; f(z) is supposed to belong to the class D, that means $f(x(w)) = g(w)$ is representable by the Dirichlet series $\sum_{\nu=1}^{\infty} a_\nu e^{-\lambda_\nu w}$, $0 \leq \lambda_1 < \lambda_2 < \ldots$, $\lambda_\nu \to \infty$, which converges [converges uniformly] to g(w) throughout every half-plane of analyticity of g [contained in the half-plane of convergence]. If $\varphi(z)$ is harmonic and bounded in $R_1 - \bar{R}_0$, continuous in $\bar{R}_1 - R_0 - A$, $= 0$ on $C_0 - A$, $= 1$ on $C_1 - A$, and if C_σ is the locus $\varphi(z) = \sigma$ $(0 < \sigma < 1)$, R_σ the interior of $C_\sigma + A$, and if f(z) is of D analytic throughout some R_ρ but no $R_{\rho'}$ $(0 < \rho < \rho' < 1)$, then for a function $f_u(z)$ of best approximation to f(z) on $\bar{R}_0 - A$, where fu(z) is analytic and $|fu(z)| \leq M$ in R_1, the

lim sup $(M \to \infty)$ of the $(\log M)^{-1}$ power of sup $|f(z) - fu(z)|$, $z \in R_\sigma - A$, sup $|fu(z)|$, $z \in R_\sigma$, is $\exp((\sigma - \rho)/(1 - \rho))$ for $0 \le \sigma < \rho$ and $\rho \le \sigma \le 1$, respectively. By the above conformal mapping the problem is reduced to another one that concerns Dirichlet series: C_σ is mapped onto the line Re $w = u_\sigma$, C_ρ onto Re $w = u_\rho$ which may be taken to be 0, point A on $w = \infty$.

In this form the problem is solved by the authors with the aid of known properties of Dirichlet series. Analog results can be gained in the discussion of the companion question of approximation to f(z) by functions fm(z) of minimum norm.

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Harvard U. [Dept. of Mathematics, Cambridge, Mass.]

SERIES EXPANSIONS IN TERMS OF THE TEMPERATURE FUNCTIONS OF PORITSKY AND POWELL, by D. V. Widder. Sept. 1961 [16]p. (AFOSR-1009) (AF 49-(638)574) AD 264704 Unclassified

Also published in Quart. Appl. Math., v. 20: 41-47, Apr. 1962.

Necessary and sufficient conditions are obtained on a solution of the heat equation (Quart. Appl. Math., v. 18: 97-106, 1960) in order that it can be expanded in an infinite series of the total set. (Contractor's abstract)

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Harvard U. [Dept. of Mathematics] Cambridge, Mass.

THE INVERSION OF A TRANSFORM RELATED TO THE LAPLACE TRANSFORM AND TO HEAT CONDUCTION, by D. V. Widder. [1961] [24]p. (AFOSR-1122) (AF 49(638)574) AD 264701 Unclassified

Also published in Jour. Australian Math. Soc., v. 4: 1-14, 1964.

An integral transform is studied for which the kernel is the fundamental solution of the heat equation. An inversion is made by use of the symbolic operator $\cosh x\sqrt{D}$ (where D stands for differentiation). Another inversion of distinctly different type is also developed. (Contractor's abstract)

948

Harvard U. [Dept. of Mathematics] Cambridge, Mass.

A GENERALIZATION OF FEJÉR'S PRINCIPLE CONCERNING THE ZEROS OF EXTREMAL POLYNOMIALS, by J. L. Walsh. [1961] [8]p. (AFOSR-3318) [AF 49-(638)574] AD 453956 Unclassified

Also published in Proc. Amer. Math. Soc., v. 14: 44-51, Feb. 1963.

The object is to give what is essentially a generalization of Fejer's principle. It applies to the minimization of the difference or quotient of 2 monotonic norms of a polynomial on 2 disjoint point sets.

949

Harvard U. [Dept. of Mathematics, Cambridge, Mass.]

CONFORMAL MAPS OF SMALL DISKS, by J. L. Walsh and T. S. Motzkin. [1961] [6]p. (AFOSR-3319) (In cooperation with California U., Berkeley) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)574] and Office of Naval Research) AD 453957 Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 47: 1838-1843, Nov. 1961.

Partial answers are given to 3 problems. (A) The simplest case of least max (Tchebycheff) approximation on a point set is that by a constant. For an analytic function, $w(z) = \sum_{j=0}^{\infty} C_j Z^j$ in the prescribed neighborhood $|z| \le \epsilon$ of zero, the value $w(0) = c_0$ is obviously a good approximation. By how much do the above best-constant and this value differ? (B) Where is the above constant attained as a value of the function, and what are the asymptotic properties of such a location when $\epsilon \to 0$? General theorems on problems (A) and (B) are proven and discussed with respect to special situations, e.g., $w(z) = z + z^2$, $\epsilon < \frac{1}{4}$. (C) The above problems are related to that of describing and determining global properties of the conformal transform of small regions, e.g., the location of the circumcenter and of the incenter of the transform $w(\epsilon)$ of $|z| \le \epsilon$ as well as establishing a distortion theorem giving displacement and ellipticity properties of the transform.

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Harvard U. [Dept. of Mathematics] Cambridge, Mass.

ZEROS OF THE ERROR FUNCTION FOR TCHEBYCHEFF APPROXIMATION IN A SMALL REGION, by T. S. Motzkin and J. L. Walsh. [1961] [9]p. (AFOSR-3320) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)574 and Office of Naval Research) AD 453958 Unclassified

Also published in Proc. London Math. Soc., v. 13: 90-98, Jan. 1963.

The object is to show that for a given analytic function and a suitably restricted point set in a neighborhood of a given point there are indeed at least n + 1 zeros of the error function near the point set. Considered first is a

given set and further sets obtained from it by a similarity transformation, and then later the circle is emphasized as a set on which best approximation is studied; specific algebraic inequalities are provided concerning the zeros of the error function.

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Harvard U. [Dept. of Mathematics] Cambridge, Mass.

REPRODUCING KERNELS AND PRINCIPAL FUNCTIONS, by B. Rodin. [1961] [11]p. (AFOSR-4932) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)574, Army Research Office (Durham) under DA 04-495-ORD-722, and National Science Foundation) AD 414122 Unclassified

Also published in Proc. Amer. Math. Soc., v. 13: 982-992, Dec. 1962.

The Hilbert space of square integrable harmonic differentials on a Riemann surface W is denoted by Γ_h. Let γ be a 1-chain on W and let ψ_γ be the element in Γ_h with the property, $(w, \psi_\gamma) = \int_\gamma w$ for all $w \in \Gamma_h$. A reproducing kernel for periods for Γ_h is referred to as ψ_γ. Let ζ be a point of W and $z = x + iy$ be a local parameter near ζ such that $z(\zeta) = 0$. A Γ_h-kernel for nth derivatives at ζ is a differential $\psi_\zeta \in \Gamma_h$ which satisfies $(w, \psi_\zeta) = (\partial^n/\partial x^n)u(0)$ for all $w \in \Gamma_h$ where $w = du(z)$ near ζ. This kernel is uniquely determined by ζ, the uniformizer z, and the positive integer n. If in the above definitions Γ_h is replaced by one of its subspaces then the corresponding kernels are referred to as reproducing kernels for that subspace. The kernels for the spaces Γ_h, Γ_{hse}, Γ_{he}, Γ_{hm}, Γ_{ho}, $\Gamma_{he} \cap \Gamma^*_{hse}$, $\Gamma_{ho} \cap \Gamma^*_{hse}$, Γ_a, Γ_{ase}, and some spaces associated with a regular partition of the ideal boundary of the surface are found in terms of principal functions. Some applications of these results are given.

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Harvard U. [Dept. of Mathematics, Cambridge, Mass.]

A UNIQUENESS THEOREM FOR BELTRAMI EQUATIONS, by L. Ahlfors and G. Weill. [1961] [4]p. (AFOSR-4979) (AF 49(638)574) AD 415443 Unclassified

Also published in Proc. Amer. Math. Soc., v. 13: 975-978, Dec. 1962.

Consider the Beltrami equation $f_{\bar z} = \tilde q(z)(1 - z\bar z)^2 f_z$ denoted as (1), where q is analytic and satisfies $|q(1 - z\bar z)^2| \le k < 1$. If v_1 and v_2 are solutions of $v'' = qv$ normalized by $v_1(0) = 1$, $v_1'(0) = 0$, and $v_2(0) = 0$, $v_2'(0) = 1$, then $f = [z\bar v_2 + (1 - z\bar z)\bar v_2']/[z\bar v_1 + (1 - z\bar z)\bar v_1']$ is a solution of (1) and both f and $\tilde g = \bar v_2/\bar v_1$ are continuous and univalent in $|z| \le 1$. They map the unit disk onto complementary regions of the extended plane whose common boundary is a Jordan curve with zero area. The function q is uniquely determined by the boundary values of f.

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Harvard U. [Dept. of Mathematics] Cambridge, Mass.

ASYMPTOTIC PROPERTIES OF POLYNOMIALS WITH AUXILIARY CONDITIONS OF INTERPOLATION, by J. L. Walsh. Apr. 1961, 15p. (AFOSR-9) (AF 49(638)574 and (AF 49(638)845) AD 256014 Unclassified

Abstract published in Amer. Math. Soc. Notices, v. 7: 206, 1960.

Also published in Ann. Polon. Math., v. 12: 17-24, 1962.

Let a closed bounded point set E be given in the z-plane. Necessary and sufficient conditions are found for validity of the following: given assigned conditions of interpolation in a finite number of points: $p_n(z_k) = A_{nk}$; there exists a sequence of polynomials $p_n(z)$ satisfying these conditions and $\lim_{n\to\infty} \sup [\max |p_n(z)|, z \text{ on } E]^{1/n} = \tau(E)$, where $\tau(E)$ is the transfinite diameter of E. (Contractor's abstract)

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Harvard U. [Dept. of Mathematics] Cambridge, Mass.

ON THE CONVEXITY OF THE OVALS OF LEMNISCATES, by J. L. Walsh. Sept. 1961, 11p. (AFOSR-794) (AF 49(638)845) AD 264702 Unclassified

Also published in Studies in Mathematical Analysis and Related Topics: Essays in Honor of George Pólya, ed. by H. Chernoff, M. M. Shiffer and others, Stanford U. Press, 1962, p. 419-423.

A lemniscate is defined as a locus in the z-plane $|P(z)| = \mu$ (> 0), where P(z) is a polynomial not identically constant and μ is a constant. This locus consists of one or more Jordan curves (branches of the lemniscate), which are mutually exterior except that each one of a finite number of points may belong to several branches. Each branch is sometimes called an oval, and the question arises whether these curves are actually ovals in the sense of being convex, at least when μ is sufficiently small. (Contractor's abstract)

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Harvard U. [Dept. of Mathematics] Cambridge, Mass.

APPROXIMATION BY BOUNDED ANALYTIC FUNCTIONS: PROBLEM β', by J. L. Walsh. Sept. 1961 [31]p. incl. refs. (AFOSR-795) (AF 49(638)845) AD 264703 Unclassified

Also published in Jour. Math. Pures et Appl., v. 41: 213-232, July-Sept. 1962.

Problem β' is the study of approximation to a function f(z) analytic but not bounded in a region D on a closed set E in D by functions $f_M(z)$ analytic and with $|f(z)| \leq M$ in D. Asymptotic relations concerning degree of approximation are derived. (Contractor's abstract)

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Harvard U. Dept. of Mathematics, Cambridge, Mass.

THE LOCATION OF THE ZEROS OF THE DERIVATIVE OF A RATIONAL FUNCTION, REVISITED, by J. L. Walsh. [1960] [33]p. (AFOSR-3076) (AF 49(638)-845) Unclassified

Also published in Jour. Math. Pures et Appl., v. 43: 353-370, 1964.

From the general standpoint of circle geometry and linear transformations of the plane, the following theorem is formulated. Let there be given a (closed) circular region C and 2 fixed points Z and z exterior to C. Let a number of particles have C as their locus with the requirement that their center of gravity with respect to Z shall be the inverse of Z in the boundary of C. Then the locus of the center of gravity of these particles with respect to z is the closed region not containing Z bounded by that circle of the coaxial family determined by the boundary of C and the null-circle Z which passes through the harmonic conjugate of z with respect to the intersections with the boundary of C of the circle through z of the conjugate coaxial family. This theorem is established for the special case Z = infinity. This is the most important special case, for if a set of points (weighted particles) in the plane is given, their center of gravity is easily found, as is a disc with the center of gravity as center containing the given points. Nevertheless some attention is devoted to the special case of this theorem when Z is the center of a disc whose closed exterior is C. Most of the conclusions deal with lemniscates and curves of higher degree. (Contractor's abstract)

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Harvard U. [Dept. of Mathematics] Cambridge, Mass.

A SEQUENCE OF RATIONAL FUNCTIONS WITH APPLICATION TO APPROXIMATION BY BOUNDED ANALYTIC FUNCTIONS, by J. L. Walsh. [1961] [13]p. incl. refs. (AFOSR-64-2487) [AF AFOSR-62-198] AD 453796 Unclassified

Abstract published in Notices, Amer. Math. Soc., v. 9: 209, 1962.

Also published in Duke Math. Jour., v. 30: 177-189, June 1963.

A series of interpolation in the z-plane whose terms are rational functions and which can be used for the expansion of an arbitrary function analytic on a suitable point set, was recently described by the present writer--that series is closely connected with a canonical domain for the mapping of an arbitrary multiply connected region, and the series has applications to approximation by bounded analytic functions. The present paper describes a new series of rational functions that is no longer a series of interpolation but nevertheless shares the more important delicate convergence properties of the previous series. A special case of the new series involves approximation by polynomials on a set of mutually exterior Jordan curves that need not be analytic Points of interpolation are distributed equally on each of the Jordan curves with respect to that parameter.

958

Harvard U. [Lyman Lab. of Physics, Cambridge, Mass.]

ON THE BOUND STATES OF A GIVEN POTENTIAL, by J. Schwinger. [1961] [8]p. (AFOSR-10) [AF 49(638)589] AD 251523 Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 47: 122-129, Jan. 1961.

A proof is given of the theorem that for any spherically symmetric potential V(r) for which $\int_0^\infty r|V(r)|dr$ exists there is only a finite number of bond states. Some generalizations are described which apply 3-dimensional potentials V(r) and spin-dependent potentials.

959

Harvard U. [Lyman Lab. of Physics] Cambridge, Mass.

CONNECTION BETWEEN GAUGE INVARIANCE AND MASS, by D. G. Boulware and W. Gilbert. [1961] [5]p. (AFOSR-1891) (AF 49(638)589) Unclassified

Also published in Phys. Rev., v. 126: 1563-1567, May 15, 1962.

The limit, as the bare mass vanishes, of a theory of a massive neutral vector meson interacting with charged fields is investigated. A redefinition of the charged-field operators is exhibited so that the original theory, involving a positive definite metric, goes over smoothly to a radiation gauge theory. The spectral forms for the boson 2-point function are exhibited to show that the limit to a gauge-invariant theory does not restrict the interacting mass of the vector particle. A soluble example is given

in which these limits can be studied in detail and in which the gauge-invariant limit describes a massive vector particle. (Contractor's abstract)

960

Harvard U. Lyman Lab. of Physics, Cambridge.

THEORY OF MANY-PARTICLE SYSTEMS. II. SUPERCONDUCTIVITY, by L. P. Kadanoff and P. C. Martin. [1961] [28]p. incl. diagrs. refs. (AFOSR-2066) (AF 49-(638)589) AD 449992 Unclassified

Also published in Phys. Rev., v. 124: 670-697, Nov. 1, 1961.

A fermion system with a simple attractive interaction is discussed with the aid of time-dependent correlation functions. Although perturbation theory is inapplicable, a sequence of correlation approximations described in Part I (Phys. Rev., v. 115: 1342, 1959) can be used. The lowest approximation in the sequence expresses the 2-particle correlation function in terms of single-particle functions and leads to the Hartree approximation; the second expresses 3-particle correlation function in terms of 1- and 2-particle correlation functions and leads to the time-dependent correlation functions that characterize the super-conductioning model of Bardeen, Cooper, and Schrieffer. Section 2: these correlation functions are determined and the thermodynamic properties of the superconductor are calculated from them. Section 3: the electromagnetic effects of the superconductor predicted by the Bardeen-Cooper-Schrieffer time-dependent correlation functions are considered. Section 4: improved density correlation functions are valid at nonvanishing temperature. Section 5: the properties of a pure superconductor which depend on the lifetimes of the single particle excitations are discussed.

961

Harvard U. [Lyman Lab. of Physics] Cambridge, Mass.

NON-ABELIAN GAUGE FIELDS. COMMUTATION RELATIONS, by J. Schwinger. [1961] [6]p. (AFOSR-2523) [AF 49(638)589] Unclassified

Also published in Phys. Rev., v. 125: 1043-1048, Feb. 1, 1962.

The question is raised for non-Abelian vector gauge fields, whether gauge invariance necessarily implies a massless physical particle. A preliminary study of this problem is carried out. The action principle is used to discover the independent dynamical variables of such gauge fields and construct their commutation relations.

962

Harvard U. [Lyman Lab. of Physics] Cambridge, Mass.

ROTATIONAL INELASTIC SCATTERING AT HIGH ENERGIES (Abstract), by R. J. Glauber. [1961] [1]p. [AF 49(638)589] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 57, Feb. 1, 1961.

Let V(r) be a spherically symmetric complex potential of arbitrary radial dependence. The potentials of spheroidal symmetry, constructed from V(r) by applying an angle-dependent scale transformation to the coordinate r, are considered. The scale factor is assumed to differ from unity by a small term proportional to the second zonal harmonic. The eccentricity β is defined by letting the scale change along the axis of symmetry be the factor $1 + \beta$. The deformed potential is assumed to be free to rotate and that the incident particles satisfy the conditions of the high-energy approximation. Let the amplitude for scattering through angle θ by the spherically symmetric potential $\lambda V(r)$ be $f_\lambda(\theta)$, where λ is an arbitrary parameter. Then the differential cross section for inelastic scattering at small angles may be shown to be equal to $\frac{1}{5}\beta^2\left\{\left|\left(1 - \frac{d}{d\lambda} + \tan\frac{\theta}{2}\frac{d}{d\theta}\right) f_\lambda(\theta)\right|^2 + 3\tan\frac{\theta}{2}\frac{d}{d\theta} f_\lambda(\theta)\right|^2\right\}$, evalued at $\lambda = 1$. This result holds to all orders in the potential strength for $\beta < 1$.

963

Harvard U. [Lyman Lab. of Physics] Cambridge, Mass.

ON A SOLUBLE GENERALIZATION OF THE THIRRING MODEL TO INCLUDE COUPLING WITH A BOSON FIELD (Abstract), by C. M. Sommerfield. [1961] [1]p. [AF 49(638)589] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 59, Feb. 1, 1961.

A generalization of Thirring's field theory in 1 space dimension was investigated. The model used, which is also exactly soluble, consists of a charged, massless fermion field coupled not only to itself but also to a vector boson field with mass. The fermion Green's function is found to possess both ultraviolet and infrared divergences; however, there exists a suitable choice of the coupling constants for which the latter disappears, while the former can be removed by means of wave-function renormalization. Two charges may be defined,

and there is a finite charge renormalization for each. The boson Green's function has a pole corresponding to a physical mass which differs by a finite amount from the bare mass. There is also a pole with zero mass corresponding to the generation of an electromagnetic field which, in 1 dimension, consists solely of gauge parts. The physical significance of these results were discussed.

964

Harvard U. [Lyman Lab. of Physics] Cambridge, Mass.

ON THE PHOTON MASS RENORMALIZATION (Abstract), by W. Gilbert. [1961] [1]p. [AF 49(638)589] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 59, Feb. 1, 1961.

The vacuum expectation value of the time-ordered product of 2 conserved currents was investigated. The limit, as points are coalesced, of a time-ordered matrix element of 4 Fermi operators does not converge to the current correlation function but differs from it by specific terms. In a perturbation approximation these terms may be calculated explicitly and cancel the most singular parts of the limit yielding a limit independent evaluation of this correlation function.

965

Harvard U. [Lyman Lab. of Physics] Cambridge, Mass.

CRITICAL FLUCTUATIONS IN SUPERCONDUCTORS (Abstract), by K. Gottfried and L. P. Kadanoff. [1961] [1]p. (In cooperation with Copenhagen U. (Denmark)) [AF 49(638)589] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 65, Feb. 1, 1961.

The existence of critical fluctuations follows directly from the Cooper effect. In terms of time-dependent correlation functions, the Cooper pairing manifests itself as an instability of $R(r, t) = \langle \psi^{\uparrow}(rt)\psi^{\downarrow}(rt)\psi^{\downarrow\dagger}(0)\psi^{\uparrow\dagger}(0)\rangle_T$ as $T \to T_c$; in fact the form of $R(r,0)$ is exactly that of the Ornstein-Zernike correlation function. This leads to the question of whether any phenomena analogous to critical opalescence occur in the vicinity of T_c. Since $\psi^{\uparrow}(rt)\psi^{\downarrow}(rt)$ cannot be coupled to an external field, R itself is not measurable. R actually describes the effective interaction between electrons; thus its anomalous behavior at T_c results in a resonant electron-electron scattering amplitude near the Fermi surface. The linear response is described by functions of the type $D(r, t) = \langle \psi_s^{\dagger}(rt)\psi_s(rt)\psi_{s'}^{\dagger}(0)\psi_{s'}(0)\rangle_T$. Therefore the question is reduced to determine the influence of the aforementioned resonance on entities like D. For this purpose, Boltzmann-like integral equations which connect D and R are constructed. The somewhat inconclusive results found here will be discussed.

966

Harvard U. Mallinckrodt Chemical Lab., Cambridge, Mass.

SPECTROSCOPIC STUDIES ON ORGANOMETALLIC COMPOUNDS. IV. FLUORINE NUCLEAR MAGNETIC RESONANCE SPECTRA OF SOME PERFLUOROVINYL DERIVATIVES OF METALS AND METALLOIDS, by T. D. Coyle, S. L. Stafford, and F. G. A. Stone. [1961] [9]p. incl. diagrs. tables, refs. (AFOSR-396) (AF 49(638)518) AD 253821 Unclassified

Also published in Spectrochim. Acta, v. 17: 968-976, Oct. 1961.

Fluorine nuclear magnetic resonance spectra have been obtained for 11 perfluorovinyl derivatives of B, Si, Ge, Sn, Hg, and As. Most of the spectra exhibit unexpected hyperfine structure, suggesting the possibility of long range spin-coupling in these compounds. (Contractor's abstract)

967

Harvard U. [Mallinckrodt Chemical Lab.] Cambridge, Mass.

CHEMISTRY OF THE METAL CARBONYLS. XIV. NEW ORGANOSULFUR DERIVATIVES OF IRON AND COBALT, by R. B. King, P. M. Treichel, and F. G. A. Stone. [1961] [5]p. incl. diagrs. tables, refs. (AFOSR-397) [AF 49-(638)518] AD 253821 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 3600-3604, Sept. 5, 1961.

Vinyl sulfides $RSCH{:}CH_2$ (R = CH_3, C_2H_5, $CH{:}CH_2$ and $CH(CH_3)_2$) react with triiron dodecacarbonyl to afford red volatile complexes of composition $[RSCH{:}CH_2]Fe_2(CO)_6$. On the basis of chemical and spectroscopic evidence a structure for these compounds is proposed in which the 2 iron tricarbonyl groups are joined by a bridging vinyl group, a bridging RS- group and an iron-iron bond. An improved preparation of the thianaphthene-iron carbonyl complex is reported and evidence is presented for the stoichiometry $C_8H_6S{\cdot}Fe_2(CO)_6$, and for a structure analogous to the vinyl sulfide complexes

mentioned above. Reactions between dimethyl disulfide and the cyclopentadienyl metal carbonyls $[C_5H_5Fe(CO)_2]_2$ and $C_5H_5Co(CO)_2$ give the sulfur compounds $[C_5H_5Fe(CO)SCH_3]_2$ and $[C_5H_5CoSCH_3]_2$, respectively. (Contractor's abstract)

968

Harvard U. Mallinckrodt Chemical Lab., Cambridge, Mass.

ORGANOBORON HALIDES. VI. HYDROBORATION OF 3,3,3-TRIFLUOROPROPENE, by J. R. Phillips and F. G. A. Stone. [1961] [4]p. incl. diagrs. refs. (AFOSR-1060) [AF 49(638)518] Unclassified

Also published in Jour. Chem. Soc. (London): 94-97, Jan. 1962.

A gas-phase reaction between diborane and 3,3,3-trifluoropropene is described. Products include 1,1-difluoropropene, 1-fluoropropene, boron trifluoride, n-propylboron difluoride, and the new compound 3,3,3-trifluoropropylboron difluoride. Product distribution shows that addition of B-H to 3,3,3-trifluoropropene is largely at the 2-position. Some properties of 3,3,3-trifluoropropylboron difluoride are described. (Contractor's abstract)

969

Harvard U. [Mallinckrodt Chemical Lab.] Cambridge, Mass.

CHEMISTRY OF THE METAL CARBONYLS. XV. FLUOROCARBON DERIVATIVES OF IRON CARBONYL, by R. B. King, S. L. Stafford and others. [1961] [5]p. incl. diagrs. tables, refs. (AFOSR-1581) (AF 49(638)-518) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 3604-3608, Sept. 5, 1961.

Perfluoroalkyl iodides react with iron pentacarbonyl at moderate temperatures to afford perfluoroalkyliron tetracarbonyl iodides. Treatment of triiron dodecacarbonyl with sodium amalgam or dispersion in tetrahydrofuran gives brown solutions which react with perfluoroacyl chlorides to yield bis-(perfluoroalkyl)-iron tetracarbonyl compounds. Some properties of the new perfluoroalkyliron compounds are described. Reaction between the salt $C_5H_5Fe(CO)_2Na$ and perfluoroalkyl chloride yields an orange crystalline solid $C_5H_5Fe(CO)_2C_3F_5$, in which the C_3F_5 moiety is present as the perfluoropropenyl group. (Contractor's abstract)

970

Harvard U. [Mallinckrodt Chemical Lab.] Cambridge, Mass.

AN ELECTRON IMPACT INVESTIGATION OF SOME ORGANOBORON DIFLUORIDES, by W. C. Steele, L. D. Nichols, and F. G. A. Stone. [1961] [5]p. incl. tables, refs. (AFOSR-1692) [AF 49(638)518] Unclassified

Also published in Jour. Amer. Chem. Soc., v. 84: 1154-1158, Apr. 1962.

The appearance potentials of the major positive ions in the mass spectra of methyl-, vinyl-, ethyl- and isopropylboron difluoride have been measured. The boron-carbon bond dissociation energy has been calculated in each of the 4 cases, and an indirect measurement of the boron-hydrogen bond dissociation energy in the HBF_2 molecule is reported. The heat of formation of methylboron difluoride has been calculated, and estimates are given for the other 3 compounds. The various processes for dissociation under electron impact are discussed. (Contractor's abstract)

971

Harvard U. [Mallinckrodt Chemical Lab.] Cambridge, Mass.

CHEMISTRY OF THE METAL CARBONYLS. XVI. SYNTHESIS OF DICARBONYLDINITROSYLIRON(O), by D. W. McBride, S. L. Stafford, and F. G. A. Stone. [1961] [3]p. incl. tables, refs. (AFOSR-2823) [AF 49(638)518] Unclassified

Also published in Inorg. Chem., v. 1: 386-388, May 1962.

Nitrosyl chloride and iron pentacarbonyl react to give dicarbonyldinitrosyliron(O) in good yields. Some new phosphine and arsine complexes derived from dicarbonyldinitrosyliron(O) are reported, and their infrared spectra are discussed and compared with those of related complexes. (Contractor's abstract)

972

Harvard U. [Mallinckrodt Chemical Lab.] Cambridge, Mass.

FLUOROCARBON DERIVATIVES OF THE METAL CARBONYLS, by R. B. King, P. M. Treichel, and F. G. A. Stone. [1961] [2]p. (AFOSR-64-1545) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)518] and National Science Foundation) AD 446122 Unclassified

Also published in Proc. Chem. Soc. (London): 69-70, Feb. 1961.

Examples of prepared transition-metal derivatives are given. (1) Cyclopentadienylcobalt dicarbonyl reacts with

perfluoroalkyl iodides and yields black compounds of the type $C_5H_5Co(CO)R_FI$ (e.g., $R_F = C_3F_7$). (2) Bisperfluoroalkyliron tetracarbonyl in ethereal solution with C_2F_5COCl to give $(C_2F_5)_2Fe(CO)_4$, which is stable in air and highly volatile, and decomposes above 100° in vacuo to yield CO and perfluoroolefins. (3) Perfluoroalkyl chloride and $C_5H_5 \cdot Fe(CO)_2Na$ yield $C_5H_5 \cdot Fe(CO)_2 \cdot C_2F_5$ (m p 70°). Nuclear magnetic resonance analysis of the compound shows that the C_3F_5 group rearranges to the perfluoropropenyl group. (4) In analogous reactions $Mn(CO)_5H$ and $C_5H_5Mo(CO)_3H$ react with C_2F_4 to yield $HCF_2 \cdot CF_2 \cdot Mn(CO)_5$ and $C_5H_5 \cdot Mo(CO)_3 \cdot CF_2 \cdot CF_2H$, respectively.

973

Harvard U. Medical School. Dept. of Pharmacology, Boston, Mass.

SINGLE UNIT ACTIVITY IN STRIATE CORTEX OF UNRESTRAINED CATS, by D. H. Hubel. [1958] [13]p. incl. illus. diagrs. refs. [AF 49(638)713] Unclassified

Published in Jour. Physiol. (London), v. 147: 226-238, Sept. 1959.

A method is described for recording from single units in unanesthetized, unrestrained cats. The following observations were made in a survey of a small region of the cat's striate cortex: (1) Most units showed firing in the absence of intentional stimuli, regardless of the waking state, and even with the animal in total darkness. (2) Cortical unit firing was generally very irregular. Grouped patterns were common, and groups often recurred rhythmically. (3) Two main arousal effects were seen: some units showed a smoothing out of grouped activity, with little change in rate of firing, others showed a marked decrease in firing rate. (4) Diffuse retinal illumination produced little or no response in most units. (5) Many units which are unresponsive to changes in background illumination responded briskly to a restricted light source. Both "on"- and "off"-type responses were seen. (6) The receptive field of most units was near the center of gaze. (7) Units which were affected by stationary spots were also affected by a horizontally moving light source. Crossing the sensitive region produced discharges which were sometimes unequal for the 2 directions horizontal movement. Many units responded to movement in 1 direction only. Some of these gave no response to a stationary spot. The region over which responses to movement could be evoked varied greatly from unit to unit, and ranged from a few degrees to about 20. (Contractor's abstract)

974

Harvard U. Medical School. Dept. of Pharmacology, Boston, Mass.

SINGLE UNIT ACTIVITY IN LATERAL GENICULATE BODY AND OPTIC TRACT OF UNRESTRAINED CATS, by D. H. Hubel. [1959] [14]p. incl. illus. diagrs. refs. [AF 49(638)713] Unclassified

Published in Jour. Physiol. (London), v. 150: 91-104, Jan. 1960.

A method is described for stereotaxic recording from single units from subcortical structures in the unanesthetized, freely moving cat. Patterns of firing and responses to diffuse and restricted light stimuli were studied in optic tract, lateral geniculate body and optic radiations; these were compared with previous findings in cells of the striate cortex. Most geniculate cells responded briskly to diffuse light stimuli. In sleep, they tended to fire impulses in brief, high-frequency clusters. Arousal, or activation by light stimulation, abolished these clusters. Similar firing patterns and responses were recorded from fibers in the optic radiation and the striate cortex below layer IV. These fibers were presumed to be geniculate axons. Receptive fields were studied in a small number of geniculate neurones. These had a concentric arrangement of excitatory and inhibitor ("on" and "off") regions, similar to that described from retinal ganglion cells by Kuffler (Jour. Neurophysiol., v. 16: 37-68, 1953). This arrangement was confirmed for units in the optic tract. A spot of light moved across the receptive field of a geniculate or optic tract unit produced responses which were independent of the direction of movement. From a comparison of optic tract and geniculate units with cortical cells, in their responses to diffuse and restricted light stimuli, it is concluded that the cortex is the site of complex integrative processes. (Contractor's abstract)

975

Harvard U. Medical School. Dept. of Pharmacology, Boston, Mass.

INTEGRATIVE ACTION IN THE CAT'S LATERAL GENICULATE BODY, by D. H. Hubel and T. N. Wiesel. [1960] [15]p. incl. illus. diagrs. refs. (AFOSR-1982) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)713 and Public Health Service) AD 621437 Unclassified

Also published in Jour. Physiol. (London), v. 155: 385-398, Feb. 1961.

Cells were recorded with tungsten electrodes in the dorsal lateral geniculate body of the cat. Receptive fields of these units were mapped out, in the light-adapted state, with small spots of light. In their general arrangement geniculate receptive fields resembled those of retinal ganglion cells, having an excitatory ("on") center and inhibitory ("off") periphery, or reverse. The two

portions of a receptive field were mutually antagonistic; the decrease in center responses caused by inclusion of peripheral portions of receptive fields was termed peripheral suppression. Cells recorded in layers A and B of the lateral geniculate body were driven from the contralateral eye; cells in layer A_1 from the ipsilateral eye. In penetrations normal to the layers receptive fields of cells in a single layer were close together or superimposed, and from one layer to the next occupied exactly homologous positions in the two retinas. Binocular interaction was not observed in any of the cells studied. All 3 layers of the lateral geniculate contained both "on"- and "off"-center units. Cells in layers A and A_1 were similar both in their firing patterns and in average receptive field size. Cells in layer B were more sluggish in their responses to light stimuli, and tended to have larger receptive field centers. Cells with receptive fields within or near the area centralis tended to have smaller field centers and stronger suppression by the receptive field periphery than cells with their fields situated in more peripheral regions of the retina.

976

Harvard U. Medical School. Dept. of Pharmacology, Boston, Mass.

ELECTROCORTICOGRAMS IN CATS DURING NATURAL SLEEP, by D. H. Hubel. [1960] [11]p. incl. diagrs. refs. [AF 49(638)713] Unclassified

Published in Arch. Ital. Biol., v. 98: 171-181, May 20, 1960.

A study of the electrocorticograms of normal cats confirms the observations of Dement that a sleeping cat shows protracted periods of low voltage high frequency activity with sporadic muscle twitching. On falling asleep a stage of high voltage slow waves and spindles precedes the low voltage twitching stage. In response to natural arousal stimuli an animal in the low voltage stage of sleep may either awaken or revert to the slow wave stage; in the slow wave stage a similar stimulus never brings on the low voltage twitching stage of sleep. It is concluded that in the cat low voltage rapid activity and twitching occur in deep sleep. The significance of this for the interpretation of corticograms in the cat is discussed.

977

Harvard U. Medical School. Dept. of Pharmacology, Boston, Mass.

RECEPTIVE FIELDS, BINOCULAR INTERACTION AND FUNCTIONAL ARCHITECTURE IN THE CAT'S VISUAL CORTEX, by D. H. Hubel and T. N. Wiesel. [1961] [49]p. incl. illus. diagrs. tables, refs. [AF 49-(638)713] Unclassified

Published in Jour. Physiol. (London), v. 160: 106-154, Jan. 1962.

The visual cortex was studied in anesthetized cats by recording extracellularly from single cells. The eyes were stimulated with spots of white light of various shapes, stationary and moving. The paper has 3 parts: (1) Organisation of receptive fields in cat's visual cortex; properties of "simple" and "complex" fields; (2) Binocular interaction and ocular dominance; and (3) Functional cytoarchitecture of the cat's visual cortex.

978

Harvard U. School of Dental Medicine, Boston, Mass.

PHARMACOLOGICAL CONTROL OF THE SECRETION OF ACTH, by P. L. Munson. [1961] [15]p. incl. diagrs. refs. (AFOSR-J213) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)740 and National Science Foundation) AD 400437 Unclassified

Abstract published in Biochem. Pharmacol., v. 8: 28, Aug. 1961.

Also published in Proc. First Internat'l. Pharmacological Meeting, Stockholm (Sweden) (Aug. 22-25, 1961), Oxford, Pergamon Press, v. 1: 11-25, 1962.

A review is given on the inhibitory effects of 3 central nervous system depressant drugs (chlorpromazine, reserpine, and morphine) on ACTH secretion. Also, the use of morphine as an aid in the bioassay of the postulated hypothalamic secretory factor for ACTH (HSF-ACTH) or CRF (Corticotropin releasing factor) is described.

979

Harvard U. School of Dental Medicine, Boston, Mass.

ENDOCRINE PHARMACOLOGY: SELECTED TOPICS, by P. L. Munson. [1961] [36]p. incl. refs. (AFOSR-J214) [AF 49(638)740] AD 400050 Unclassified

Also published in Ann. Rev. Pharmacol., v. 1: 315-350, 1961.

A survey of literature up to Aug. 1960 is given for the following topics: androgens, parathyroid hormone, and the hypothalamic secretory factor for ACTH. A total of 256 references is listed.

980

Harvard U. School of Dental Medicine, Boston, Mass.

PHARMACOLOGY OF NEUROENDROCRINE BLOCKING AGENTS, by P. L. Munson. [1961] [33]p. incl. diagrs.

refs. (AFOSR-J959) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)740 and National Science Foundation) AD 415919
Unclassified

Also published in Advances in Neuroendocrinology; a Symposium, Miami, Fla. (Dec. 6-8, 1961), Urbana, Illinois U. Press, 1963, p. 427-459.

Essentially all of the drugs and hormones that block the release of pituitary gonadotropin exert at least part of their effects indirectly via the central nervous system. As demonstrated in the rabbit or rat, the blocking agents exert profound influences on a rhinencephalic-hypothalamic system—influences that are registered as altered EEG patterns or marked changes in threshold of a peculiar "EEG after-reaction" response to direct electrical stimulation. Several blocking drugs and the natural sex steroids also alter the threshold of another system, the "EEG arousal" system of the reticular formation, but changes in this threshold appear to be more closely related to sexual behavior than to pituitary function. A differential elevation of the EEG after-reaction threshold characterizes the action of the new progestational antifertility steroids. The critical site of estrogen "feedback" appears to be the basal tuberal-posterior median eminence region, an area with other claims, from stimulation-lesion evidence, to the title, "gonadotropic center." Certain ovulation blocking agents appear to exert their critical blocking action between the basal tuberal region and the median eminence. The gonadotropins themselves appear to exert a direct feedback influence on the nervous system, perhaps to control the release of further gonadotropin. (Contractor's abstract)

981

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

RESEARCH IN THE AREA OF MATHEMATICAL ANALYSIS, by S. Agmon, A. Dvortezky and others. Annual summary rept. no. 2, Oct. 1960, 34p. (AFOSR-TR-60-169) (AF 61(052)187) AD 246976
Unclassified

Part I covered the period from Nov. 1, 1958 to Sept. 30, 1959. Part II covered the period from Oct. 1, 1959 to Sept. 30, 1960. A brief summary is given of work accomplished by each of the authors. (For work accomplished under the contract, see item nos. 634-643, Vol. III and item nos. 796-802, Vol. IV).

982

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

LIMITS AT ∞ OF SEMI GROUPS OF CONTRACTION, by S. R. Foguel. Jan. 1961 [13]p. (Technical scientific note no. 13) (AFOSR-654) (AF 61(052)187) AD 258234
Unclassified

The behavior at infinity of semi groups of contractions in Hilbert space is discussed. Applications to Markov processes are indicated. (Contractor's abstract)

983

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

TAUBERIAN CONSTANTS FOR HAUSDORFF TRANSFORMATIONS, by A. Jakimovski. Feb. 1961, 16p. (Technical scientific note no. 15) (AFOSR-801) (AF 61-(052)187) AD 258237
Unclassified

Also published in Bull. Research Council Israel, v. 9F: 175-184, Apr. 1961.

The existence of Tauberian constants is proved and their value is computed for a certain class of Hausdorff transformations. (Contractor's abstract)

984

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

OCCUPATION TIMES FOR MARKOV AND SEMI-MARKOV CHAINS, by H. Kesten. Mar. 1961 [45]p. incl. refs. (Technical scientific note no. 16) (AFOSR-980) (AF 61(052)187) AD 262032
Unclassified

Also published in Trans. Amer. Math. Soc., v. 103: 82-112, Apr. 1962.

Let $y_0, y_1 \ldots$ form a recurrent, irreducible Markov chain with integer states. Let $\{y(t)\}$ be the semi-Markov chain obtained from $\{y_n\}$ by making the waiting times between transitions random variables whose distribution depends (only) on the state occupied. This paper studies limiting distributions for functionals $\beta(\lambda) = \int_0^\lambda V(y(t))dt$ as $\lambda \to \infty$, where V is a function on the integers; if V is the characteristic function of a set J, $\beta(\lambda)$ is thus the occupation time of J up to λ. The results are described roughly. Suppose V is the characteristic function of a finite set J. Suppose that the total time spent in J during the first i visits has a limiting distribution as $i \to \infty$, and so does $K(\lambda)$, which denotes the number of visits to J before the total time outside J reaches λ. Then $\beta(\lambda)$ (the time in J before $t = \lambda$) also has a limit law, and it can be expressed in terms of the other two (Theorem 1). In Theorem 2, V can be any function with finite support. The main new hypothesis is that $\lambda^{-1}\beta(\lambda)$ tends in probability to a constant $\lambda \to \infty$; the conclusion gives a limit distribution for $\beta(\lambda) - BM(\lambda)$, where $M(\lambda) + 1$ is the number of visits to J before time λ and B is a certain constant. Theorem 3 specializes the results to Markov chains. The last result is of a different kind; it provides a limit distribution as λ and $A \to \infty$ for $M(A, \lambda)$, defined as the number of k for which $s_k \leq \lambda$ and $s_k - s_{k-1} \geq A$, where s_0, s_1, s_2 are the successive times when $y_n = j_0$ for some fixed j_0. The

hypothesis here is the familiar one that

$\Sigma P_{00}^{(n)} z^n = (1-z)^{\alpha} L(1/1-z)$, where $[P_{ij}]$ is the transition matrix of $\{y_n\}$, $0 \leq \alpha \leq 1$, and L is slowly varying.

The basic idea underlying the proofs of these theorems is that $\beta(\lambda)$ can be written as a sum of a random number of random variables with the number and the summands almost independent. This provides a very natural approach, though the execution is not simple.

985

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

MARKOV PROCESSES WITH STATIONARY MEASURE, by S. R. Foguel. Apr. 1961, 8p. (Technical scientific note no. 17) (AFOSR-1199) (AF 61(052)187) AD 262034 Unclassified

Also published in Pacific Jour. Math., v. 12: 505-510, 1962.

The analysis deals with Markov processes with stationary measure that is not finite. Various results on processes with finite stationary measure are generalized and few added.

986

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

EXISTENCE OF INVARIANT MEASURES FOR MARKOV PROCESSES, by S. R. Foguel. Apr. 1961 [9]p. (Technical scientific note no. 18) (AFOSR-1282) [AF 61(052)187] AD 264005 Unclassified

Also published in Proc. Amer. Math. Soc., v. 13: 833-838, Dec. 1962.

Let X be a locally compact Hausdorff space with a countable base. Let P(x,A) be a transition function defined for x in X and A a Borel subset of X such that $x \to P(x, U)$ is continuous for all open sets U and $P(x,X) = 1$. A (finite, positive) measure μ is invariant if $\mu(A) = \int \mu(A) = \int \mu(dx) P(x,A)$. Theorem: If a compact set C a measure ν exists such that $\liminf \int^n \nu(c) > 0$, then there exists an invariant measure. In addition, it is shown that certain sets are null with respect to any invariant measure and obtains a criterion for the uniqueness of an invariant measure.

987

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

SOME PROBABILISTIC THEOREMS ON DIOPHANTINE APPROXIMATIONS, by H. Kesten. May 1961 [43]p. (Technical scientific note no. 19) (AFOSR-1283) (AF 61(052)187) AD 264006 Unclassified

Also published in Trans. Amer. Math. Soc., v. 103: 189-217, May 1962.

Some metrical theorems on diophantine approximations are proved. The last theorem concerns simultaneous diophantine approximations. Probability language and expressions are used throughout.

988

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

TAUBERIAN CONSTANTS FOR THE [J,f(x)] TRANSFORMATIONS, by A. Jakimovski. June 1961, 17p. (Technical scientific note no. 20) (AFOSR-1503) (AF 61(052)187) AD 266530 Unclassified

Also published in Pacific Jour. Math., v. 12: 567-576, 1962.

The value of the best Tauberian constants for a class of [J,f(x)] transformations is obtained. The class of [J,f(x)] transformations is defined as the sequence-to-function analogues to the Hausdorff transformations. (Contractor's abstract)

989

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

RESEARCH IN THE AREA OF MATHEMATICAL ANALYSIS, by A. Dvoretzky, S. R. Foguel and others. Annual summary rept. no. 3, Oct. 1961, 13p. (AFOSR-1883) (AF 61(052)187) AD 272417 Unclassified

The investigations of the mathematical analysis research group during the contract year (1960/61) are described.

990

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

POSITIVE CONTRACTIONS, by S. R. Foguel. Aug. 1961, 9p. (Technical scientific note no. 21) (AFOSR-1884) (AF 61(052)187) AD 272166 Unclassified

The contractions are considered on a Hilbert space which are order preserving. Applications to Markov processes are indicated.

991

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

ON THE EXTENSION PROPERTY FOR COMPACT OPERATORS, by J. Lindenstrauss. Oct. 1961 [10]p. (Technical scientific note no. 22) (AFOSR-2086) (AF 61(052)187) AD 272265 Unclassified

Also published in Bull. Amer. Math. Soc., v. 68: 484-487, Sept. 1962.

Several characterizations of Banach spaces having an extension property for compact operators are considered. In particular a characterization of such spaces is given in terms of intersection properties of their spheres similar to that given by Nachbin for P_1 spaces.

Theorem 1 extends previous results of Grothendieck. Some applications are given, among them a new characterization of C(K) spaces. In this connection some problems raised by Aronszajn and Panitchpakdi and by Grothendieck and Nachbin are solved. Some results are presented concerning the C.L. spaces introduced recently by Fullerton.

992

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

SOME NEAR-SPHERICITY RESULTS, by A. Dvoretzky. [1961] [8]p. [AF 61(052)187] Unclassified

Published in Convexity; Proc. of Symposia in Pure Mathematics, Washington U., Seattle (June 13-15, 1961), Providence, Amer. Math. Soc., v. 7: 203-210, 1963.

The purpose of this paper is to discuss some results of a former report (item no. 800, Vol. IV). A new result of the projections of a cube, which is a counterpart to a result given in the previous report on the sections of a cube but is more precise and easier to prove, is given. A discussion of some open questions is also included, and a new result on the convergence of series in Fréchet spaces, which is derived from near-orthogonality—a rather poor relation of near-sphericity—is presented. The paper deals almost exclusively with Euclidean spaces.

993

Hebrew U. Dept. of Physics, Jerusalem (Israel).

OPTICAL SPECTRA OF PARAMAGNETIC SOLIDS, by W. Low. Mar. 1961, 22p. incl. tables, refs. (Technical note no. 16) (AFOSR-918) (AF 61(052)59) Unclassified

Presented at Second Internat'l. Conf. on Quantum Electronics, Berkeley, Calif., Mar. 23-25, 1961.

Also published in Advances in Quantum Electronics, New York, Columbia U. Press, 1961, p. 138-154.

Methods of calculating the complete matrices for cubic crystal fields and spin-orbit coupling are given for the d^n configurations. This is illustrated for d^3 (Cr^{3+}) and d^6 (Fe^{2+}) in cubic fields and compared with experiments. The agreement is very good. A number of tentative conclusions regarding the validity of the methods are presented. A brief discussion of the energy level calculations in the rare earth group in solids is presented. A number of problems in the interpretation of these spectra are indicated. These are line shape, line widths, vibration and satellite lines, and the fluorescence efficiency. (Contractor's abstract)

994

Hebrew U. Dept. of Physics, Jerusalem (Israel).

PARAMAGNETIC RESONANCE OF RARE EARTH IONS WITH A $\Gamma 8$ GROUND STATE, by W. Low and G. Vincow. Dec. 1961 [21]p. incl. diagrs. tables, refs. (Technical note no. 17) (AFOSR-?114) (AF 61(052)59) AD 273497 Unclassified

In rare earth ions it is often found that the ground state consists of a degenerate quartet. Cases when this may occur are discussed. The spin Hamiltonian is solved for the particular cases of f^3, and the angular variation as well as the transition probabilities are computed. The theoretical calculations are compared with the experimental data obtained for Nd^{3+} and U^{3+} cubic sites of CaF_2. A short description on the thermal treatment is given. (Contractor's abstract)

995

Hebrew U. Dept. of Physics, Jerusalem (Israel).

PARAMAGNETIC RESONANCE SPECTRA OF RARE EARTH IONS IN THE CRYSTAL FIELD OF CALCIUM FLUORIDE, by W. Low. [1961] [9]p. incl. diagr. table, refs. (Technical note no. 18) (AFOSR-2167) (AF 61-(052)59) AD 274000 Unclassified

Presented at Internat'l. Conf. on Magnetism and Crystallography, Kyoto (Japan), Sept. 25-30, 1961.

Also published in Jour. Phys. Soc. Japan, v. 17, Suppl. B-I: 440-442, Mar. 1962.

Paramagnetic resonance data of various rare earth ions in the crystal field of calcium fluoride are presented. It is found that there are at least 3 types of symmetries, cubic, axial, and trigonal. Some spectra of cerium^{3+}, ytterbium^{3+}, erbium^{3+}, and neodymium^{3+} are presented. (Contractor's abstract)

996

Hebrew U. Dept. of Physics, Jerusalem (Israel).

PARAMAGNETIC RESONANCE SPECTRA OF f^3 IONS IN A CUBIC SITE, by G. Vincow and W. Low. [1961] [3]p. incl. tables, refs. (AFOSR-3098) [AF 61(052)59] Unclassified

Also published in Phys. Rev., v. 122: 1390-1392, June 1, 1961.

The paramagnetic resonance spectra of Nd^{3+} and U^{3+} in the cubic field of CaF_2 have been investigated at 3 cm at 20°K. In the case of Nd^{3+} transitions within the lowest quartet Γ_8 and possibly in the next higher quartet Γ_8 have been observed. The angular behavior conforms with that predicted by Bleaney's formulism of the spin Hamiltonian of a Γ_8 state. In the case of U^{3+} there are considerable deviations of the experimental g values from the calculated ones. It is suggested that these deviations are caused by the stronger cubic field. The efficiency of the thermal conversion from axial to cubic site is discussed. Additional lines suggest a new axial center along the [111] direction. (Contractor's abstract)

997

Hebrew U. Dept. of Physics, Jerusalem (Israel).

ANISOTROPIC BROADENING OF LINEWIDTH IN THE PARAMAGNETIC RESONANCE SPECTRA OF MAGNETICALLY DILUTE CRYSTALS, by D. Shaltiel and W. Low. [1961] [6]p. incl. diagrs. tables. (AFOSR-3099) [AF 61(052)59] Unclassified

Also published in Phys. Rev., v. 124: 1062-1067, Nov. 15, 1961.

The effects of mosaic structure on the anisotropic broadening of the linewidth in paramagnetic resonance spectra of dilute crystals is investigated. A general formula for the line shape and the linewidth at half max is derived. The half-width of the spectrum of Gd^{3+} in the single crystal of ThO_2 is measured as a function of the angle of the magnetic field with respect to the cubic axes. Good agreement is found with the above theory. The average deviation of the crystallites from the symmetry axis is found to be about 0.12°. Small deviations from the agreement indicate a compensating defect approximately along the [100] direction which gives rise to a small axial distortion. (Contractor's abstract)

998

Hebrew U. [Dept. of Physics] Jerusalem (Israel).

RESEARCH ON DOUBLE X-RAY REFLECTIONS OF SINGLE CRYSTALS, by B. S. Fraenkel. Final technical rept. Mar. 19, 1961 [5]p. (AFOSR-658) (AF 61(052)-222) AD 258038 Unclassified

Intensities of double (simultaneous) Bragg reflections have been calculated, by calculating Lorentz and polarization factors for small perfect crystals. A method of indexing double reflections has been developed. Comparison with experiment shows that the relative intensities of the double reflections agree fairly well with the calculated intensities. A method has been developed to get double reflections whose sum of indices is an allowed reflection. (Contractor's abstract)

999

Hebrew U. [Dept. of Physics] Jerusalem (Israel).

SOFT X-RAY AND FAR ULTRAVIOLET SPECTROSCOPY, by E. Alexander and B. S. Fraenkel. Final technical rept. Oct. 1-Dec. 31, 1961, 7p. (AFOSR-2395) (AF 61(052)340) AD 279511 Unclassified

Two 30-hr exposures of Zr showed that, though the vacuum was very good, about 2×10^{-7}, some C was adsorbed on the anticathode. This was probably caused by the gettering properties of the Zr. (Contractor's abstract)

1000

Hebrew U. [Dept. of Physics] Jerusalem (Israel).

PROPERTIES OF THE SLIDING SPARK AND THE VACUUM SPARK TRIGGERED BY THE SLIDING SPARK, by B. S. Fraenkel, U. Feldman and others. [1961] [3]p. (Bound with its AFOSR-2395; AD 279511) (AF 61(052)-340) Unclassified

The degree of ionization in the sliding spark, as obtained from emission spectra, is shown to be remarkably smaller than the degree of ionization in the triggered spark. A qualitative explanation is proposed. In the 3 electrode spark the auxiliary spark produces electrons and ions. In the vacuum sliding spark, however, the electrons and ions "slide" along the surface of the insulating material. Experiments made, using the sliding spark method in the 2000 to 4000A range show that there is a certain correlation between the strongest spectrum obtained of an element and its valence. Thus the spectra of Cu II, Fe II, Zr IV, and Si IV were the strongest obtained from these elements, under the sliding spark method. This may suggest that when an atom is pulled away instantaneously from the solid state it may leave, in many cases, all its valence electrons there, and the strongest spectrum is the one which is obtained when it captures another electron. In the Bockasten type of spark chamber the first spectrum of Cu was obtained more prominently than in the soft x-ray tube spark chamber. This seems to be caused by the higher vapor density in this, relative to the other, arrangement. (Contractor's abstract)

1001

Hebrew U. Dept. of Physics, Jerusalem (Israel).

STUDY OF THE LOW-TEMPERATURE TRANSITION IN MAGNETITE AND THE INTERNAL FIELDS ACTING

ON IRON NUCLEI IN SOME SPINEL FERRITES, USING MOSSBAUER ABSORPTION, by R. Bauminger, S. G. Cohen and others. [1961] [10]p. incl. diagr. table, refs. (Technical note no. 3) (AFOSR-657) (AF 61(052)347) AD 258337 Unclassified

Also published in Phys. Rev., v. 122: 1447-1450, June 1, 1961.

A study has been made of the internal fields acting on Fe^{57} nuclei in some spinel ferrites, with particular reference to the low-temperature order-disorder transition in magnetite, using the techniques of Mössbauer absorption. For the Fe^{3+} ions at both the octahedral and tetrahedral sites in nickel ferrite ($NiFe_2O_4$) at 300°K, γ Fe_2O_3 at 85° and 300°K, and magnetite (Fe_3O_4) at 85°K, the effective magnetic field at the Fe^{57} nuclei is the same and equal to about 5.1×10^5 oe. In magnetite, the value of H_{eff} in the Fe^{2+} ions is about 4.5×10^5 oe at 85°K. Measurements on Fe_3O_4 at room temperatures provide a microscopic confirmation of Verwey's hypothesis that above the transition temperature of magnetite there is a fast exchange between the ferrous and ferric ions in the octahedral sites. (Contractor's abstract)

1002

Hebrew U. Dept. of Physics, Jerusalem (Israel).

HYPERFINE INTERACTIONS IN THE GROUND STATE AND FIRST EXCITED STATE OF D_y^{161} IN DYSPROSIUM IRON GARNET, by R. Bauminger, S. G. Cohen and others. [1961] [16]p. incl. diagrs. tables, refs. (Technical note no. 4) (AFOSR-987) (AF 61(052)347) AD 262033 Unclassified

Also published in Phys. Rev. Ltrs., v. 6: 467-470, May 1, 1961.

The hyperfine Zeeman splittings in the recoil-free absorption spectrum of the 26 kev γ-rays from Dy^{161m} in Dy^{161} situated in dysprosium iron garnet have been observed. At 85°K, the magnetic hyperfine interactions of the ground state and first excited state of Dy^{161} are -400 ± 40 mc and 455 ± 40 mc, respectively. The electric quadrupole interactions (eq Q/4) at this temperature are 120 ± 30 and 90 ± 30 mc, respectively. At 300°K the effective magnetic field, H_{eff} is 4.6 times smaller, and illustrates the proportionality between H_{eff} and spontaneous magnetization of the Dy sub-lattice. Assuming Parks value of -0.37 ± 0.05 nm for the Dy^{161} ground state magnetic moment, H_{eff} (85° K) equals 3.5×10^6 oe, and 0.42 ± 0.08 nm for the magnetic moment of the first excited state were obtained. At 300°K a quadrupole interaction of less than 20 mc was obtained. The strongly temperature dependent quadrupole interaction is interpreted as being largely due to the effective electric field gradient produced at the nucleus by the 4f electrons which should be partially aligned below the Curie temperature. (Contractor's abstract)

1003

Hebrew U. Dept. of Physics, Jerusalem (Israel).

NUCLEAR MOMENTS OF STATES OF Dy^{161}, by R. Bauminger, S. G. Cohen and others. [1961] [4]p. incl. table, refs. (AFOSR-3518) (AF 61(052)347) Unclassified

Also published in Proc. Rutherford Jubilee Internat'l. Conf., Manchester (Gt. Brit.) (Sept. 4-8, 1961), New York, Academic Press, 1961, p. 329-332.

Hyperfine Zeeman splittings in the recoil-free absorption spectrum of the 26 kev γ-ray from Dy^{161} situated in dysprosium iron garnet have been observed. At 85°K, the magnetic hyperfine interactions ($g\mu_n H_{eff}$) of the ground state and first excited state of Dy^{161} are (-400 ± 40) mc/s and (+455 ± 40) mc/s respectively. The electric quadrupole interactions (eqQ/4) at this temperature are (120 ± 30) mc/s and (90 ± 30) mc/s respectively. From earlier measurements on the ground state we obtain H_{eff} (85°K) = 3.5×10^6 oe, and (+0.42 ± 0.08) nm for the magnetic moment of the first excited state. A theory of the origin of the large temperature dependent quadrupole interaction is outlined. Preliminary results relating to the second excited state of Dy^{161} are mentioned. (Contractor's abstract)

1004

Hebrew U. Dept. of Physics, Jerusalem (Israel).

STUDIES OF THE INTERNAL FIELDS ACTING ON NUCLEI IN FERRIMAGNETIC AND PARAMAGNETIC SOLIDS, USING RECOIL-FREE RESONANCE ABSORPTION (MÖSSBAUER EFFECT), by R. Bauminger, S. G. Cohen and others. [1961] [2]p. (AFOSR-4046) [AF 61-(052)347] AD 611500 Unclassified

Presented at Internat'l. Conf. on Magnetism and Crystallography, Kyoto (Japan), Sept. 25-30, 1961.

Also published in Jour. Phys. Soc. Japan, v. 17, Suppl. B-I: 123-124, Mar. 1962.

Recoil-free gamma ray absorption spectra have been observed in ferrimagnetic and paramagnetic solids containing nuclei of Fe^{57} and Dy^{161}, using radioactive sources of Co^{57} and Tb^{161}. The hyperfine Zeeman

splittings in ferrimagnetic materials permit a determination of the effective magnetic field (H_{eff}) at the nuclei. H_{eff} at Fe^{57} nuclei in yttrium iron garnet, dysprosium iron garnet and in some spinel ferrites have been measured at 300°K and 85°K. Measurements on Fe_3O_4 confirm Verwey's hypothesis of a fast exchange between ferrous and ferric ions in the octahedral sites above the transition temperature. H_{eff} at Dy^{161} in dysprosium iron garnet has been found to be 3.5×10^6 oe at 85°K and 7.5×10^5 oe at 300°K and is proportional to the Dy sub-lattice spontaneous magnetization. A large temperature dependent quadrupole interaction in dysprosium iron garnet has been observed, which is ascribed to an effective electric field gradient at the Dy nuclei produced by the partially aligned orbitals of the 4f electrons, and thus correlated with the spontaneous magnetization. (Contractor's abstract)

1005

Hebrew U. Dept. of Physics, Jerusalem (Israel).

ELECTRON DENSITY AND IONIZATION RATE IN THERMALLY IONIZED GASES PRODUCED BY MEDIUM STRENGTH SHOCK WAVES, by Y. Manheimer-Timnat and W. Low. [1959] [13]p. incl. illus. diagrs. tables, refs. (AFOSR-3729) [AF 61(052)401] Unclassified

Also published in Jour. Fluid Mech., v. 6: 449-461, Oct. 1959.

A method, based on the measurement of attenuation of microwaves, which allows the electron density and the ionization rate of shock-heated gases to be obtained, is described. Results obtained for air in the shock Mach range 8.2—10.4, and for nitrogen containing 0.25% oxygen in the range 7.4—8.8, show that the electron density is in agreement with theoretical calculations based on thermodynamic equilibrium. Ionization time measurements in air are presented in this range and these results extend the measurements of Niblett and Blackman to a lower Mach range. (Contractor's abstract)

1006

Hebrew U. Dept. of Physics, Jerusalem (Israel).

MICROWAVE MEASUREMENTS OF ELECTRON DENSITIES IN IONIZED GASES, by W. Low and Y. Manheimer[-Timnat]. [1958] [5]p. incl. illus. diagrs. refs. (AFOSR-3730) [AF 61(052)401] Unclassified

Also published in Proc. Ninth Internat'l. Astronaut. Cong., Amsterdam (Netherlands) (Aug. 25-30, 1958), Vienna, Springer-Verlag, v. 1: 20-24, 1959.

The electron density in thermally ionized air produced in a shock-tube has been calculated from measurements of the attenuation of a microwave beam. Results obtained show that thermal equilibrium is reached in a very short time. (Contractor's abstract)

1007

Hebrew U. Dept. of Sociology, Jerusalem (Israel).

REPORT ON THE ROLE OF THE AGRICULTURAL PRODUCER IN COOPERATIVE SETTLEMENTS (MOSHAVIM) IN ISRAEL, by D. Weintraub, E. Yuchtmann, and H. Weihl. Oct. 1961 [77]p. incl. diagrs. tables. (Technical note no. 2) (AFOSR-2240) (AF 61-(052)480) AD 280494 Unclassified

The main purpose of this study is to define the role of the settler in Smallholders' Cooperative Settlements in Israel and to investigate the cause of the changes under different situations. It is based on a re-analysis of a series of community studies on the structure and the development of the settler-role. The concept of the role is considered as a pattern of actions normatively defined, designed for one actor, and set within a given situation, and which fulfills a specific social function. It is analyzed with respect to the situation (ecological background and time), the resources (material resources and man-power), the know-how, and motivation. The adaptive norm is discussed with regard to the relative danger to person and property, the ecological and climatic conditions. The economic and occupational norms are analyzed with regard to the production directed to the market economy, agricultural work, the family small-holding, the dependence on public and national considerations and planning and the specific significance of different branches of the farm. It is concluded that other studies must be made on the multiple-role in order to correlate the influence of the independent variables on the dependent variables.

1008

Hebrew U. Dept. of Sociology, Jerusalem (Israel).

REPORT ON THE ROLE OF THE PILOT-CADET IN ISRAEL, by M. Lissak, D. Weintraub and others. Dec. 1961, 31p. (Technical note no. 3) (AFOSR-2241) (AF 61(052)480) AD 280496 Unclassified

The role of the cadet in the military school for fighter pilots is defined as a soldier who must learn to handle different types of planes within a limited period of time and on a certain level of competence. Then the normative pattern of the role is defined and analyzed in detail with respect to the ecological background, time, material complements, man-power, know-how, and motivation.

1009

Henri-Rousselle Hospital, Paris (France).

[CHEMORECEPTOR ORIGIN OF RETICULAR AND CORTICAL ACTIVATION IN HYPOXIA] Activation réticulaine et corticale d'origine chemoceptive au cours de l'hypoxie, by A. Hugelin, M. Bonvallet and P. [C.] Dell. [1959] [16]p. [AF 61(052)45] Unclassified

Published in Electroencephalog. and Clin. Neurophysiol. Jour., v. 11: 325-340, 1959.

Hypoxia, induced by inhalation of low O_2 mixture, induces cortical arousal in unanesthetized cats and dogs immobilized with Flaxedil concurrently with the respiratory stimulation. It depends on the carotid and aortic bodies and is related to mesencephalic reticular activity. This activation, which precedes the classical cortical depression, is dependent on an adequate pCO_2.

1010

Henri-Rousselle Hospital, Paris (France).

EFFECTS OF HYPOXIA ON THE RETICULAR AND CORTICAL DIFFUSE SYSTEMS, by P. [C.] Dell, A. Hugelin, and M. Bonvallet. [1959] [13]p. incl. illus. diagrs. refs. [AF 61(052)229] Unclassified

Published in Cerebral Anoxia and the Electroencephalogram, Internat'l. Colloquium on Anoxia and the EEG, Marseille (France) (Oct. 5-9, 1959), ed. by H. Gastaut and J. S. Meyer, Springfield, Ill., Charles C. Thomas, 1961, p. 46-58.

The purpose of this paper is to use hypoxia as a tool for analyzing the functional interrelations between cortex and brain stem reticular system, rather than to study hypoxia itself. It is now clear that the effects of hypoxia upon non-specific systems of the CNS occur earlier and are far more important than the effects upon specific sensory and motor pathways. During the entire evolution of hypoxia, the essential central mechanism is a reticular activation due to the discharges of the aortic and carotid chemoceptors. The patterns of this activation are, however, modified by the cortical control of the reticular activity. The result of this control is to introduce 2 stages in the evolution of the central effects of hypoxia. The first phase of hypoxia is a state of an enhanced vigilance, represented physiologically by electrical cortical arousal. Although the motor activity for the most part is not facilitated, more integrated functions are intensified. The second phase, introduced by cortical depression and the release of the reticular activity from the cortical inhibitory control shows the pathological motor hyperactivities studied clinically in men.

1011

Henri-Rousselle Hospital, Paris (France).

[ACTIVATING RETICULAR SYSTEM AND MOTOR COORDINATIONS] Systeme réticulaire activateur et coordinations motrices, by A. Hugelin. [1960] [6]p. incl. illus. diagrs. refs. (AF 61(052)229) Unclassified

Published in Compt. Rend. Séances Soc. Biol., v. 154: 24-29, May 31, 1960.

The effects of changes in alertness on the activity of several segmentary and supra-segmentary reflex systems using the same final common pathway are studied. This phenomena was studied first from a theoretical point of view and then from an experimental point of view. Experiments were performed on the isolated brains of cats.

1012

Henri-Rousselle Hospital, Paris (France).

[COMPARATIVE STUDY OF THE CONTRACTIONS OF THE STAPEDIUS AND OF THE TENSOR TYMPANI UNDER THE EFFECT OF RETICULAR MESENCEPHALIC STIMULATIONS] Etude comparée des contractions du stapedius et du tensor tympani sous l'effet de stimulations réticulaires mésencéphaliques, by A. Hugelin, N. Paillas, and S. Dumont. [1960] [5]p. incl. diagrs. [AF 61(052)229] Unclassified

Published in Compt. Rend. Séances Soc. Biol., v. 154: 30-34, May 31, 1960.

The differential action of the reticular discharge on the contraction of the stapedius and the tensor tympani is studied. Results are presented in graphic form.

1013

Henri-Rousselle Hospital, Paris (France).

[FLUCTUATING FORM OF UNIFYING MOTOR POTENTIALS OF A REINNERVATED DIAPHRAGM] Forme fluctuante des potentiels d'unités motrices d'un diaphragme réinnervé, by M. Dussardier. [1960] [5]p. incl. illus. (AF 61(052)229) Unclassified

Published in Compt. Rend. Séances Soc. Biol., v. 154: 34-38, May 31, 1960.

The contraction of the diaphragm of an anesthetized cat is studied. Results are presented in the form of an electromyogram.

1014

Henri-Rousselle Hospital, Paris (France).

[INHIBITED BULBAR CONTROL OF ELECTRODERMAL RESPONSES] Le contrôle inhibiteur bulbaire des réponses électrodermales, by V. Bloch and M. Bonvallet. [1960] [4]p. incl. table. (AF 61(052)229) Unclassified

Published in Compt. Rend. Séances Soc. Biol., v. 154: 42-45, May 31, 1960.

The conditions under which an afferent stimulation is able to set off an inhibition of sub-cortical origin is studied. It is shown that this inhibition is due to a putting into action of the recticular inhibited bulbar formations. The sequence of this putting into action is studied.

1015

Henri-Rousselle Hospital, Paris (France).

MECHANISMS OF RETICULAR DEACTIVATION, by P. [C.] Dell, M. Bonvallet, and A. Hugelin. [1960] [17]p. incl. diagrs. refs. (AF 61(052)229) Unclassified

Published in Ciba Foundation Symposium on The Nature of Sleep, London (Gt. Brit.) (June 27-29, 1960), Boston, Little, Brown and Co. [1961], p. 86-102.

Passive reticular deactivation, i.e., a diminution in reticular activity as a result of the absence of the every-day stream of stimuli of humoral, interoceptive, exteroceptive and cortical origin, is briefly discussed. Recent experimental facts concerning the origin and initiation of the tonic and phasic effects produced by the cortex and the medulla which bring out an active reticular deactivation are discussed in detail. Some evidence is presented which suggests that, at least in the animal, sleep may result from the cumulative effects of active as well as passive reticular deactivation. (Contractor's abstract)

1016

Henri-Rousselle Hospital, Paris (France).

BULBAR CONTROL OF CORTICAL AROUSAL, by M. Bonvallet and V. Bloch. [1960] [2]p. incl. diagrs. (AF 61(052)229) Unclassified

Published in Science, v. 133: 1133-1134, Apr. 14, 1961.

In the cat, the cortical arousal induced by reticular or nociceptive stimulation is more intense and more long-lasting after elimination of the caudal and medial part of the medulla than in preparations with intact brain. This difference is explained by the intervention of a phasic-ascending inhibitory bulbar control secondarily triggered by the mesencephalic activating system.

1017

Henri-Rousselle Hospital, Paris (France).

[MOVING AND WAKEFUL INTEGRATIONS IN THE ISOLATED BRAIN. I. RETICULAR INHIBITION OF THE OPENING REFLEX OF THE MOUTH] Intégrations motrices et vigilance chez l'encéphale isolé. I. Inhibition réticulaire du réflexe d'ouverture de la gueule, by A. Hugelin and S. Dumont. [1960] [25]p. incl. illus. diagrs. refs. (AF 61(052)229) Unclassified

Published in Arch. Ital. Biol., v. 99: 219-243, July 5, 1961.

It is concluded that the suprabulbar reticular formation exerts a differential action on the different circuit relays of the reflex of the opening of the mouth. Results also show that the inhibition of the reflex response to the stimulation of the lingual nerve is solely due to the control of afferent messages at the level of the first relay.

1018

Henri-Rousselle Hospital, Paris (France).

[MOVING AND WAKEFUL INTEGRATIONS IN THE ISOLATED BRAIN. II. RETICULAR CONTROL OF THE FINAL COMMON PATHWAYS OF THE OPENING AND CLOSING OF THE MOUTH] Intégrations motrices et vigilance chez l'encéphale isolé. II. Contrôle réticulaire des voies finales communes d'ouverture et de fermeture de la gueule, by A. Hugelin. [1960] [26]p. incl. illus. diagrs. refs. (AF 61(052)229) Unclassified

Published in Arch. Ital. Biol., v. 99: 244-269, July 5, 1961.

It is concluded that the reticular discharge entirely frees the final common pathways from the predominating influence exerted by the afferents of groups I and II. Results also show that the different segmentary and supra-segmentary motor relays possess a distinct sensibility to the reticular discharge and that the level of the reticular activity determines the type of motor activity.

1019

Henri-Rousselle Hospital, Paris (France).

[INFLUENCE OF THE RETICULAR FORMATION AND OF THE CEREBRAL CORTEX ON MOTOR EXCITABILITY DURING HYPOXIA] Influence de la formation reticulaire et du cortex cérébral sur l'excitabilite motrice au cours de l'hypoxie, by M. Bonvallet and A. Hugelin. [1960] [15]p. incl. illus. [AF 61(052)229] Unclassified

Published in Electroencephalog. and Clin. Neurophysiol. Jour., v. 13: 270-284, 1961.

In curarized cats, acute progressive hypoxia (6.5%

O_2 in N_2) induces reticular facilitation of motoneurons excitability. The delay of the onset and manner of development of this phenomenon depend on 3 factors: early chemoreflex reticular excitation, direct excitation of reticular cells, and release of a corticofugal inhibitory influence. In the unanesthetized animal with a functional cortex, the onset and the manner of development of motor facilitation of reticular orgin depend entirely on the last of these factors. In encéphale isolé preparations where telencephalic influence had been eliminated by a diencephalic transection of the brain stem (tronc cérébral isolé preparation), acute progressive hypoxia (APH) produces progressive facilitation of the monosynaptic masseter reflex (cranial homologue of a monosynaptic extension reflex). After elimination of the aortic and carotid chemoreceptors, APH still produces motor facilitation, although it is less intense and more delayed than previously. At relatively high partial pressures of oxygen, the progressive facilitation of the motoneurons therefore arises from the increased discharge of the carotid and aortic chemoreceptors. At very low partial pressures of oxygen, however, the facilitatory reticular formation can be excited by another mechanism. Unit recording in an islet of réticulée isolée shows that this action consists of a direct humoral activation of reticular cells. In ordinary encephalé isolé preparations, the development of motor facilitation due to hypoxia is entirely different owing to the presence of a cortical control system. The results indicate that: (a) in the encephalé isolé preparation with functional cortex, reticular activity is subject to tonic inhibitory control which ceases at the moment when cortical activity stops; (b) reticular excitation provoked by intensification of chemoreceptor discharge is controlled in a phasic manner by the same cortical system; (c) these conclusions are similar to those derived from a series of earlier investigations which demonstrated the existence of a feedback system, comprising the ascending activating system, a diffuse cortical system and a cortico-reticular descending system; the static and dynamic properties of this system can account for both the motor and the cortical manifestations obtained during hypoxia. In the non-curarized encephalé isolé preparation or in a preparation with a transection at the level of D_2, acute progressive hypoxia gives rise to a series of movements beginning at the same time as cortical arousal and ceasing at the same time as the convulsions. Since the descending facilitatory reticular activity is not increased simultaneously, it appears that the latter is not necessary for the development even of intense motor activity. The functional consequences of this fact are considered in relation to homeostatic regulation. (Contractor's abstract)

1020

Hermann Föttinger Inst. für Strömungstechnik. Technische Universität, Berlin-Charlottenburg (Germany).

GROWTH OF TURBULENT FLUCTUATIONS IN FREE SHEAR FLOW, by R. Wille, O. Wehrmann, and A. Michalke. Apr. 30, 1961 [52]p. incl. diagrs. refs. (AFOSR-2142) (AF 61(052)412) AD 272261 Unclassified

The results of experimental investigations on the laminar-turbulent transition in a special flow regime are given. They are part of a research program for determining a critical value of vorticity linked with the onset of turbulence. The flow investigated is called a free shear flow and this term is used for a flow region with a velocity gradient or with an asymmetrical velocity profile in an otherwise infinite fluid. The border range of the free jet is a special case of a free shear flow. (Contractor's abstract)

1021

Herner and Co., Washington, D. C.

BASIC RESEARCH RESUMÉS 1960. A SURVEY OF BASIC RESEARCH ACTIVITIES IN THE OFFICE OF AEROSPACE RESEARCH. 1961, 389p. (AFOSR-925) (AF 49(638)903) AD 268200 Unclassified

The purpose here is to promote the broad accessibility of information about fundamental research projects supported by the Air Research and Development Command. The volume is a by-product of a research project whose purpose is the comparative study of indexing systems for scientific information. The subject index used is a working example of one means of organizing highly technical information for search and retrieval. It utilizes a system involving the permutation of key terms in phrases describing the content of documents, or, as in the present case, project outlines. The descriptive phrases, drawn directly from the texts of the project outlines, give as specifically as possible the subject of the work done, and where applicable the method used. Since there are, as a rule, as many descriptive phrases per project outline as there are major subjects discussed, there is an unusual depth and informativeness of index entry. The effectiveness and look-up flexibility of this form of entry are enhanced by the permutation of key terms within descriptive phrases. (Contractor's abstract)

1022

Herner and Co., Washington, D. C.

METHODS OF ORGANIZING INFORMATION FOR STORAGE AND SEARCHING, by S. Herner. Nov. 14, 1961 [12]p. incl. refs. (AFOSR-5038) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)903 and Rome Air Development Center) AD 413947 Unclassified

Presented at Eleventh annual convention of the Amer. Doc. Inst., Massachusetts Inst. of Tech., Cambridge, Nov. 7, 1961.

Also published in Amer. Doc., v. 13: 3-14, Jan. 1962.

The act of organizing bodies of information for subsequent search and retrieval of pertinent parts can be broken down into 2 distinct phases. The first of these 2 phases might be termed the analytical and categorization phase: What is a document about and what subject headings, terms, descriptors, or classes best describe the subject contents of the document. The second phase might be called the file or storage phase: the part given to incorporating the index record of the document into the over-all index record for the entire collection, and to arranging the physical document or an image of the document within the collection of documents or images. A definition of the status of these 2 phases of the organization of information is discussed. Trends and developments that have had a far-reaching effect on how information and sources of information are organized for search, retrieval, and subsequent consultation and use are discussed. Specific projects and project descriptions out of the recent past as illustrative guideposts in the description of trends and developments are used. (Contractor's abstract)

1023

Hull U. [Dept. of Chemistry] (Gt. Brit.).

[KINETICS OF HYDROGEN-OXYGEN, HYDROCARBON-OXYGEN REACTIONS AFFECTED BY INHIBITORS] by R. R. Baldwin. Final rept. Oct. 1961 [6]p. incl. refs. (AFOSR-2015) (AF 61(052)62) AD 272254
Unclassified

Research was conducted to study the explosion limits and slow reaction of H_2 and O_2 as affected by solected inhibitors and reaction vessel surfaces, to establish the mechanism of these reactions. A preliminary study was made of the chemical kinetics of the oxidation of aldehydes and hydrocarbons in the temperature range 450-500°C to determine the most suitable features for detailed study. The effect of addition of CO in aged boric-acid-coated vessels and other surfaces was studied to examine the relative importance of the reactions of CO with O, OH and HO_2 in the H_2/O_2 reaction. (Contractor's abstract)

1024

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

EFFICIENCY OF WATER AS A THIRD BODY IN THE REACTION H + O_2 + M, by R. R. Baldwin and C. T. Brooks. [1961] [7]p. incl. diagrs. tables, refs. (AFOSR-4388) (AF 61(052)62) AD 296191
Unclassified

Also published in Trans. Faraday Soc., v. 58: 1782-1788, Sept. 1962.

The relative efficiency of water ($m_{H_2O} = k_{4,H_2O}/k_{4,H_2}$) as a third body in the reaction H + O_2 + M = HO_2 + M has been studied by examining the effect of water on the second limit of the H_2 + O_2 reaction in KCl-coated and aged boric-acid-coated vessels. m_{H_2O} is independent of vessel surface, temperature (460-540°C) and water vapor concentration (0.4-4%) over a wide range of mixture compositions with H_2/O_2 ratios varying from 5:1 to 1:6. The mean value of 6.4 ± 0.7 obtained from 126 observations is substantially lower than the value quoted by others, but is supported by several independent studies. (Contractor's abstract)

1025

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

THE INHIBITION OF THE HYDROGEN+ OXYGEN REACTION BY FORMALDEHYDE, by R. R. Baldwin and D. W. Cowe. [1961] [14]p. incl. diagrs. table, refs. (AFOSR-J147) [AF 61(052)62] AD 416081
Unclassified

Also published in Trans. Faraday Soc., v. 58: 1768-1761, Sept. 1962.

The inhibiting action of HCHO on the first and second limits of the H_2 + O_2 reaction has been studied in KCl-coated vessels at 540°C. The efficiency of inhibition is almost inversely proportional to the mol fraction of O_2, and is less dependent on the mol fraction of H_2. This indicates that the main primary termination process is the reaction H + HCHO(14) which competes with the reaction H + O_2(2); a smaller contribution results from the reaction of OH + HCHO(15) competing with OH + H_2(1), or from O + HCHO = OH + HCO(13) competing with O + H_2 = OH + H(3). The efficiency of inhibition is independent of diam showing that the HCO radicals are not destroyed at the surface; this is confirmed by the fact that the fraction of HCO radicals undergoing chain-termination reactions is effectively independent of mixture composition and of pressure over the range 4-100 mm Hg. Evidence against the reactions HCO = H + CO and HCO + O_2 = CO_2 + OH is provided, and it is concluded that chain termination ultimately results either from the reaction HCO + O_2 = CO + HO_2, or from the reaction HCO + O_2 = HCO_3, the HCO_3 radicals being destroyed at the surface. The results permit the evaluation of the ratios k_{14}/k_2 and k_{15}/k_1 (or k_{13}/k_3) and from estimates of k_{14}, a value of k_2 can be obtained which agrees with earlier estimates. (Contractor's abstract)

1026

Hull U. [Dept. of Chemistry (Gt. Brit.)]

HOMOGENEOUS GAS-PHASE DECOMPOSITION OF HYDROGEN PEROXIDE, by R. R. Baldwin and D. Brattan. [1960] [10]p. incl. diagrs. table, refs. (Sponsored jointly by [Air Force Office of Scientific Research under AF 61(052)62], Imperial Chemical Industries, Ltd., Royal Soc., and Shell Research Ltd.) Unclassified

Also published in Eighth Symposium (Internat'l.) on Combustion, California Inst. of Tech., Pasadena (Aug. 28-Sept. 3, 1960), Baltimore, Md., Williams and Wilkins Co., 1962, p. 110-119. (AFOSR-TR-60-127)

The kinetics of the homogeneous gas-phase decomposition of H_2O_2 is reviewed. Experimental procedure carried out in this study gives the following results: (1) The decomposition is of first order; and the rate is independent of the total pressure. (2) In the presence of H_2, as the mol fraction of H_2 increases, the decomposition rate increases linearly to a max and then decreases. Mechanisms are proposed for the variation of rate in the presence of H_2.

1027

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

THERMAL AND ISOTHERMAL EXPLOSIONS IN THE INHIBITION OF THE HYDROGEN + OXYGEN REACTION BY HYDROCARBONS, by R. R. Baldwin, D. Booth, and R. W. Walker. [1961] [6]p. incl. diagrs. (AFOSR-J522) (AF 61(052)62) AD 406786 Unclassified

Also published in Trans. Faraday Soc., v. 58: 60-65, Jan. 1962.

The inhibiting efficiency of ethane at the second limit of hydrogen + oxygen + inert gas mixtures was shown to be independent of the inert gas used, thus confirming the isothermal nature of the inhibited boundary. With methane as inhibitor, the efficiency increases in the order: argon, nitrogen, helium, carbon dioxide. This is the order expected if the boundary is thermal in character. Further support for the thermal character of the methane-inhibited limit is obtained from studies of the diam effect, and the observation of pressure pulses in mixtures that do not explode. (Contractor's abstract)

1028

Hull U. [Dept. of Chemistry] (Gt. Brit.).

KINETICS OF HYDROGEN-OXYGEN AND HYDROCARBON-OXYGEN REACTIONS, by R. R. Baldwin. [1961] [2]p. [AF 61(052)62] Unclassified

Presented at Second AFOSR Contractors' meeting on Chemical Kinetics of Propulsion, Illinois Inst. of Tech. Armour Research Foundation, Chicago, Ill., Sept. 11-12, 1961. (AFOSR-1417; AD 265513)

Methane, ethane, propane, butane, ethylene, propylene and formaldehyde were studied to obtain information on the relative rates of reaction of the radicals, H, OH and O, with different hydrocarbons RH, and on the subsequent reactions of the radical R. With all these inhibitors except methane, the inhibited second limit has no isothermal boundary, and the inhibition arises directly from termination reactions of the radical R produced in the primary inhibition process. A detailed study has been made of the slow reaction and second limit of moist carbon monoxide-oxygen mixtures in aged boric-acid-coated vessels. The effects of the concentration of carbon monoxide, oxygen and water vapor, of inert gas addition, of vessel diam and of temperature have been examined. A striking feature of the second limit studies is that the limit rises sharply at low mol fractions of oxygen, recalling the behavior of the hydrogen-oxygen system when quadratic branching is occurring.

1029

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

THE ROLE OF HYDROGEN PEROXIDE AT THE SECOND LIMIT OF THE HYDROGEN + OXYGEN REACTION, by R. R. Baldwin and P. Doran. [1961] [12]p. incl. diagrs. refs. (AF 61(052)62) Unclassified

Published in Trans. Faraday Soc., v 57: 1578-1589. Sept. 1961.

The effect of experimental procedure on the second limit of hydrogen + oxygen mixtures has been examined in fresh and aged boric-acid-coated vessels over the temperature range 440-500°C. At the lower temperatures, and particularly at low mol fractions of O_2, the limit increases significantly with increase in the manipulation time prior to explosion. This is attributed to the fact that the H_2O_2 requires appreciable time to reach its equilibrium concentration, and the important role of H_2O_2 in the quadratic branching mechanism is thus confirmed. Even with very fast manipulation at 440°C, so that initiation by H_2O_2 seems unlikely, there still appears to be a residual quadratic branching effect which is greater in fresh than in aged vessels. It is suggested that this results from a surface initiation which is greater in fresh vessels than in aged vessels: this suggestion also accounts for the increase in limit with decreasing diam found in fresh vessels at 500°C. It is shown that these views on the role of H_2O_2 are consistent with the inhibiting effect of H_2O_2 found by Forst and Giguère (Contractor's abstract)

1030

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

THE DECOMPOSITION OF HYDROGEN PEROXIDE IN THE PRESENCE OF HYDROGEN, by R. R. Baldwin, D. Booth, and D. Brattan. [1961] [4]p. incl. diagr. (AF 61(052)62) Unclassified

Published in Canad. Jour. Chem., v. 39: 2130-2133, Oct. 1961.

Studies were carried out by means of a flow system at atmospheric pressure, the partial pressure of H_2O_2 varying from 0.2-1.0 mm Hg, and partial pressure of H_2 varying from 10-760 mm Hg. The following mechanisms are obtained: (1) $H_2O_2 + M' = 2OH + M'$; (2) $OH + H_2 = H_2O + H$; (3) $H + H_2O_2 = H_2O + OH$; (4) $H + H_2O_2 = H_2 + HO_2$; (5) $OH + H_2O_2 = H_2O + HO_2$; (6) $2HO_2 = H_2O_2 + O_2$; and (7) $H + O_2 + M = HO_2 + M$. The above mechanism is consistent with those obtained by Forst (see item no. LAV.01:021, Vol. II). By assuming that the relative coefficients of H_2 and O_2 are the same in reactions (7) and (1), and since the ratio of the rate constants for reaction (7), $k_{N_2}/k_{H_2} = 0.43$ and for reaction (1) $k_P/k_{N_2} = 6\text{-}7$, the calculated value for reaction (1) k_{H_2}/k_P is ~ 0.33-0.38, whose P is H_2O_2. The value obtained by a plot of the experimental data is 0.30, thus further reactions need not be postulated.



1031

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

THE NATURE OF THE PRIMARY PROCESSES IN ELECTRON AND GAMMA IRRADIATED SYSTEMS, by P. Y. Feng. Feb. 21, 1961 [26]p. incl. diagrs. (AFOSR-241) (AF 18(603)121) AD 251616; PB 154909 Unclassified

A study was conducted on the distribution of the primary events in electron irradiated systems as a function of electron energy. It is shown that, for systems of radiation chemical interest (i. e. with radiation energies in the kev to mev region) approximately one-half of the absorbed energy is dissipated via secondary electrons with average energies less than approximately 60 ev and that variations in the effective spectrum of the electrons occur only in the higher energy region. Since the relative cross sections for the various electronic transitional events are much less sensitively energy dependent with high energy electrons, the results of this model explain satisfactorily the known insensitivity of many primary radiation chemical processes on the initial radiation energy spectrum. (Contractor's abstract)

1032

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

RADIATION EFFECTS ON ORGANIC SYSTEMS, by P. Y. Feng. Final technical rept. Sept. 16, 1956-Jan. 15, 1961. Apr. 13, 1961 [57]p. incl. illus. diagrs. tables, refs. (Rept. no. ARF 1093-16) (AFOSR-555) (AF 18(603)121) AD 256908 Unclassified

The objectives of this research are to study the feasibility of radiation induced "cross-fluorination" for the preparation of organic compounds, the effect of radiation on organic compounds, and to understand certain aspects of the primary processes in radiation chemistry. Several copies of the reports or reproductions of the publications which result directly from this contract are included. (Contractor's abstract)

1033

[Illinois Inst. of Tech.] Armour Research Foundation, Chicago.

STRUCTURE OF DEFECT CLUSTERS IN SOLIDS, by J. W. Buttrey. Terminal rept. Mar. 1, 1960-Mar. 15, 1961. May 12, 1961, 27p. incl. refs. (AFOSR-732) (AF 49(638)829) AD 258384 Unclassified

Preliminary results have been obtained on a small angle scattering study of defect clustering in irradiated single crystals. Silicon single crystals irradiated to a total of 2×10^{19} nvt fast neutron flux fail to show any small angle scattering. Some small angle x-ray scattering was detected from a lightly irradiated sample of LiF, but preliminary results from a lithium-doped silicon single crystal are negative, even though it was thought to contain 100A clusters of pure lithium metal. Such clusters should be detectable using small angle x-ray diffraction; no conclusive reasons are apparent why this sample did not show small angle scattering. Scattering intensity calculations are treated in an appendix. (Contractor's abstract)

1034

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

SIZE DISTRIBUTIONS FROM SMALL ANGLE SCATTERING (Abstract), by R. H. Bragg. [1961] [1]p. (Bound with its AFOSR-732; AD 258384) [AF 49(638)829] Unclassified

Presented at meeting of the Amer. Phys. Soc., Monterey, Calif., Mar. 20-23, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 158, Mar. 20, 1961.

The main features of the size distribution in a system of particles (inhomogeneous regions) are revealed by analysis of the function $h^3I(h)$, where $h = 4\pi \sin \theta/\lambda$ and I(h) is the scattered intensity. For nearly-spherical particles a maximum is found for each mode of the distribution and the location of these maxima are used to determine characteristic sizes for each mode. These sizes are used as a check on the radius of gyration, R, derived from the slope of curves of log I(h) vs h^2. The function $h^3I(h)$ approaches S, the total surface area, for large h provided the experimental conditions approximate infinite slit height collimation. In systems of nonspherical particles the dominant type, i. e., rods, spheres, or plates, is recognized by visual inspection. Other details, such as axial ratios based on an ellipsoidal model of shape are obtained from a simple analysis based on curve fitting.

1035

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

SECOND AFOSR CONTRACTORS' MEETING ON CHEMICAL KINETICS OF PROPULSION. PROGRAM AND ABSTRACTS OF PAPERS, Chicago, Ill., Sept. 11-12, 1961, 20p. (AFOSR-1417) [AF 49(638)847] AD 265513 Unclassified

This meeting allowed investigators concerned with the chemical kinetics of propulsion to discuss the problems of combustion, free radical beams, ion electron kinetics, and kinetics of hydrogen-oxygen reactions. The research conducted with shock tubes and pyrolytic reactions was also discussed. Included also were some reports on low temperature research.

1036

[Illinois Inst. of Tech.] Armour Research Foundation, Chicago.

PHOTOCHEMICAL DECOMPOSITION OF OZONE, by C. K. Hersh. [1961] [1]p. [AF 49(638)847] Unclassified

Preeented at Second AFOSR Contractors' meeting on Chemical Kinetics of Propulsion, Illinois Inst. of Tech. Armour Research Foundation, Chicago, Sept. 11-12, 1961. (AFOSR-1417; AD 265513)

The objective of this program is to compare the thermal and photochemical decomposition rates of gaseous ozone as a method of determining the mechanism of ozone decomposition. Apparatus for the study consists of two one-liter flasks, a fluorocarbon oil manometer, and a reference manometer. The flasks now being used are silvered on the outside to eliminate stray radiation effects. The 2 flasks are separated by the oil manometer and are thermostated. The incident radiation from a sodium light is admitted to one flask at a time. Currently the decomposition is being studied at 61°C and initial ozone pressures of up to 0.25 atm. The experimental procedures are detailed and the thermal data compared with data reported in the literature.

1037

[Illinois Inst. of Tech.] Armour Research Foundation, Chicago.

STUDIES ON RADIATION-IMAGE DETECTORS, by L. Reiffel. [1961] [28]p. incl. illus. diagrs. (AFOSR-1185) (AF 49(638)1010) AD 456576 Unclassified

Also published in Nuclear Electronics; Proc. Conf., Belgrade (Yugoslavia) (May 15-20, 1961), Vienna (Austria), International Atomic Energy Agency, v. 1: 269-284, 1962.

Work underway on radiation detectors capable of preserving spatial distribution information is described. Preliminary problems are to determine intensity distributions in a plane or possibly over a cylindrical surface. This class of problems includes neutron diffraction, neutron radiography and x-ray and γ-ray radiography or scattering studies with these radiations. Emphasis is being given to imaging radiation detectors based on spark breakdown and on luminescence or stimulated phosphorescence. Very large spark counters, which weigh over 100 lb and have sensitive areas of about 2000 cm^2 defined by staggered planar arrays of up to 400 anode and cathode wires are developed. Flow-counter operation using an air or argon-methane gas atmosphere provides an α-sensitive system and slow neutron detection is accomplished with enriched B^{10} converter plates. With other fill gases, proton and electron sensitivity has been demonstrated. Read-out of the intensity distribution is by photographic recording of the spark distribution. Neutron Laue patterns have been recorded in 10 min using the Armour Research Reactor at low power; peak core flux was 10^{11} nv and the collimator was a straight 1 x 1 cm tube. Application of these counters to other neutron studies are described with comments on the ultimate resolution to be obtained with smaller electrode spacings, dynamic scanning and possibly space filtering of the optical image. A second general approach to radiation-image detection concerns the use of luminescent or phosphorescent converter screens. Matrices of luminescent fibres are being tested which comprise very thin glass tubes filled with liquid scintillator. These are useful in x-ray and γ-ray detection and either the wall materials or the core liquid may be "loaded" to obtain neutron sensitivity. New methods of fabricating various types of luminescent fiber screens are presented together with optical performance data also germane to scintillation-chamber technology. Possible imaging detectors using thick blocks of material which are capable of significant energy storage and stimulated phosphorescence upon irradiation are discussed briefly along with read-out methods using optical scanning beams to eliminate resolution loss due to finite phosphor thickness. (Contractor's abstract)

1038

Illinois Inst. of Tech. Dept. of Chemistry, Chicago.

ATTEMPTED PREPARATION OF 2-AZABICYCLO-OCTATRIENE, by S. Kikkawa, R. L. Bartosiewicz, and S. I. Miller. [1961] [2]p. incl. diagrs. (AFOSR-3476) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)39] and National Institutes of Health) Unclassified

Also published in Jour. Org. Chem., v. 27: 320-321, Jan. 1962.

Three approaches to the 2-azabicyclo[2, 2, 2]-octatriene system in order to find analogs of barreiene, bicyclo[2, 2, 2]-octatriene containing nitrogen are described. (1) Experiments carried out to degenerate 1, 4-diazabicyclo[2, 2, 2]octane or Dabco were failures. (2) Electrolysis of 3-styryl-7, 8-dicarboxy-2-azabicyclo[2, 2, 2]-2, 5-octadiene led to undefined products. (3) Treatment of N-benzoyl-3-phenylethynyl-7, 8-dicarboxy-2-azabicyclo[2, 2, 2]-5-octene anhydride with $Pb(OAc)_4$ in decalin yielded some 3-styryl-7, 8-dicarboxy-2-azabicyclo[2, 2, 2]-2, 5-octadiene, benzaldehyde, benzoic acid, stibazole, benzonitrile, and benzylacetophenone. A scheme is proposed to account for 3 plausible intermediates by PbO_2 oxidation. The presence of a fugitive 3-styryl-2-azabicyclooctatriene appeared as a highly plausible precursor of PhCh:CHCOPh and PhCN.

1039

Illinois Inst. of Tech. Dept. of Chemistry, Chicago.

THERMODYNAMIC PROPERTIES IN THE SYSTEM HYDROGEN-HAFNIUM, by R. K. Edwards and E. Veleckis. [1957] [16]p. incl. diagrs. tables.

(AFOSR-1108) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)346] and Office of Naval Research) Unclassified

Presented at meeting of the Phys. and Inorg. Chem. Div. of the Amer. Chem. Soc., Miami, Fla., Apr. 7-12, 1957.

Abstract published in 131st meeting of the Amer. Chem. Soc. Abstracts of Papers, 1957, p. 22R.

Also published in Jour. Phys. Chem., v. 66: 1657-1661, Sept. 1962. (Title varies)

Equilibrium vapor pressure measurements have been carried out as a function of composition for the hydrogen-hafnium system in the temperature range 251-827°C and up to a max pressure of 1 atm. A partial phase diagram is presented. The extrapolated phase boundaries show good correlation with the room-temperature x-ray studies of Sidhu and McGuire. The solubility of hydrogen in the primary solid solution phase, α-Hf, reaches nearly 11 atom-% hydrogen at the highest temperature investigated, but decreases rapidly at lower temperatures. Henry's law is obeyed by monatomic hydrogen in the α-phase. The δ-phase exists from a min composition of 24 atom-% hydrogen at the highest temperature and from 63 atom-% hydrogen at the highest temperature to a max of about 64.3 atom-% hydrogen. The latter composition boundary remains essentially constant with temperature up to 365°, which was as far as observations were made. A very narrow 2-phase region separating the δ-phase field and the ε-phase field is inferred with the latter extending to $HfH_{1.98}$ for the authors' lowest temperature. The relative partial molal and integral thermodynamic quantities in the composition range 0-56 atom-% hydrogen are presented for 779°C. The exothermic nature of the solution reaction was established. The integral enthalpy of solution at 50 atom-% hydrogen (δ-phase) is -32.06 kcal/mol of diatomic hydrogen. The relative partial molal contribution of diatomic at this composition is -40.38 kcal/mol. (Contractor's abstract)

1040

Illinois Inst. of Tech. Dept. of Chemistry, Chicago.

CHEMICAL THERMODYNAMICS OF MATERIAL AT HIGH TEMPERATURES, by R. K. Edwards and P. G. Wahlbeck. Final rept. June 30, 1961 [14]p. incl. diagr. tables. (AFOSR-1109) (AF 49(638)346) AD 259044 Unclassified

The activities of Ga and In are to be determined as a function of the composition of the 2-component system, Ga-In. An investigation of the Sc-H and Y-H systems is in progress. The present effort is aimed at the establishment of the thermodynamic properties of the systems and construction of the phase diagrams. For this purpose, equilibrium H pressure-temperature-composition data are obtained. The behaviors of the Sc-H and Y-H systems are similar, with the equilibrium pressures in the Sc-H system being higher than those of the Y-H system. Experimental work was completed on the volume of mixing of non-interacting spheres of various radius ratios. Glass beads, 126 to 222 μ in diam were used.

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Illinois Inst. of Tech. [Dept. of Chemistry] Chicago.

DISSOCIATION ENERGIES OF DIATOMIC MOLECULES BY THE KNUDSEN-TORSION EFFUSION METHOD (DISSOCIATION ENERGY OF GASEOUS S_2), by P. Budininkas. Jan. 1961 [62]p. incl. diagrs. tables, refs. (AFOSR-1110) (AF 49(638)346) AD 282434 Unclassified

A Knudsen-Torsion effusion apparatus was developed which permits the study of a 2-species gaseous equilibrium system at variable pressures and high temperature. In particular, this apparatus is suitable for the determination of the dissociation energies of S_2, Se_2, and Te_2. The dissociation energy of diatomic sulfur, obtained by this method is 76.46 - 1.36 kcal. This value shows that the spectroscopically observed dissociation of diatomic sulfur is into the 1 normal and 1 excited atom.

1042

Illinois Inst. of Tech. Dept. of Metallurgical Engineering, Chicago.

TRANSIENT AND DESTRUCTIVE INSTABILITY IN TORSION, by N. H. Polakowski and S. Mostovoy. [1961] [13]p. incl. illus. diagrs. table, refs. (AFOSR-592) (AF 49(638)308) Unclassified

Also published in Trans. Amer. Soc. Metals, v. 54: 567-579, Sept. 1961.

Cold stretched or drawn polycrystalline copper, iron and some of their alloys as well as quenched and tempered 4340 steel are shown to deform in torsion by propagation of localized annular shear zones. These zones superficially resemble Luder's bands; the shear strain γ within them increases with the relative initial hardness level, γ reaching 3 to 4.5 after only 50% cold reduction or γ = 1 after quenching and tempering at about 315°C (600°F). The severe local shearing is accompanied by a drooping torque-twist curve which may show several humps, each corresponding to a new band forming and spreading. The phenomenon occurs when the strain-hardening exponent (or Meyer's index) is quite low and is attributed to an easy glide condition progressively developing with increasing prestrain at the planes normal to the specimen axis. While the suggested mechanism is tentative and is less likely to apply to quenched and tempered steel, the effect as such seems to be typical of FCC and BCC metals and alloys of substantially single-phase structure. Moreover, the results presented appear to throw a new light on certain long known but ill-understood aspects of the mechanical behavior of metals. (Contractor's abstract)

1043

Illinois Inst. of Tech. Dept. of Metallurgical Engineering, Chicago.

DIRECT STUDY OF IMPERFECTIONS IN NEARLY PERFECT CRYSTALS, by R. H. Bragg and L. V. Azároff. Mar. 1, 1961 [26]p. incl. diagrs. refs. (AFOSR-308) (AF 49(638)425) AD 254141
Unclassified

Also published in Direct Observation of Imperfections in Crystals, Proc. Technical Conf., St. Louis, Mo. (Mar. 1-2, 1961) New York, Interscience Publishers, 1962, p. 415-429.

The Laue focusing geometry employed by Guinier and Tennevin (Acta Cryst., v. 2: 133, 1949) to observe imperfections in deformed crystals can be used to study imperfections in nearly perfect crystals as well by interpreting the observed intensity distributions in terms of the dynamical theory of x-ray diffraction. A rather perfect silicon crystal was examined by this method. It was found that neighboring regions of the same crystal slice consist of mosaic blocks approx. 10^{-3} cm thick whose relative tilts range from 8 to 12 sec of arc. As suggested by the more qualitative etch pit densities and diffraction line breadths, the central portions of the crystal contain larger blocks with smaller relative misorientations than those lying near the surfaces of the crystal. It is thus possible to use this method to accurately map the distribution of imperfections throughout as small or as large a region of a single crystal as is desired. (Contractor's abstract)

1044

Illinois Inst. of Tech. Dept. of Metallurgical Engineering, Chicago.

STRUCTURE STUDIES OF IMPERFECTIONS IN CRYSTALS, by L. V. Azároff. Final rept. Oct. 1, 1961, 7p. (AFOSR-1463) (AF 49(638)425) AD 264936
Unclassified

Two procedures for studying imperfections present in crystals are described. In 1, electron density distributions in pure and doped CdS and ZnO crystals were obtained and their differences used to determine the imperfections present. This method was sufficiently sensitive to clearly establish the presence and amount of interstitial zinc atoms in ZnO. This excess zinc atom concentration led to the development of a diffusion theory for binary compounds. The second method makes use of the dynamical theory of x-ray diffraction to interpret intensity variations from single crystals in terms of imperfections present in such crystals. It has been applied successfully to transistor grade Si crystals. (Contractor's abstract)

1045

Illinois Inst. of Tech. [Dept. of Metallurgical Engineering] Chicago.

POLARIZATION CORRECTION FOR CRYSTAL-MONOCHROMATIZED X-RADIATION, by L. V. Azároff. [1955] [4]p. incl. tables. (AFOSR-3570) [AF 49(638)425] Unclassified

Also published in Acta Cryst., v. 8: 701-704, Nov. 1955.

For abstract see item no. IIT.04:002, Vol. I.

1046

Illinois Inst. of Tech. [Dept. of Metallurgical Engineering] Chicago.

DIFFUSION PATHS AND ACTIVATION ENERGIES IN AgI AND ZnO CRYSTALS (Abstract), by L. V. Azároff. [1961] [1]p. [AF 49(638)425]
Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 23, Feb. 1, 1961.

The diffusion paths in hexagonal closest packed structures consist of successive octahedral voids and in cubic closest packed structures of alternating octahedral and tetrahedral voids. The saddle points encountered in both paths are the same since 2 adjacent voids share a triangular face composed for 3 closest packed atoms. The activation energy for diffusion is primarily composed of the saddle-point energies because other terms tend to cancel. The existence of continuous paths in the zinc blende and wurtzite structures eliminates the need for vacancies, and it can be shown that the activation energy in β AgI is twice that in γ AgI because 2 saddle points must be crossed in the wurtzite structure as opposed to one only in zinc blende. Similarly, it can be shown that the different activation energies for diffusion of Zn in ZnO measured by electrical and by tracer methods can be explained when actual diffusion paths are considered.

1047

Illinois U. Coordinated Science Lab., Urbana.

ON THE REALIZABILITY OF LINEAR DIFFERENTIAL SYSTEMS, by J. B. Cruz, Jr. [1960] [2]p. incl. diagr. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-56695)
Unclassified

Published in I. R. E. Trans. on Circuit Theory, v. CT-7: 347-348, Sept. 1960.

This is a letter on the application of network theory to generalized linear differential systems. In particular the possibilities of time-varying singularities are considered and the following theorem is proposed: If the input and output variables of a stable system are related by a linear differential equation, then the system function cannot have time-varying singularities.

1048

Illinois U. Coordinated Science Lab., Urbana.

ON A PHASE METHOD FOR TREATING STURM-LIOUVILLE EQUATIONS AND PROBLEMS, by N. Wax. [1960] [18]p. incl. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-56695; and Rand Corporation) Unclassified

Published in Jour. Soc. Indus. and Appl. Math., v. 9: 215-232, June 1961.

The general linear second-order differential equation $d^2W/ds^2 + \nu^2 f^2(s)W = 0$, in which ν is a constant, is investigated by use of the first-order non-linear equation (1) $\frac{dx}{d\theta} = [2 - \sin\theta \frac{d(\log f)}{dx}]^{-1}$, in which the "phase" θ is defined by $W^{-1}(dW/ds) = -f(s)\tan\frac{1}{2}\theta$, and the variable x by $x = \int_0 sf(\eta)d\eta$. Thus if (1) is integrated numerically, the zeros of W will be related to the values of x at which θ is an odd multiple of π. Here, this method is applied to the evaluation of zeros of Bessel functions and quotes numerical results. The results are compared with those of a similar method by F. J. W. Olver (Proc. Cambridge Philos. Soc., v. 46: 570-580, 1950) based on a different definition of phase. Another application is to the evaluation of eigenvalues in boundary-value problems. A method of successive approximation, again based on the numerical integration of (1), is proposed.

1049

Illinois U. Coordinated Science Lab., Urbana.

GENERATION OF WATER WAVES BY THE WIND, by B. L. Hicks. [1959] [2]p. incl. 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 Nature, v. 188: 1016-1017, Dec. 17, 1960.

Data on variation spectral energy density of small deep-water waves with wind-speed and fetch is analyzed. The results indicated the existence of a saturated spectrum at frequencies above a critical value, with spectral density almost independent of speed and fetch and decreasing roughly as f^{-5} (f is the frequency), indicating the presence of gravity waves. The author raises the question of whether large-scale waves in oceans will show a similar saturation effect.

1050

Illinois U. Coordinated Science Lab., Urbana.

COMMENTS ON "OPTIMIZATION BASED ON A SQUARE ERROR CRITERION", by J. B. Cruz, Jr. and G. J. Murphy. [1960] [2]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-95122]) Unclassified

Published in I. R. E. Trans. on Automatic Control, v. AC-5: 328-329, Sept. 1960.

This is a letter denying the validity of some of the mathematical procedures used by Murphy and Bold (I. R. E. Trans. on Automatic Control, v. AC-5: 24-30, Jan. 1960). These comments are refuted by the authors of the original paper, claiming that the limitations imposed on the procedures by the letter would also invalidate the solution of the ordinary Wiener-Hopf integral equation.

1051

Illinois U. Coordinated Science Lab., Urbana.

TERMINAL AND BRANCH CAPACITY MATRICES OF A COMMUNICATION NET, by W. Mayeda. [1960] [9]p. incl. diagrs. (Sponsored jointly by [Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-85122]) Unclassified

Published in I. R. E. Trans. on Circuit Theory, v. CT-7: 261-269, Sept. 1960.

Communication net consists of branches representing communication channels with the weight of each branch being a positive real number which represents the capacity of transferring information through the branch (called a "branch capacity"). The terminal capacity between the vertices i and j of a communication net is the capacity of transferring information between the vertices i and j by considering the net as a whole. To indicate the terminal capacities between all possible pairs of vertices in a net, a terminal capacity matrix is defined. The necessary and sufficient conditions for a terminal capacity matrix are then given. To represent the structure of a communication net, a branch capacity matrix is defined. The synthesis of a communication net from a given terminal capacity matrix can be obtained by using the relationship between a branch capacity matrix and a given terminal capacity matrix.

1052

Illinois U. [Coordinated Science Lab.] Urbana.

DETERMINATION OF THE HYPERFINE STRUCTURE OF ATOMIC NITROGEN BY CONTINUOUS OPTICAL ORIENTATION, by W. W. Holloway, Jr. and E. Lüscher. [1960] [2]p. incl. illus. (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 Nuovo Cimento, Series X, v. 19: 1296-1297, Dec. 16, 1960.

The technique of atomic orientation by optical pumping with spin-exchange was used to measure the hyperfine splitting constants of atomic nitrogen. Cesium was used as the optical pumping agent and air-cooled r f electrodeless discharges produced a continuous supply of N_2 atoms. The zero field splitting for N^{14} was measured as $\nu(5/2 - 3/2) = 26\ 127\ 325 \pm 125$ Hz, $\nu(3/2 - 1/2) = 15\ 676\ 380 \pm 75$ Hz; and for N^{15} as $\nu(2 - 1) = 29\ 290\ 950 \pm 100$ Hz. The hyperfine structure constants were measured as: N^{14} magnetic h f s coupling constant $|A(14)| = 10\ 450\ 928 \pm 45$ Hz, N^{14} quadrupole coupling constant $|B(14)| = 14\ 645\ 475 \pm 50$ Hz. The hyperfine structure anomaly, due to effects of finite nuclear volume is $\Delta = (1.000 \pm 0.006) \times 10^{-3}$.

1053

Illinois U. Coordinated Science Lab., Urbana.

SENSITIVITY CONSIDERATIONS FOR TIME-VARYING SAMPLED-DATA FEEDBACK SYSTEMS, by J. B. Cruz, Jr. [1960] [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

Published in I. R. E. Trans. on Automatic Control, v. AC-6: 228-236, May 1961.

A synthesis procedure for linear time-varying sampled-data feedback systems is described. Just as in the continuous system case, one of the advantages of feedback in a sampled-data system is that it can potentially reduce the effect of plant variations on the system performance. To a certain extent, load disturbance and instrument noise may be simultaneously reduced also. A time-domain sensitivity matrix is defined and used in the design of the digital compensators for prescribed insensitivity of the system to plant variation. In addition, two optimization criteria are presented for the design of these compensators when load disturbance and instrument noise have to be reduced as well. The procedure is also applicable to time-invariant sampled-data systems. (Contractor's abstract)

1054

Illinois U. Coordinated Science Lab., Urbana.

MINIMIZING EFFECTS OF DISTURBING SIGNALS THROUGH MINIMUM SQUARE-ERROR CRITERION, by M. Sobral, Jr. [1960] [6]p. incl. diagr. (Sponsored jointly by [Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-85122] Unclassified

Published in I. R. E. Trans. on Automatic Control, v. AC-6: 306-311, Sept. 1961.

One of the reasons for using feedback is the improvement in the rejection of disturbing signals. This improvement can be obtained through an analytical design utilizing as a performance index the integral square-error criterion. In the usual technique the sum of the command signal plus the disturbing signal transferred to the input of the system is used as the input signal. When this done, 1 of the 2 compensating transfer functions (for the particular case of a system with 2° of freedom) has to be fixed arbitrarily. Then the optimum over-all transfer function, which minimizes the integral of the square of the error between the desired output and the actual one, is calculated and thus the remaining compensator can be obtained. As the technique does not provide a method for determining one of the compensators, and the transferred disturbing signal is a function of this compensator, a required rejection of the disturbing signal may not be satisfied. The purpose of the present paper is to suggest an analytical technique for determining both of the 2 compensators which have the min band-width necessary to satisfy a desired over-all transfer function and a required rejection of a disturbing signal. In addition, the technique provides physically realizable compensating transmission. (Contractor's abstract)

1055

Illinois U. Coordinated Science Lab., Urbana.

SOME TECHNIQUES FOR THE ANALYSIS AND SYNTHESIS OF NONSTATIONARY NETWORKS, by J. B. Cruz, Jr. [1961] [9]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-85122) Unclassified

Presented at I. R. E. Internat'l. Convention, New York, Mar. 20-23, 1961.

Published in I. R. E. Internat'l. Convention Record, Pt. 4: 277-285, 1961.

A class of nonstationary or time-variable linear networks which are realizable as cascades of fixed multi-output networks and multi-input modulators is studied. It is shown that if several of these separable networks are connected in cascade, then under certain conditions, the modulators or time-varying gain amplifiers may be consolidated in one group and the cascade may be realized as a single separable network. Time domain and frequency domain behavior of these networks are examined. Although feedback structures are more difficult to analyze and synthesize, they are potentially advantageous from the standpoint of noise reduction and control of sensitivity due to a component variation. As a starting point in the control of sensitivity in time-varying systems, input-output relationships of interconnected subsystems are formulated using general operators. A sensitivity operator analogous in form to the sensitivity matrix used by Horowitz is then defined and derived for a simple feedback structure. The sensitivity function is quite flexible and may be used in controlling effects of a component variation directly in the time domain, frequency domain, or any other that a designer may choose.

1056

Illinois U. Coordinated Science Lab., Urbana.

ON NUMERICAL INTEGRATION OF ORDINARY DIFFERENTIAL EQUATIONS, by A. Nordsieck. May 1961, 52p. incl. diagrs. tables. (Rept. no. R-127) (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 Math. Comput., v. 16: 22-49, Jan. 1962.

A reliable efficient general purpose method for automatic digital computer integration of systems of ordinary differential equations is described. The method operates with the current values of the higher derivatives of a polynomial approximating the solution. It is thoroughly stable under all circumstances, incorporates automatic starting and automatic choice and revision of elementary interval size, approximately minimizes the amount of computation for a specified accuracy of solution, and applies to any system of differential equations with derivatives continuous or piecewise continuous with finite jumps. (Contractor's abstract)

1057

Illinois U. Coordinated Science Lab., Urbana.

PLATO: AN AUTOMATIC TEACHING DEVICE, by D. Bitzer, P. Braunfeld, and W. Lichtenberger. [1961] [5]p. incl. illus. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, Ordnance Corps, and Signal Corps under DA 36-039-sc-85122) Unclassified

Presented at WESCON Convention, San Francisco, Calif., Aug. 22-25, 1961.

Published in I. R. E. Trans. on Education, v. E-4: 157-161, Dec. 1961.

PLATO (Programmed Logic for Automatic Teaching Operations) is a device for teaching a number of students individually by means of a single, central, high-speed general-purpose digital computer. Each student is provided with his own keyset and television display. The keyset enables the student to control the sequence of materials presented to him by the machine, as well as to transmit to the computer answers to its questions. The computer communicates to each student by closed circuit television. It selects slides and writes or erases sentences and diagrams on a storage tube. These 2 outputs are superimposed and displayed on the student's television screen. Not only are textual materials presented to each student at a rate determined by that student, but the computer frequently poses questions. The student's answers—which may take the form of numerals, algebraic expressions, or words and phrases— are judged by the computer without revealing the correct answer to the question. Supplementary material is presented by the machine upon request for any question which the student finds difficult. The computer keeps detailed records of each student's progress through the material. Though a 2-student version of PLATO is now in operation, the paper describes in detail an earlier 1-student system. The system has been used to present a variety of subject matters, ranging from mathematics to topics in French grammar. (Contractor's abstract, modified)

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Illinois U. Coordinated Science Lab., Urbana.

A TRANSISTORIZED DIGITAL-TO-ANALOG CONVERTER, by W. J. Kopek. Sept. 1961 [61]p. incl. diagrs. tables. (Rept. no. R-130) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-85122) AD 263895 Unclassified

The table of contents is as follows: (1) statement of the problem; (2) general converter considerations pertaining to voltage vs current operation, constant current generators, ladder or weighted resistor arrangement, transistor parameters, and components and operating levels, (3) precision ladder network pertaining to attenuation ratio design, factors involved in ladder attenuation accuracy, and impedance levels and voltage distributions, (4) constant current transistor switch with respect to current generator configuration, factors involved in constant current generation, and output impedance of switch, (5) laboratory results and conclusions concerning laboratory equipment, experimental results, limitations, and possible future research are described and discussed.

1059

Illinois U. [Coordinated Science Lab.] Urbana.

NATURE OF THE V CENTER, by F. Seitz. [1961] [2]p. incl. refs. [DA 36-039-sc-85122] Unclassified

Published in Phys. Rev. Ltrs., v. 7: 282-283, Oct. 1, 1961.

The evidence in support of an interstitial negative ion model for the V_i center is reviewed.

1060

Illinois U. Coordinated Science Lab., Urbana.

LINEAR SYSTEMS WITH TIME-VARYING COMPONENTS, by J. B. Cruz, Jr. [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

Presented at Nat'l. Electronics Conf., Chicago, Ill., Oct. 9-11, 1961.

Published in Proc. Nat'l. Electronics Conf., v. 17: 71-80, 1961.

A survey is given of concepts and methods used in the analysis and design of linear systems with time-varying components. The significance and usefulness of certain input-output characterizations are discuseed. In particular, impulse responee, frequency responee, and general transfer function methods of completely describing a time-varying system are considered. The most commonly known application of these models ie an approximate analyeis of parametric devices. A more recent and very promising application ie the eynthesis of transfer functions which are theoretically realizable by time-invariant elemente but which are unfeasible practically. In many cases, time-variability may be traded off with certain component requiremente such ae high gain-bandwidth product, extremely high Q, or impractical values. In order to facilitate analog simulation and theoretical etability studies, the equilibrium equations are formulated in normal form using convenient state variables. (Contractor'e abstract)

1061

Illinois U. Coordinated Science Lab., Urbana.

THE ELECTROSTATIC INSTABILITY OF A BEAM OF CHARGED PARTICLES PENETRATING A PLASMA, by G. Ascoli. [1961], 30p. (Rept. no. R-131) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Reeearch, and Signal Corps under DA 36-039-sc-85122) Unclassified

The stability of an infinite beam of charged particles penetrating a plasma against small amplitude electrostatic perturbations is investigated. In Section A the dispersion relation is derived, taking into account the velocity distribution of the beam particles. In Section B it is shown that in the presence of collisione the electrostatic instabilities can be quenched if the beam particles have a velocity spread. In Section C the results are applied to a beam of finite croes section held together by its own magnetic field. The criteria for the stability of such a beam against electrostatic perturbations is derived. (Contractor's abstract)

1062

Illinois U. Coordinated Science Lab., Urbana.

THERMAL CONDUCTIVITY OF NORMAL AND SUPERCONDUCTING ALUMINUM, by C. B. Satterthwaite. [1961] [4]p. incl. diagrs. refs. (Sponsored jointly by [Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-85122]) Unclassified

Published in Phys. Rev., v. 125: 873-878, Feb. 1, 1962.

The thermal conductivity of 3 specimens of Al differing widely in residual reeistivity was measured in the normal and superconducting states. The experimental method yielded quite accurate results of the ratio of the superconducting state thermal conductivity to that in the normal state, k_s/k_n. The ratios k_s/k_n, for specimens differing in electronic mean free path by as much as a factor of 140, were essentially the same over the range of temperature covered by the experiments, 0.32-1.20°K. Agreement of the experimental results with the theoretical predictions of Bardeen, Rickayzen, and Tewordt was quite good. (Contractor's abstract)

1063

Illinois U. Coordinated Science Lab., Urbana.

A TECHNIQUE FOR THE ADAPTIVE CONTROL OF HIGH-ORDER SYSTEMS, by E. A. Huber. [1961] [8]p. incl. diagrs. (Sponsored jointly by [Air Force Office of Scientific Research, Office of Naval Reeearch], and Signal Corps under DA 36-039-sc-85122) Unclassified

Published in I. R. E. Trans. on Automatic Control, v. AC-7: 22-29, Apr. 1962.

A technique which is a modification of the model-reference method of adaptive control is developed to handle high-order systems. The transfer function of the model is the inverse of the desired transfer function of the closed-loop eystem insofar ae it ie practically realizable. Proper operation is obtained by adjueting the system until the polee of the closed-loop eystem are canceled by the zeros of the model. Special filtere are designed to aid in the detection of thie cancellation. They have a narrow pulse for an impulee response and the dispersion of this pulse is used as the measure of error when an impulse ie applied to the system. The criterion used for the design of the filter is that ite impulse response should have a minimum second moment about the time of the maximum. The technique is applied to a fourth-order pitch-rate control eystem and the results of the computer simulation are given. (Contractor's abstract)

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Illinois U. Coordinated Science Lab., Urbana.

HYPERFINE INTERACTION CONSTANTS OF THE F-CENTER ELECTRON WITH THE LATTICE IN ALKALI HALIDES (WITH NaCl STRUCTURE), by T. E. Feuchtwang. [1961] [12]p. incl. tables, refe. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Reeearch, and Signal Corps under [DA 36-039-sc-85122]) Unclassified

Published in Phys. Rev., v. 126: 1616-1627, June 1, 1962.

On the basis of the de Boer model for the F center, one can obtain expressions for the coupling constants in the hyperfine interaction of the F electron with a nucleus of the lattice. These constants can be determined experimentally by means of electron nuclear double resonance. The comparison of the theoretical expressions and the empirical values permits an estimate of the importance of the several factors determining these coupling constants. The formal similarity between the magnetic dipole-dipole constants and the

contribution of the F electron to the electric quadrupole coupling constants is exploited. The measured magnetic constants are used in the discussion of the quadrupole constants. It is shown that the polarization of the lattice, as a result of the displacement of the ions in the first few shells around the negative-ion vacancy, is important in determining the electric quadrupole coupling constant. This conclusion is in qualitative agreement with Kojima's calculations in LiF. It also explains the fact that while the magnetic interaction shows negligible deviation for axial symmetry at sites of lower symmetry, this is not true for the electric quadrupole interaction. (Contractor's abstract)

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Illinois U. Coordinated Science Lab., Urbana.

ELECTRON-NUCLEAR DOUBLE RESONANCE SPECTRUM OF AN F-CENTER ELECTRON IN ALKALI HALIDES (WITH NaCl STRUCTURE, by T. E. Feuchtwang. [1961] [8]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-85122) Unclassified

Published in Phys. Rev., v. 126: 1628-1635, June 1, 1962.

From the de Boer model of the F center, one can calculate a spin Hamiltonian to describe the hyperfine interaction of the F-center electron with an arbitrary nucleus in the lattice. In this paper this Hamiltonian is used to construct a spin Hamiltonain describing the hyperfine interaction of the F electron with all nuclei in the lattice in the presence of a constant and uniform magnetic field. From this one can deduce the electron-nuclear double resonance spectrum for the F electron. The negative-ion vacancy (in a cubic lattice) is an inversion center, and the magnetic field is a pseudovector. Consequently, nuclei at sites which are mapped into each other by an inversion in the vacancy are physically equivalent. If this fact is accounted for, then the entire electron-nuclear double resonance spectrum may be viewed as a set of spectra, each one of which is associated with the interaction of the F electron with a particular pair of physically equivalent nuclei. This contrasts with the present theory which assumes that the F electron interacts with individual nuclei. The new theory leads to a marked improvement in the agreement between the calculated and observed spectra. An even more interesting result is that the calculated spectrum is now sensitive to the relative sign of the nuclear g factor and the electric quadrupole coupling constant. Thus the experimental data can be used to determine not only the magnitude but also the sign of the electric field gradient at lattice sites closed to the F center. (Contractor's abstract)

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Illinois U. Coordinated Science Lab., Urbana.

THE DIGITAL ADAPTIVE CONTROL OF A LINEAR PROCESS MODULATED BY RANDOM NOISE, by C. Potle. [1961] [87]p. incl. diagrs. refs. (Rept. no R-134) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-85122) AD 271714 Unclassified

Also published in I. E. E. E. Trans. on Automatic Control, v. AC-8: 228-234, July 1963.

A procedure for the design of a digital controller to compensate a certain class of linear time-varying processes is presented. The process time variation may be rapid compared to the input signals and is assumed to be caused by modulation of a plant with known parameters (perhaps also time-varying) by a number of correlated random disturbances. The general results are applied through digital computer simulation to an example involving a plant modulated at the input by correlated random noise. The adaptive controller employed to compensate this plant is shown to produce far better performance than a nonadaptive fixed controller which cannot take noise correlation into account. Finally, a method of generating sets of correlated gaussian time series with specified cross- and autocorrelation functions is described. Such a technique is required in the simulation study, as well as having important applications in many other fields. (Contractor's abstract)

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Illinois U. Dept. of Chemistry and Chemical Engineering, Urbana.

RAPID AND ACCURATE AUTOMATIC TITRATION OF CALCIUM AND MAGNESIUM IN DOLOMITES AND LIMESTONES: USE OF EDTA TITRANT AND AUTOMATIC DERIVATIVE SPECTROPHOTOMETRIC END-POINT TERMINATION, by H. V. Malmstadt and T. P. Hadjiioannou. [1958] [7]p. incl. diagr. tables, refs. [AF 18(603)137] Unclassified

Published in Anal. Chim. Acta, v. 19: 563-567, Dec. 1958.

A direct automatic derivative spectrophotometric EDTA titration procedure for determination of Ca and Mg in Dolomites and Limestones is described. Calcium is automatically titrated in the presence of Mg at pH 13 using Calcon as indicator, and the total amount of Ca and Mg, at pH 10 using Eriochrome Black T as indicator. The method is simple, precise and accurate, and requires less than 5 min for titrations. The subjective evaluation of end-points is eliminated and the attention of the operator is not required because the titrations are automatically terminated at the end-point. (Contractor's abstract)

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Illinois U. Dept. of Chemistry and Chemical Engineering, Urbana.

AUTOMATIC TITRATION OF CALCIUM OR

MAGNESIUM IN BLOOD STREAM, by H. V. Malmstadt and T. P. Hadjiioannou. [1958] [7]p. incl. tables. [AF 18(603)137] Unclassified

Published in Clin Chem., v. 5: 50-56, Feb. 1959.

Direct automatic derivative spectrophotometric EDTA titration procedures for Ca and Mg in blood serum are described. Calcium is automatically titrated in the Sargent-Malmstadt "Spectro" titrator at pH 13 using Calcon as indicator. The results obtained by the automatic method are of the same degree of accuracy and reproducibility as those obtained by the classic permanganate titration of precipitated calcium oxalate. Total Ca and Mg can be titrated automatically at pH 10 with Eriochrome Black T as indicator, and Mg is calculated by difference between total Ca and Mg and Ca only. The average automatic titration time for each Ca determination is about 10 sec and about 15 sec for total Ca and Mg. The total time for the complete procedure for each Ca or Mg determination is about 3 min. (Contractor's abstract)

1069

Illinois U. Dept. of Chemistry and Chemical Engineering, Urbana.

DETERMINATION OF CHLORIDE IN BLOOD SERUM, PLASMA, OR OTHER BIOLOGIC FLUIDS BY A NEW RAPID PRECISION METHOD, by H. V. Malmstadt and J. D. Winefordner. [1958] [13]p. incl. diagr. table. [AF 18(603)137] Unclassified

Published in Clin Chem., v. 5: 284-296, Aug. 1959.

The new, extremely sensitive and accurate precision null-point potentiometric method has been applied to the determination of chloride in blood serum or plasma and 2 simple procedures are described, one for deproteinized serum and the other for serum directly. Measurements of chloride in diluted serum samples containing only 0.02 ml blood serum can be carried out in less than 1 min by the precision null-point potentiometric method with relative errors less than 0.5% for the complete procedure. Sample manipulations and all other operations for the chloride determination requires about 1-3 min, the longer time for deproteinizing the serum. The same procedure is suitable for chloride determinations in other biologic samples, and the general considerations are presented. (Contractor's abstract)

1070

Illinois U. Dept. of Chemistry and Chemical Engineering, Urbana.

DETERMINATION OF CALCIUM, MAGNESIUM, AND TOTAL HARDNESS BY AUTOMATIC SPECTROPHOTOMETRIC TITRATION, by H. V. Malmstadt and T. P. Hadjiioannou. [1959] [7]p. incl. tables, refs. [AF 18(603)137] Unclassified

Published in Jour. Amer. Water Works Assoc., v. 51: 411-417, Mar. 1959.

A direct, automatic spectrophotometric EDTA titration for calcium and Mg hardness is described. Calcium is determined in the presence of Mg at pH 13 using Calcon as indicator. The total amounts of Ca and Mg are determined at pH 10 using Eriochrome Black T as indicator. Both titrations are automatically terminated at their equivalence points, and the subjective evaluation of endpoints is eliminated. Interference by heavy metals is presented by adding a few drops of KCN. The automatic-titration method was applied to more than a thousand samples with total hardness from 0.5-600 ppm, and the results were very reproducible and accurate. The time required for an automatic titration varies from a few sec to a few min, depending on the water hardness. Sample preparation and manipulation and buret reading require less than a min/water sample. (Contractor's abstract)

1071

Illinois U. Dept. of Chemistry and Chemical Engineering, Urbana.

DETERMINATION OF CHLORIDE BY PRECISION NULL-POINT POTENTIOMETRY, by H. V. Malmstadt and J. D. Winefordner. [1959] [9]p. incl. diagrs. tables. [AF 18(603)137] Unclassified

Published in Jour. Amer. Water Works Assoc., v. 51: 733-741, June 1959.

A new, rapid, accurate procedure is described for the determination of chloride in ground and river water samples. The samples are rapidly prepared for analysis, and chloride is measured by precision null-point potentiometry. Small water samples of 0.01-10 ml are used to cover the wide chloride concentration range of about 4.000-0.04 mg/l; the concentration of standard reagents remains the same throughout this range. The entire procedure for chloride determination in typical water samples, including sample preparation, chloride measurement, and calculation of final results, requires only about 1 min. (Contractor's abstract)

1072

Illinois U. Dept. of Chemistry and Chemical Engineering, Urbana.

MICRO RANGE IODOMETRY BY COMBINING PRECISION NULL-POINT POTENTIOMETRY AND ELECTROLYTIC GENERATION OF IODINE, by H. V. Malmstadt and H. L. Pardue. [1960] [5]p. incl. diagrs. table, refs. [AF 18(603)137] Unclassified

Published in Anal. Chem., v. 32: 1034-1038, July 1960.

The accurate iodometric determination of oxidants and reductants in the micro range has been difficult because of the necessity for maintaining standard iodine and thiosulfate solutions and the errors associated with the iodine-thiosulfate titration.

Combination of the new precision null-potentiometric technique with electrolytic generation of iodine has eliminated the necessity for using thiosulfate as a titrant for iodine and permitted the partial compensation for a number of the difficulties associated with the iodine-iodide system. Oxidants (or reductants) were reacted with an excess of iodide (or iodine) to liberate (or consume) an equivalent amount of iodine and the change in iodine was measured by the precision null-point potentiometric technique. Oxidants and reductants were determined in concentrations equivalent to 0.5-5 ppm of iodine with accuracy and reproducibility better than 0.02 ppm of iodine. (Contractor's abstract)

1073

Illinois U. Dept. of Chemistry and Chemical Engineering, Urbana.

MICRODETERMINATION OF SILVER AND COPPER IN SILVER-COPPER ALLOYS USING PRECISION NULL-POINT POTENTIOMETRY, by H. V. Malmstadt, T. P. Hadjiioannou, and H. L. Pardue. [1960] [3]p. incl. tables. [AF 18(603)137] Unclassified

Published in Anal. Chem., v. 32: 1039-1041, July 1960.

Precision null-point potentiometry has been applied to the determination of micro amounts of Ag and Cu without prior separation. Silver was determined at concentrations between 20-100 ppm with an average error of about 0.1 ppm and relative average deviation of 0.1%. Copper was determined at concentrations between 0.3-4.5 ppm with precision and accuracy better than 0.005 ppm. (Contractor's abstract)

1074

Illinois U. Dept. of Chemistry and Chemical Engineering, Urbana.

SPECIFIC ENZYMATIC DETERMINATION OF ALCOHOL IN BLOOD BY AN AUTOMATIC SPECTROPHOTOMETRIC REACTION RATE METHOD, by H. V. Malmstadt and T. P. Hadjiioannou. [1961] [16]p. incl. diagrs. tables, refs. (AFOSR-1482) (AF 18(603)137) Unclassified

Also published in Anal. Chem., v. 34: 455-458, Apr. 1962.

An automatic spectrophotometric reaction rate method is described for the selective determination of ethyl alcohol in blood. The alcohol is selectively oxidized in the presence of ADH and DPN to form an absorbing species DPNH. The time required for a small fixed (0.06) change in absorbance is measured automatically during the early part of the reaction and the readout value is related directly to alcohol concentration. Measurement times vary from a few sec to a couple of min, and samples vary from 0.1-0.25 ml of blood. The method is sensitive, more rapid than conventional methods and relative errors are only about 2-3% for the entire range of 0.015-0.300 g ethanol/100 ml blood.

1075

Illinois U. Dept. of Chemistry and Chemical Engineering, Urbana.

A NEW AUTOMATIC SPECTROPHOTOMETRIC RATE METHOD FOR SELECTIVE DETERMINATION OF GLUCOSE IN SERUM, PLASMA, OR BLOOD, by H. V. Malmstadt and S. I. Hadjiioannou. [1961] [1]p. incl. diagrs. tables. (AFOSR-1483) (AF 18(603)137) Unclassified

Also published in Anal. Chem., v. 34: 452-455, Apr. 1962.

The instrument used is described. It consists of 5 relatively inexpensive commercial units: a Spectro unit with stable light source, interference filter, sensitive detector, and efficient stirring; a thermostated test tube cell; a measurement unit; control unit; and readout device. Glucose is oxidized selectively in the presence of glucose oxidase and the H_2O_2 produced reacts immediately with iodide in the presence of molybdate catalyst to form tri-iodide which absorbs strongly at about 360 mμ. Near the start of the reaction, the rate of change of the tri-iodide concentration is proportional to the glucose concentration and the time required for a small preset change in tri-iodide concentration is related easily to the glucose in the sample. Glucose is determined in 0.08 ml of serum, plasma, or blood with relative errors within 2% and measurement times are about 1-3 min. The results are tabulated.

1076

Illinois U. Dept. of Chemistry and Chemical Engineering, Urbana.

RESEARCH IN NEW EMISSION AND ABSORPTION SPECTROCHEMICAL METHODS, TECHNIQUES AND APPLICATIONS, by H. V. Malmstadt. Final rept. Sept. 25, 1961 [22]p. incl. refs. (AFOSR-1484) (AF 18(603)137) Unclassified

Summaries are given for work achieved for the following aspects: (1) development of new spectrophotometric titration procedures; (2) turbidimetric titrations with coagulation at the end point; (3) atomic absorption spectrochemical analysis; (4) emission spectrochemical analysis by the spark-in-spray solution technique; (5) spectrophotometric reaction rate methods of analysis. A list of publications is also given.

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Illinois U. Dept. of Chemistry and Chemical Engineering, Urbana.

DETERMINATION OF GLUCOSE IN BLOOD SERUM BY A NEW RAPID AND SPECIFIC AUTOMATIC SYSTEM, by H. V. Malmstadt and G. P. Hicks. [1959] [5]p. incl. diagrs. tables. (AFOSR-3125) [AF 18(603)-137] Unclassified

Also published in Anal. Chem., v. 32: 394-398, Mar. 1960.

The method is based on the coupled enzyme reaction, in which oxidation of glucose is catalyzed specifically, with the subsequent formation of a colored reaction point. A few sec after the start the rate of formation of the colored reaction product is proportional to glucose concentration, and this rate can be measured accurately and automatically within about 1 min after the reaction begins. An instrument was assembled to measure precisely the extremely small change of absorbance that occurs during the first part of the glucose reaction. A time ratio is obtained which is directly proportional to concentration. A few commercially available basic units and an easily constructed control system and enzyme injector are put together so that the glucose measurement is rapid and simple. Automatic results for the determination of glucose in standards and blood serum show good proportionality and a coefficient of variation of about 25%. (Contractor's abstract)

1078

Illinois U. Dept. of Chemistry and Chemical Engineering, Urbana.

SPECIFIC ENZYMATIC DETERMINATION OF GLUCOSE IN BLOOD SERUM OR PLASMA BY AN AUTOMATIC POTENTIOMETRIC REACTION-RATE METHOD, by H. V. Malmstadt and H. L. Pardue. [1961] [10]p. incl. diagrs. tables. (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)-137 and National Heart Institute) Unclassified

Published in Clin Chem., v. 8: 606-615, Dec. 1962.

A new automatic potentiometric reaction-rate method has been applied to the specific enzymatic measurement of glucose in blood plasma or serum. A new filtering technique is described for removal of precipitated protein. The use of injection pipets to simplify and speed up the reagent- and sample-handling step is described. Glucose is determined in 0.02 ml of serum or plasma with relative errors within 2%. The average measurement time is about 30 sec. (Contractor's abstract)

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Illinois U. [Dept. of Chemistry and Chemical Engineering] Urbana.

THE MASS SPECTRUM OF ETHYLLITHIUM VAPOR, by J. Berkowitz, D. A. Bafus, and T. L. Brown. [1961] [4]p. incl. diagr. tables, refs. (AFOSR-220) (AF 49(638)466) AD 253804 Unclassified

Also published in Jour. Phys. Chem., v. 65: 1380-1383, Aug. 1961.

The mass spectrometric results for ethyllithium show that the saturated vapor consists predominantly of a hexamer and a tetramer in roughly equal concentrations at 80-95°C. The presence of hexamer and tetramer suggests a ring structure, rather than a linear configuration. The preferential fragmentation of the C_2H_5 radical during ionization suggests that Li is bonded to more than one atomic center, while C_2H_5 is not. The very high appearance potential of Li^+ in these experiments is further evidence for this conclusion. The majority of freezing point depression studies of ethyllithium in benzene, and in particular those which have been performed with solutes of pure, recrystallized ethyllithium, indicate a degree of association in the range 5-7.

1080

Illinois U. [Dept. of Chemistry and Chemical Engineering] Urbana.

THE INFRARED AND NUCLEAR MAGNETIC RESONANCE SPECTRA OF ETHYLLITHIUM, by T. L. Brown, D. W. Dickerhoof, and D. A. Bafus. [1961] [6]p. incl. diagrs. table, refs. (AFOSR-2064) [AF 49(638)466] Unclassified

Also published in Jour. Amer. Chem. Soc., v. 84: 1371-1376, Apr. 1962.

The infrared spectra for ethyllithium in hydrocarbon solvents, in a Nujol mull, and as a solidified melt are reported. Some bands previously associated with various associated and non-associated species of ethyllithium are shown to be due to lithium ethoxide. The proton and lithium n m r spectra are reported. The spectral results, along with other experimental observations, suggest that ethyllithium exists as a single species in hydrocarbon solvent, probably as a hexamer. Models for both a hexamer and tetramer form of ethyllithium are presented and discussed in terms of the presently known properties of the compound. (Contractor's abstract)

1081

Illinois U. Dept. of Mining and Metallurgical Engineering, Urbana.

RELATIVE POLYGONIZATION RATES IN COPPER AND COPPER-ZINC ALLOYS, by W. E. Heitmann and R. W. Ballufi. [1961] [2]p. incl. illus. table, refs. (AFOSR-3368) [AF 18(603)106] Unclassified

Also published in Jour. Appl. Phys., v. 32: 963-964, May 1961.

Single crystals of Cu, Cu-0.28% Zn, and Cu-31% Zn were deformed and the rate of polygonization on subsequent annealing was measured. Simple theories of polygonization dislocation climb and vacancy diffusion are not in accord with these results.

1082

Illinois U. Dept. of Mining and Metallurgical Engineering, Urbana.

BASIC AND APPLIED RESEARCH ON SEMICONDUCTORS, by E. K. Welse. Final rept. Feb. 28, 1961, 6p. incl. refs. (AFOSR-509) (AF 49(638)212) AD 253674 Unclassified

The results of this contract, concerned with the electrical conductivity properties of magnesium, calcium, strontium, and barium titanates as functions of composition and temperature, are reviewed. Additional details of the work are also presented. Rod shaped samples of magnesium dititanate, magnesium metatitanate, and magnesium orthotitanate were formed by extrusion of the raw material with polyvinylalcohol added as a binder. The results confirm the older discovery of the appearance of a strong magnetic phase in magnesium dititanate at a Ti^{3+} concentration corresponding to 0.18% weight loss. The same compounds were shaped into sintered disc samples for thermoelectric investigations also. Thermoelectric coefficients up to 350 microvolts per degree were found but the correlated electrical resistivities were too high, up to 3000 ohm-cm, for technical applications of these materials for power generation or for refrigeration.

1083

Illinois U. Dept. of Mining and Metallurgical Engineering, Urbana.

SOME COMMENTS ON THE AUSTENITE-MARTENSITE INTERFACE, by C. M. Wayman. Jan. 1961 [13]p. incl. diagr. refs. (AFOSR-116) (AF 49(638)-420) AD 253150 Unclassified

The formal crystallographic theory developed for the description of martensitic transformations apparently now has more far reaching implications than initially intended. In addition to providing reasonable agreement between theory and experiment in known martensite transformations, application of the basic ideas behind the martensite theory have shown that some order-disorder and precipitation type transformations possibly can be accounted for in a crystallographic sense. It thus appears that there may be some fundamental underlying principles governing these different classes of transformations, i.e., some common interface behavior or dislocation distribution at the interface itself. A more thorough understanding of the geometry of the interface involved would add to the development of a dislocation model for interface propagation. In this report, an observation pertaining to the dilation in such an interface—the austenite-martensite interface—is pointed out.

1084

Illinois U. [Dept. of Mining and Metallurgical Engineering] Urbana.

OBSERVATIONS ON THE GROWTH OF α-IRON SINGLE CRYSTALS BY HALOGEN REDUCTION, by C. M. Wayman. [1961] [8]p. incl. illus. refs. (AFOSR-730) (AF 49(638)420) AD 257331 Unclassified

Also published in Jour. Appl. Phys., v. 32: 1844-1845, Oct. 1961.

By large scale modification of established whisker growing techniques, it was possible to produce single crystals of alpha iron between 1 and 2 mm in diam and up to 80 mm in length. These crystals grew along a <100> axis and had {100} faces. The final size of the crystals appeared to depend upon the quantity of $FeCl_2$ vapor available for reduction. Some growth features are reported.

1085

Illinois U. Dept. of Mining and Metallurgical Engineering, Urbana.

AUSTENITE-MARTENSITE CRYSTALLOGRAPHY IN Fe-1.51C-3.09Cr, by K. A. Johnson and C. M. Wayman. [Aug. 1961] [24]p. incl. diagrs. table, refs. (AFOSR-1309) (AF 49(638)420) AD 263898 Unclassified

Also published in Acta Cryst., v. 16: 480-490, June 10, 1963. (Title varies)

An alloy of Fe-1.51 wt-%C-3.09 wt-%Cr undergoes an austenite-martensite transformation at -14°C. The lattice parameters of the austenite and martensite, the lattice orientation relationship, and the habit plane for this transformation were experimentally determined. An analysis of the crystallography on the basis of the Wechsler-Lieberman-Read (Trans. AIME, v. 197: 1503, 1953) and Bowles-Mackenzie (Acta Metall., v. 2: 129, 138, 224, 1954) theories showed that the experimental quantities could not be accounted for completely by either theory. Better agreement may be possible by incorporating an anisotropic dilation into the austenite-martensite interface. This more general theory is under consideration at present. (Contractor's abstract)

1086

Illinois U. Dept. of Mining and Metallurgical Engineering, Urbana.

THE MARTENSITIC TRANSFORMATION IN Fe-31 wt-% Ni, by J. F. Breedis and C. M. Wayman. 1961 [23]p. incl. illus. diagrs. tables, refs. (AFOSR-1979) [AF 49(638)420] AD 270904 Unclassified

Also published in Trans. Metall. Soc. AIME, v. 224: 1128-1133, Dec. 1962.

The crystallography of the martensitic transformation in the Fe-30 Ni alloy was reinvestigated. The scatter in the habit plane as determined from measurements on the mid-rib plane was smaller than reported previously, and the orientation relationship

was determined from a martensite plate having known direction cosines. From agreement with crystallographic theory and from observations of the morphology of the martensite plates, it is suggested that the mid-rib plane represents the starting region of the transformation. (Contractor's abstract)

1087

Illinois U. Dept. of Mining and Metallurgical Engineering, Urbana.

COMMENTS ON THE DILATION IN THE AUSTENITE-MARTENSITE CONTACT INTERFACE, by C. M. Wayman. [1961] [4]p. incl. diagrs. refs. (AFOSR-2788) (AF 49(638)420) AD 613111 Unclassified

Also published in Acta Metall., v. 9: 912-915, Sept. 1961.

The implications to reach a formal crystallographic theory for the description of martensitic transformations are reviewed. Thus far, a reasonably well developed theory is based on an interface (habit) plane which is essentially macroscopically invariant. In the present case, the amount of interface dilation is variable and chosen so that the theory fits the experimentally determined quantities. If the Bowles-Mackenzie dilation parameter is taken to be unity, as in the case of the $\{259\}_A$ transformation in iron alloys, their theory is equivalent to the other ones. This means that an interface dilation parameter can be incorporated into any of the existing theories. The use of such a parameter amounts to adjusting the lattice parameters of one of the coexistent phases at the plane of contact. Various works done by means of a dilation parameter are discussed.

1088

Illinois U. [Dept. of Mining and Metallurgical Engineering] Urbana.

SIMPLIFIED TECHNIQUE FOR POSITIONING SMALL DIAMETER X-RAY BEAMS ON SPECIMENS FOR BACK REFLECTION ANALYSIS, by L. C. Michels and C. M. Wayman. [1961] [2]p. incl. illus. (AFOSR-3363) [AF 49(638)420] Unclassified

Also published in Rev. Scient. Instr., v. 33: 572-573, May 1962.

Existing methods are quoted with their drawbacks. The method described uses a light-beam instead of an x-ray beam for locating the fiducial reference and is applicable to cases where the desired area to be x-rayed may be only 10-20 μ in diam. A graticule is formed on an optical flat with lines 18 μ wide and viewed with a microscope of x100 or more, x and y positioning of the stage is micrometer operated with 0.0025 mm scale divisions for close alignment. Following the preliminary procedure a Hilger microfocus x-ray unit with a 40 μ focal spot is used to follow the optical path.

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Illinois U. [Dept. of Mining and Metallurgical Engineering] Urbana.

THERMALLY ACTIVATED DISLOCATION MOBILITY (Abstract), by R. Thomson and M. Meyer. [1961] [1]p. [AF 49(638)420] Unclassified

Presented at meeting of the Amer. Phys. Soc., Monterey, Calif., Mar. 20-23, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 162, Mar. 20, 1961.

The model of Lothe and Hirth has been extended to higher stress regimes where the kink population is highly perturbed by the external stress. The extension over the original model involves a new set of boundary conditions for kink collisions. The results show a linear stress dependence at low stresses which is equivalent to the original treatment of Lothe and Hirth. At higher stresses, the mobility is exponential in the stress. The model is particularly well suited to a crystal like Ge, where the creep data of Van Bueren are adequately described by the theory in terms of the Peierls energy as computed by Celli. Certain types of impurity effects can also be understood in terms of the pinning of kinks on the line.

1090

Illinois U. [Dept. of Mining and Metallurgical Engineering] Urbana.

THE ZENER RELAXATION IN TERNARY Au-Ag-Zn ALLOYS, by A. Pirson and C. Wert. July 3, 1961 [13]p. incl. diagrs. tables. (AFOSR-1112) (AF 49-(638)672) AD 266243 Unclassified

Presented at Conf. on Internal Friction due to Crystal Lattice Imperfections, Cornell U., Ithaca, N. Y., July 10-11, 1961.

Also published in Acta Metall., v. 10: 299-304, Apr. 1962.

Well-formed Zener damping peaks were observed in ternary alloys of Au, Ag and Zn. The relaxation strength across the ternary along a line of constant Zn concentration of 15 at -% goes through a max at about an equal ratio of Au to Ag. This max is large, being nearly 3 times what might have been expected by averaging the effects of the 2 binaries. The relaxation strength at low concentration of Zn for an alloy of equal ratio of Au to Ag increases as the square of the Zn concentration, as is true for binary alloys. (Contractor's abstract)

1091

Illinois U. [Dept. of Mining and Metallurgical Engineering] Urbana.

DIFFUSION OF GASES IN HAFNIUM, by E.

Bisogni and C. Wert. Aug. 2, 1961 [14]p. incl. diagrs. (AFOSR-1226) (AF 49(638)672) AD 265212 Unclassified

This study shows that damping effects may be a general attribute of ncp alloys and demonstrates that similar peaks appear in alloys of Hf. From this study a number of interesting characteristics of the diffusion of oxygen in the alloys is deduced. A description of the laboratory procedure is included. (Contractor's abstract)

1092

Illinois U. [Dept. of Mining and Metallurgical Engineering] Urbana.

ANELASTIC MEASUREMENT OF DIFFUSION OF OXYGEN IN HAFNIUM (Abstract), by E. Bisogni and C. Wert. [1961] [1]p. [AF 49(638)672] Unclassified

Presented at meeting of the Amer. Phys. Soc., Monterey, Calif., Mar. 20-23, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 173, Mar. 20, 1961.

The anelastic behavior of hafnium has been measured in the temperature region 25° to 700°C. Two regions of high damping were observed, 1 a distinct damping peak at about 475°C (for 1 cps), the other a region of constantly increasing damping starting at 500°C and increasing steadily with temperature to 700°C, where the measurements stopped. The first of these is identified as being caused by diffusion of oxygen (and possibly nitrogen) in hafnium. The second is believed to be grain boundary damping. These results are similar to those found for alloys of titanium and oxygen by Miller and Weinig and Gupta. In the present investigation most attention was paid to the peak at 475°C. It is enhanced in magnitude by oxidizing treatments. It is also enhanced by nitriding treatment, but this may be caused by oxidation during the nitriding. The activation energy for the peak is 52 to 58 kcal/mol, close to that reported for diffusion of oxygen in hafnium. A model is proposed for the damping effect.

1093

Illinois U. [Dept. of Mining and Metallurgical Engineering] Urbana.

ENERGY-BAND STRUCTURE OF SOLIDS FROM A PERTURBATION ON THE 'EMPTY LATTICE', by F. Bassani and V. Celli. [1960] [12]p. incl. diagrs. tables, refs. (AFOSR-384) (AF 49(638)819) AD 612226 Unclassified

Also published in Jour. Phys. and Chem. Solids, v. 20: 64-75, June 1961.

A simple perturbation approach is developed to obtain the energy-band structure of solids. The unperturbed Hamiltonian consists of the kinetic part and of a uniform potential; the perturbing operator is the crystal potential plus a term which originates from the requirement that valence and conduction states be orthogonal to the inner states. This amounts to an approximation to the O. P. W. method. Reasons are given for the validity of such a simple scheme and applications are made to the case of the diamond lattice and of the zincblende lattice. It is shown how features of the energy-band structure depend on the symmetry of the lattice, on the lattice parameter and on the 'core states' of the atomic components. Numerical results obtained for diamond, silicon and BN are in fair agreement with recent calculations. An energy-band structure consistent with experimental information is obtained for Ge and GaAs by fixing the values of a few parameters. (Contractor's abstract)

1094

Illinois U. [Dept. of Mining and Metallurgical Engineering] Urbana.

THE FRENKEL KONTOROVA DISLOCATION IN A DISCRETE LATTICE, by R. Hobart. Apr. 28, 1961, 1v. incl. diagrs. refs. (AFOSR-647) (AF 49(638)-819) AD 258645 Unclassified

Presented at meeting of the Amer. Phys. Soc., Monterey, Calif., Mar. 20-23, 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 163, Mar. 20, 1961.

The drag on a moving dislocation due to buffeting by the Peierls hills is studied. Hart has calculated the drag with an assumption that the dislocation motion is inertially dominated. Arguments are given which cast some doubt on this assumption and show it is critical to the results. An alternative approach is proposed and studied in the Frenkel-Kontorova model. A solution to the F-K nonlinear difference equation is obtained. The effect of the Peierls energy can be localized as due to a force on a single central atom. For a moving dislocation this force acts as a source for outgoing radiation. The problem is studied as a driven normal mode problem in a continuous F-K model. The point driven responds both inertially and resistively. The latter response is directly related to the loss of translational energy to radiation and thus to the buffeting drag. A nonlinear partial differential equation describing a Peierls-Nabarro model is proposed to serve as the basis of a similar calculation in 3 dimensions.

1095

Illinois U. [Dept. of Mining and Metallurgical Engineering] Urbana.

A SOLUTION TO THE FRENKEL-KONTOROVA DISLOCATION MODEL, by R. Hobart and V. Celli. [1961] [3]p. incl. table. (Technical note no. 3) (AFOSR-953) (AF 49(638)819) AD 451555 Unclassified

Also published in Jour. Appl. Phys., v. 33: 60-62, Jan. 1962.

An exact solution to the nonlinear difference equation which describes a static configuration in the Frenkel-Kontorova dislocation model is given. The solution is in terms of a power series which is proved convergent. Previously, only approximate solutions had been obtained by replacing the difference equation by a differential equation. A numerical comparison is made between the exact and the approximate solutions and the Peierls energies they give. (Contractor's abstract)

1096

Illinois U. [Dept. of Mining and Metallurgical Engineering] Urbana.

KINETIC THEORY OF DISLOCATION CLIMB. II. STEADY STATE EDGE DISLOCATION CLIMB, by R. W. Balluffi and R. M. Thomson. [1961] [10]p. incl. diagrs. table. (Technical note no. 5) (AFOSR-1277) (AF 49(638)819) AD 456577 Unclassified

Also published in Jour. Appl. Phys., v. 33: 817-826, Mar. 1962.

Quantitative expressions for the steady state climb rate of a straight unconstrained edge dislocation are obtained. The results represent specific solutions to a general kinetic model of climb developed in Part I (item no. 1097, Vol. V). Solutions are obtained for the case where interstitials in the lattice can be neglected compared to vacancies, where the dominant point defects responsible for fast diffusion along dislocation cores are vacancies, and where unlike jogs attract one another. No a priori assumptions are made about the ability of the dislocation or its jogs to maintain local point defect equilibrium. A wide range of conditions is treated including positive and negative climb where the vacancy concentrations may be either near or far from equilibrium. Positive and negative climb are shown to be inherently different processes, and it is found that dislocations tend to get joggy in crystals far from equilibrium. Several brief applications to problems of current interest are given. A need for critical experiments is emphasized. (Contractor's abstract)

1097

Illinois U. [Dept. of Mining and Metallurgical Engineering] Urbana.

KINETIC THEORY OF DISLOCATION CLIMB. I. GENERAL MODELS FOR EDGE AND SCREW DISLOCATIONS, by R. M. Thomson and R. W. Balluffi. [1961] [14]p. incl. diagrs. refs. (Technical note no. 4) (AFOSR-1278) (AF 49(638)819) AD 456578 Unclassified

Also published in Jour. Appl. Phys. v. 33: 803-816, Mar. 1962.

General kinetic models are established for the climb of edge and screw dislocations. The climb of a straight unconstrained edge dislocation is considered in terms of the diffusion of nonequilibrium point defects to (or from) the line and their absorption (emission) and destruction (creation) at the line. The climb is nucleated by the formation of short rows of defects which are attached to the edge of the extra plane and are bounded by jog pairs. Climb occurs by the growth of these aggregates until they destroy each other by mutual collisions. No a priori assumptions are made about the ability of either the dislocation or the jogs to maintain local point defect equilibrium during climb, and account is taken of rapid defect diffusion along the core. Effects of nonequilibrium defects in perturbing the jog population are also included. Equations describing this edge dislocation climb are developed but are left in a general form. Complete solutions are worked out in Part II (item no. 1096, Vol. V). Complications which arise when geometrical constraints and line curvature are present are discussed, and a description of the relationships between curvature, macroscopic line tension, and jog density is given. It is concluded that the results for the unconstrained climb model can be used in many such cases over a considerable range of conditions. The treatment of screw dislocation climb focuses attention on the climb of an initially straight dislocation into a multi-turned helix. The detailed mechanisms are found to depend strongly upon the geometry and mobility of point defects and point defect aggregates on the core, and therefore only a qualitative theory is given. It is suggested that in many crystals vacancies largely dissociate into kinks when they enter the core, and that the helical turns build up rather uniformly along the line by the aggregation of ordered arrangements of these kinks. (Contractor's abstract)

1098

Illinois U. [Dept. of Mining and Metallurgical Engineering] Urbana.

ELECTRONIC STATES ON DISLOCATIONS IN SEMICONDUCTORS, by V. Celli, A. Gold, and R. [M.] Thomson. [1961] [2]p. incl. diagr. (AFOSR-3625) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)819] and Office of Naval Research) AD 612341 Unclassified

Also published in Phys. Rev. Ltrs., v. 8: 96-97, Feb. 1, 1962.

The question of the pure shear-strain field of a screw dislocation giving rise of acceptor levels in Ge is considered theoretically. Calculation shows that a screw dislocation produces a bound state at 0.045 ev below the conduction band edge, while preliminary studies suggest that <112> edge and <110> 60° locations also produce states about 0.05 ev below the edge.

1099

Illinois U. [Dept. of Physics] Urbana.

SURFACE STUDIES IN ULTRAHIGH VACUUM BY

RADIO-TRACER TECHNIQUES, by E. Von Goeler. Jan. 1961, 74p. incl. diagrs. tables, refs. (Rept. no. TN-3) (AFOSR-113) (AF 18(603)49) AD 252022
Unclassified

A number of laboratory techniques relevant to surface research have been developed, most prominent of which is the production of ultrahigh vacuum that can be maintained for indefinite periods of time. One of the basic surface phenomena is the interaction of single atoms or molecules with the surface. Statistical thermodynamics can be used profitably to establish simple relations between the surface forces, the temperature, and the number of particles being adsorbed to the surface. Detection is facilitated by the use of radioactive isotopes. The method is straight-forward and has been repeatedly employed. The results of such experiments are questioned, however, since problems which arise from the necessity for establishing a well defined, uncontaminated surface, have not been solved satisfactorily. An attempt was made to overcome these difficulties and improve the radiotracer method so that it can be considered a respectable tool of clean surface research. (Contractor's abstract)

1100

Illinois U. Dept. of Physics, Urbana.

ADSORPTION STUDY OF GOLD ATOMS ON MOLYBDENUM, by E. Von Goeler and E. Lüscher. [1961] [1]p. (AFOSR-3553) (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(603)49], Office of Naval Research and Signal Corps)
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. 1: 161-173, 1962.

Condensation and desorption of gold atoms on a surface of clean polycrystalline molybdenum was investigated at a total gas pressure of $2 \cdot 10^{-9}$ Torr using a radiotracer method. The sticking coefficient of gold on Mo was found to be $S_o = 1$. From desorption measurements performed at temperatures ranging from 300 to 1400°K, the desorption energy for Au on a clean polycrystalline molybdenum surface was determined to be: $E_D = 3.9 \pm 0.3$ ev.

1101

Illinois U. Dept. of Physics, Urbana.

BLEACHING AND SYMMETRY PROPERTIES OF THE V_4 CENTER, by J. D. Kingsley. [1961] [5]p. incl. diagrs. (AFOSR-4257) (Sponsored jointly by [Air Force Office of Scientific Research under AF 49-(638)529] and Office of Naval Research)
Unclassified

Also published in Jour. Phys. and Chem. Solids, v. 23: 949-953. July 1962.

V_4-centers were formed by exposing KBr crystals to x-rays at 175°K. The partial optical bleaching of the V_4-band at 80°K and its regeneration caused by raising the temperature of the crystal above 164°K or by exposing the crystal at wavelengths outside the V_4-band were investigated. The symmetry of the V_4-center was investigated by making the V_4 absorption band dichroic and it was found that the bleaching and regeneration properties of the center occur because a V_4-center is excited strongly by radiation polarized along one of the <100> crystal axes and weakly by radiation in a direction orthogonal to this axis. It is concluded that the available results indicate that the V_4-center may be the antimorph of the F-center. (Contractor's abstract)

1102

Illinois U. Dept. of Physics, Urbana.

FINE STRUCTURE IN THE ABSORPTION EDGE OF THE SILVER HALIDES, by F. C. Brown, T. Masumi, and H. H. Tippins. Aug. 1961 [20]p. incl. diagrs. tables, refs. (Technical note no. 6) (AFOSR-1392) (AF 49(638)579) AD 611301
Unclassified

Presented at the 1961 Internat'l. Conf. on Photoconductivity, Cornell U., Ithaca, N. Y., Aug. 21-24.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 478, Nov. 24, 1961.

Also published in Jour. Phys. and Chem. Solids, v. 22: 101-107, Dec. 1961.

The results of new optical absorption measurements on pure AgCl and AgBr will be reported and compared with the wavelength dependence of photoconductivity in these materials. Detailed structure consisting of low-level absorption tails and several shoulders has been found at various temperatures down to 4.2°K. The data will be analyzed in terms of indirect optical transitions together with a plausible band structure and vibration spectrum.

1103

Illinois U. Dept. of Physics, Urbana.

RECOMBINATION OF ELECTRONS AND DONORS IN SEMICONDUCTORS, by G. Ascarelli and S. Rodriguez. Aug. 1961 [17]p. incl. diagrs. refs. (Technical note no. 7) (AFOSR-1393) (AF 49(638)-579) AD 454655
Unclassified

Presented at the 1961 Internat'l. Conf. on Photoconductivity, Cornell U., Ithaca, N. Y., Aug. 21-24.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 485, Nov. 24, 1961.

Also published in Jour. Phys. and Chem. Solids, v. 22: 57-62, Dec. 1961.

A description is given of a calculation of the recombination of electrons in the conduction band of a semiconductor with ionized donor impurities. The process which is assumed, consists in the initial capture of the electron in an excited state of the donor center followed by a transition to the ground state. This mechanism is most effective in the case in which all transitions are accompanied with emission or absorption of phonons. The results obtained are compared with earlier theoretical calculations and with experiments. The agreement between the present theory and experiment is reasonably good.

1104

Illinois U. Dept. of Physics, Urbana.

MOBILITY OF ELECTRONS IN SILVER CHLORIDE AT HIGH ELECTRIC FIELD, by T. Masumi. Oct. 1961 [9]p. incl. diagrs. refs. (Technical note no. 8) (AFOSR-1706) (AF 49(638)579) AD 267224 Unclassified

Also published in Phys. Rev., v. 129: 2564-2565, Mar. 15, 1963.

The theory of the polaron in ionic crystals usually applies to a slow electron in thermal equilibrium with the crystal lattice. As the electron gains energy from an electric field departing from thermal equilibrium, it is expected that the slow electron concept will begin to fail and, in addition, certain differences in electron scattering will take place. The mobility of electrons in AgCl under high electric field was investigated in order to clarify these points. (Contractor's abstract)

1105

Illinois U. Dept. of Physics, Urbana.

LIFETIME OF THE EXCITED F-CENTER, by R. K. Swank and F. C. Brown. Nov. 1961 [11]p. incl. diagrs. table. (Technical note no. 9) (AFOSR-1842) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)579 and National Science Foundation) AD 271392 Unclassified

Also published in Phys. Rev. Ltrs., v. 8: 10-12, Jan. 1, 1962.

Because of the strong absorption of the F-band in alkali halide crystals, it was assumed that the radiative lifetime of the excited state would be of the order of that for an allowed atomic transition. It is the purpose of this analysis to report direct measurement this lifetime, showing that it is of the order of 10^{-6}/sec. It also will be shown how measurements of photoconductivity, luminescence, and lifetime may be used to obtain interesting information about the excited states of the F-center. (Contractor's abstract)

1106

Illinois U. [Dept. of Physics] Urbana.

MAGNETORESISTANCE OF THE SILVER HALIDES, by H. H. Tippins. Dec. 1961 [54]p. incl. diagrs. refs. (Technical note no. 10) (AFOSR-2040) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)579 and General Electric Foundation) AD 271393 Unclassified

A study was made of the effect of a magnetic field on the conductivity, i. e., the magnetoresistance effect. The detailed behavior of conduction electrons in a solid in the presence of external fields is determined primarily by 2 factors, the band structure of the material, and the scattering processes which the electrons experience. Comparison of experimental results with the theoretical predictions for various assumed band structures and scattering mechanisms could provide important evidence for the correct band structure and scattering to be associated with the particular material of interest. To obtain the full information available from electronic conduction measurements it was necessary to apply both electric and magnetic fields.

1107

Illinois U. [Dept. of Physics] Urbana.

HALL MOBILITY OF ELECTRONS IN PURE SILVER CHLORIDE (Abstract), by T. Masumi and F. C. Brown. [1961] [1]p. [AF 49(638)579] Unclassified

Presented at meeting of the Amer. Phys. Soc., Monterey, Calif., Mar. 20-23, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 131, Mar. 20, 1961.

The Hall mobility of photoelectrons in crystals of AgCl was studied as a function of temperature down to 5°K using pulse techniques as previously reported. (item no. ILL. 08:016, Vol. II). Further measurements for samples of different preparation and purity have been made in an attempt to determine the factors which control electron scattering. Very high purity AgCl was prepared by zone refining in a halogen atmosphere starting with the central portions of previously zone refined ingots. A few crystals containing additions of certain heavy metal impurities were also investigated. The results show that electron mobility below 40°K is a sensitive function of crystal purity. Mobilities in excess of 2×10^4 cm^2/v-sec have been observed in the purest crystals whereas heavy metal additions in concentrations of the order of 1 part in 10^5 reduce the residual mobility to values below 3×10^3 cm^2/v-sec. Optical mode scattering is definitely observed above 40°K in the pure crystals, and, in fact, the Debye temperature associated with longitudinal optical vibrations can be deduced from the mobility experiments for comparison with Reststrahl data.

1108

Illinois U. Dept. of Physics, Urbana.

LOW-FIELD BREAKDOWN IN n-TYPE GERMANIUM, by G. Ascarelli. [1961] [15]p. incl. diagrs. table, refs. (In cooperation with Massachusetts Inst. of Tech., Cambridge) [AF 49(638)579] Unclassified

Published in Nuovo Cimento, Series X, v. 22: 251-265, Oct. 16, 1961.

Measurements of the time necessary to produce low field break-down in n-type germanium have been made as a function of the applied electric field; this time interval is proportional to E^{-2}. The experimental results presented herein, as well as the results obtained from dc measurements can be explained (on the basis of the avalanche multiplication model of breakdown) if it is assumed that the distribution function of the electrons whose energy is smaller than the ionization energy of the impurities is given by $f(x) \propto (1 + px) \exp [-x]$ (where p is proportional to $(\mu_0 E)^2$ with μ_0 equal to the observed low field mobility, $x = \epsilon/kT$, where ϵ is the electron energy) and that the cross-section for impact ionization is constant for $\epsilon > \epsilon_0$ and equal to zero for $\epsilon > \epsilon_0$. (Contractor's abstract)

1109

Illinois U. Dept. of Physics, Urbana.

LIFETIME EFFECTS IN CONDENSED FERMION SYSTEMS, by A. Bardasis and J. R. Schrieffer. [1961] [3]p. incl. diagr. (AFOSR-1102) [AF 49(638)882] Unclassified

Also published in Phys. Rev. Ltrs., v. 7: 79-81, July 15, 1961.

An integral equation for the energy gap at $T = 0°K$ is obtained using a Green's function method which includes finite-lifetime effects. The effects of damping on this equation are considered. Damping lowers the possible critical temperature T_c of liquid He^3, the value $T_c = 8 \times 10^{-4}°K$ being obtained using a separable effective 2-body potential.

1110

Illinois U. Dept. of Physics, Urbana.

EXCITONS AND PLASMONS IN SUPERCONDUCTORS, PART I. LIFETIME EFFECTS IN CONDENSED FERMION SYSTEMS, PART II, by A. Bardasis. Nov. 1961 [109]p. incl. diagrs. refs. (Technical rept. no. 1) (AFOSR-2045) (AF 49(638)882) AD 271181 Unclassified

The exciton mode in the superconductor as a bound pair of quasi-particles whose center-of-mass propagates with a certain momentum is discussed. The exciton spectrum is investigated through generalized equations of motion involving the quasi-particle operators of Bogoliubov and Valatin rather than c_k, the usual electron operators. In these equations an expansion of the interaction potential in terms of spherical harmonics is presented. It is found that excitons may be characterized by the approximate quantum numbers L and M describing the symmetry of the states with respect to the relative coordinates. The existence of an L-state exciton (corresponding to the p, d, f, ... excitons) is dependent on VL being negative, where VL is the L-wave part of the interaction potential. The plasmon state corresponds to an s-state exciton whose energy is greatly increased by the long-range Coulomb interaction.

1111

Illincis U. [Dept. of Psychology] Urbana.

TEST OF THE HYPOTHESIS OF PSYCHOLOGICAL REFRACTORY PERIOD, by J. A. Adams. [1961] [8]p. incl. diagrs. tables, refs. (AFOSR-2099) (AF 49(638)371) Unclassified

Also published in Jour. Exper. Psychol., v. 64: 280-287, Sept. 1962.

An experiment was performed to test the hypothesis of psychological refractory period that is offered to account for the established finding that response to the second of 2 closely spaced stimuli shows decrement. One line of explanation argues for a central decision time, where time must be allowed for processing the first stimulus and response before the second sequence can be undertaken. A competing explanation is the expectancy hypothesis which ascribes decrement to S's past experience with the random array of interstimulus intervals that is usually used in experiments on this topic. Through practice, S comes to expect a longer delay and the decrement is because he is not optimally ready to respond. The experiment involved a 2-dimensional, bisensory discrete tracking task. The statistical structure of interstimulus time intervals was the experimental variable aimed towards discriminating between the 2 hypotheses by asking if decrement could be a function of the temporal organization of stimuli. The results supported the expectancy hypothesis. Reliably less decrement was found for Ss who trained on a stimulus series with a predominance of small time intervals and could learn behavior appropriate to them. (Contractor's abstract)

1112

Illinois U. Electrical Engineering Research Lab., Urbana.

STUDIES IN QUANTUM AND SOLID STATE ELECTRONICS, by R. Strain, R. Swendson, and D. Akitt. Technical operating rept. no. 10, June 1-Nov. 30, 1961. Dec 1, 1961, 8p. (AFOSR-2099) (AF 18-(603)62) Unclassified

Status of the work and plans for the immediate future

are outlined with respect to laser studies, solid state maser, and non-linear quantum mechanics. Work achieved is summarized as follows: (1) Optical pumping: Techniques of Zeeman resonances in Cs were observed with great reliability and sensitivity. (2) A laser facility capable of delivering up to 3200 joules at 4 kv and down to 24 joules at 4000 v has been assembled. (3) A dark-ruby maser has been designed for operation at a frequency of 480 kmc, utilizing transition among the spin levels in the ground state of the Cr-pairs that are responsible for fluorescence at 7010A. Extensive calculations have been made on the behavior of quantum mechanical dipoles in the presence of static and dynamic fields. (4) A new system for the dielectrically loaded Fabry-Perot interferometer shows a high interaction impedance, coupled with a nearly plane wave output, and the capability for frequency selection. (5) An experimental study of Mylar electron beam windows was completed.

1113

Illinois U. Electrical Engineering [Research Lab.] Urbana.

MYLAR ELECTRON BEAM WINDOWS, by W. H. Stier. [1961] [2]p. incl. table. (AFOSR-J72) (AF 18-(603)62) AD 400466 Unclassified

Also published in I. R. E. Trans. on Electron Devices, v. ED-8: 436-437, Nov. 1961.

Thin sheets of Mylar have been found a useful material for electron beam windows for beams in the 0.5- to 1.0 mev energy range. The material finds special application in beam excited plasma devices where the plasma and the electron gun are to be held at different pressures. Experiments are described in which the amount of beam scatter and beam debunching caused by the Mylar are determined. Data are presented on the damage to the Mylar caused by the electron beam and the resultant decrease in pressure differential that the bombarded Mylar can withstand. The experiments were also conducted using Mylar sheets coated with 4000-5000 A coatings of aluminum. (Contractor's abstract)

1114

Illinois U. [Electrical Engineering Research Lab.] Urbana.

FREQUENCY CONVERSION IN A MICROWAVE DISCHARGE, by J. R. Baird and P. D. Coleman. [1961] [11]p. incl. illus. diagrs. tables. (AFOSR-J74) (Sponsored jointly by Atomic Energy Commission, [Air Force Office of Scientific Research under AF 18-(603)62], and Wright Air Development Division) AD 400468 Unclassified

Also published in Proc. Inst. Radio Engineers, v. 49: 1890-1900, Dec. 1961.

One nonlinear property of a microwave discharge located between 2 closely spaced parallel plates whose dimensions are small compared to the wavelength is analyzed. This discharge geometry, with its small volume, permits the attainment of CW microwave power densities in the discharge of the order of 0.1-1 mw/cm^3. It is concluded that the high power density coupled with the high diffusion rate of the closely spaced parallel plates results in a modulation of the electron density at the microwave frequency. The source of this nonlinearity is postulated to be a modulation of the ionization frequency ν_i whose functional form is taken to be $\nu_i = \alpha|v_d|$ where v_d is the ordered drift velocity and α is a proportionality factor constant in time. The theoretical analysis is compared to experimental results obtained by approximating the assumed geometry in an X-band and K-band frequency multiplier and in an X-band mixer. Harmonics up through the 7th at X band and up through the 4th at K band are studied. Frequency mixing of 9- and 11-kmc signals in s yielded predictable results. Parametric amplification in a discharge is briefly considered. (Contractor's abstract)

1115

Illinois U. Electrical Engineering Research Lab., Urbana.

ELECTRON BEAM EXCITATION OF A FABRY-PEROT INTERFEROMETER, by M. D. Sirkis, R. J. Strain, and W. E. Kunz. [1961] [2]p. incl. illus. diagrs. (AFOSR-J77) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)62 and Wright Air Development Division) AD 400386 Unclassified

Presented at Electron Device Conf., Troy, N. Y., June 21-23, 1961.

Also published in Jour. Appl. Phys., v. 32: 2055-2056, Oct. 1961.

Calculations show that the Fabry-Perot interferometer is a practical resonator for generation of short microwaves by electron beam techniques. An interferometer with dimensions of many wavelengths was used to extract energy from a 1 mv bunched electron beam. Harmonics of 8.15 mm were extracted. The theory of the system is given. The experimental interferometer is 7.6 cm in diam, the Teflon cylinder length is 12.5 cm. This dielectric Fabry-Perot resonator provides a large and easily predicted interaction with a bunched electron beam.

1116

Illinois U. [Electrical Engineering Research Lab.] Urbana.

ELECTRON DEVICES FOR THE MILLIMETER-INFRARED GAP, by P. D. Coleman. [1961] [29]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)62, Atomic Energy Commission, and Wright Air Development Division) Unclassified

Presented at I. R. E. Internat'l. Convention, New York, Mar. 20-23, 1961.

Published in I. R. E. Internat'l. Convention Record, Pt. 3: 54-63, 1961.

The basic problems challenging extending electron devices into the submillimeter region are discussed. Directions of the research in this area in trying to solve these problems are indicated by selected examples. It is concluded that electron devices will be able to generate practical amounts of coherent power in this millimeter-infrared gap in the near future. (Contractor's abstract)

1117

Illinois U. [Electrical Engineering Research Lab.] Urbana.

CERENKOV RADIATION APPROACH TO THE SUBMILLIMETER WAVE PROBLEM, by P. D. Coleman. [1961] [19]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)62 and Wright Air Development Division) Unclassified

Presented at Second Internat'l. Conf. on Quantum Electronics, Berkeley, Calif., Mar. 23-25, 1961.

Published in Advances in Quantum Electronics, New York, Columbia U. Press, 1961, p. 581-594.

Theoretical analysis is given of the generation of coherent Cerenkov radiation by a high energy, tightly space-bunched, electron beam. The charge density and current density of this bunched beam will consist of discrete harmonic terms. A hole in the material medium must be provided for the beam to pass so that the electro-magnetic boundary value problem generally involves the following 3 regions: (1) the beam region of radius R_B, (2) the hole region of radius R_H, and (3) the material medium region. The equations for the scalar potential and vector potential must be solved for each of the 3 regions and their solutions matched at the 2 boundary surfaces. The driven electronic system producing bunched beam is discussed. The S-band Rebatron at the University is used. The method coupling Cerenkov radiation out of the medium is described. Some results obtained from the Cerenkov experiments at 8.31 mm wavelength are described. It is concluded that it is possible to extract nearly all the Cerenkov radiation produced and form it into a predictable radiation pattern when given the appropriately bunched, high energy beam in a simple, scalar, dielectric medium.

1118

Illinois U. [Electrical Engineering Research Lab.] Urbana.

GENERATION OF MILLIMETER AND SUBMILLIMETER WAVES, by P. D. Coleman. [1961] [33]p. incl. illus. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)-62, and Wright Air Development Division) Unclassified

Presented at I. R. E. Canadian Electronics Conf., Toronto (Canada), Oct. 2-4, 1961.

The specific problems of frequency conversion in a microwave discharge and an electron beam are analyzed. Only 2 basic momentum transfer and continuity equations are used in this analysis along with the assumption that the ionization frequency is proportional to the absolute value of the drift velocity. If the biasing voltage producing the dc bias field does not exceed the ionization potential of the gas, the power ratio (power in the kth harmonic/fundamental drive power) can be studied as a function of the ratio of the dc field amplitude to rf drive field amplitude. Also, if the discharge is placed in a circuit where the resistances drive frequency and radiation resistance associated with the kth harmonic current) can either be measured or computed, then the absolute power P_k in the kth harmonic can be calculated and compared to measured experimental values. The methods used are described and analyzed.

1119

Illinois U. Electrical Engineering Research Lab., Urbana.

APPLICATION OF TUNNEL DIODES IN LINEAR NETWORK SYNTHESIS, by B. A. Shenoi. Dec. 1, 1961 [101]p. incl. diagrs. refs. (Technical note no. 17) (AFOSR-1898) (AF 49(638)63) AD 271179 Unclassified

An investigation is presented of the application of tunnel diodes in grounded lossy networks without any transformers for realizing transfer functions with as few restrictions as necessary. After choosing a lumped, linear, small-signal equivalent circuit for the model of the device as a capacitance in parallel with a negative conductance, some properties of networks in which the tunnel diode is embedded are obtained. A systematic study of transfer function synthesis is developed. One of the synthesis techniques gives rise to a cascade connection of an RC and an RL network embedded with at most 2 tunnel diodes. Hence the capacitors and inductors can be provided with different amounts of dissipation. An integral part of this transducer network can be used as the dc bias circuit for the tunnel diodes, thereby assuring no change in the transfer characteristic of the network when the diodes are energized by a single dc supply. DC stability of the diodes is also guaranteed when the network is ac stable. The decomposition of a polynomial such that its zeros can be realized as the natural frequencies of a cascade connection of an RC and an RL network with a tunnel diode in shunt between them is considered. (Contractor's abstract)

1120

Illinois U. Electrical Engineering Research Lab., Urbana.

CRITICAL PATH ANALYSIS OF TIME-ORDERED

CONSTRUCTION AND ASSEMBLY PROJECTS, by B. R. Myers. Dec. 29, 1961 [26]p. incl. diagrs. tables. (Technical note no. 19) (AFOSR-2060) (AF 49-(638)63) AD 273034 Unclassified

A method for analyzing time-sequential ordered construction and assembly projects with multiduration jobs and arbitrary job scheduling is presented. The method employs partitioning techniques applied to an oriented linear graph representation of the project. The main principle involves the critical path, which is the longest continuous path from the starting vertex to the finishing vertex in the graph, and therefore represents the minimum time in which the project can possibly be completed. Bounds on project time and number of men required are given. (Contractor's abstract)

1121

Illinois U. Electrical Engineering Research Lab., Urbana.

STUDIED IN TRANSISTOR-RC NETWORK SYNTHESIS, by M. E. Van Valkenburg. Final rept. Dec. 1, 1956-Nov. 30, 1961, 16p. incl. refs. (AFOSR-2250) (AF 49(638)63) AD 273416 Unclassified

Research was carried out in 5 major areas as follows: (1) Active network synthesis; (2) sensitivity; (3) approximation of a prescribed function in the frequency domain; (4) synthesis of time-varying linear systems; and (5) switching circuits, linear programming, probabilistic graphs. The use of such active devices as transistors, negative impedance converters, gyrators and tunnel diodes were assumed in the synthesis of active networks. Several criteria of sensitivity were investigated. (Contractor's abstract)

1122

Illinois U. Electrical Engineering [Research Lab.] Urbana.

SENSITIVITY MINIMIZATION IN ACTIVE RC SYNTHESIS, by D. A. Calahan. [1961] [5]p. incl. diagrs. (AFOSR-3595) (AF 49(638)63) Unclassified

Also published in I. R. E. Trans. on Circuit Theory, v. CT-9: 38-42, Mar. 1962.

Since the majority of active RC synthesis techniques are based upon the partitioning of network functions into subnetwork functions, it was thought to be of interest to discover how this decomposition might be achieved to minimize sensitivity to the active element. This is, then, an extension of the work of Horowitz, Sipress, and others. Two types of active decompositions were considered: RC-NIC and RC-RL. It was shown that, regardless of the degree of the polynomial decomposed, when RC-RL decomposition is possible at all, an RC-RL decomposition can be found which results in a lower zero (pole) sensitivity figure than any RC-NIC decomposition. In the process of obtaining this result, the form of the RC-RL decomposition(s) which minimize(s) zero sensitivity is obtained. It is shown that, in general, there are an infinite number of these RC-RL decompositions with the same minimum sensitivities at all zeros (poles). This is in contrast to the Horowitz decomposition, which uniquely minimizes sensitivity in the RC-NIC case.

1123

Illinois U. Electrical Engineering [Research Lab.] Urbana.

RESTRICTIONS ON THE NATURAL FREQUENCIES OF AN RC-RL NETWORK, by D. A. Calahan. [1961] [22]p. incl. diagrs. (AFOSR-3596) (AF 49(638)63) Unclassified

Also published in Jour. Franklin Inst., v. 272: 112-133, Aug. 1961.

The following problem is investigated: given any polynomial $N(s)$ of the form $N(s) = \prod_1^n (s + p_i) \prod_1^m (s + s_\lambda) (s + \delta_i)$ what are the necessary and sufficient conditions that $N(s)$ be formed in the following manner $N(s) = A_0 \Pi (s + a_i) + B_0 \Pi (s + b_i)$ $A_0, B_0 > 0$ where the $-a_i$ and $-b_i$ alternate at most in pairs along the negative real axis. Such formation is necessary for the $-p_i$ and s_i to be the natural frequencies of a network consisting of RC and RL subnetworks joined at two terminals. It is shown that $N(s)$ may be so formed if and only if (a) for $n = 0$, $\sum_1^m \arg s_i \leq \pi/2$; and (b) for $n > 0$, $p_i > 0$ and $\sum_1^m \arg s_i < \pi/2$. Also, a simple method is presented for finding suitable a_i and b_i whenever formation is possible. The result is expected to have application in the synthesis of both passive and active networks. (Contractor's abstract)

1124

Illinois U. Electrical Engineering [Research Lab.] Urbana.

NOTES ON THE AUGMENTATION OF POLYNOMIALS, by D. A. Calahan. [1960] [2]p. (AFOSR-3612) (AF 49(638)63) Unclassified

Also published in I. R. E. Trans. on Circuit Theory, V. CT-8: 170-171, June 1961.

The following problem that occurs in the Miyata method of driving-point synthesis is analyzed: $N_1(z) = \sum_0^{2m+n} a_i z^i = \prod_1^n (\delta - p_i) \cdot \prod_1^m (z - z_i)(z - \bar{z}_i)$, where $p_i \neq 0$, $a_{2m+n} = 1$, $a_i < 0$ for any $1 \leq i \leq 2m + n - 1$, find the lowest degree polynomial $N_2(z)$ such that $N_3(z) = N_1(z)N_2(z) = \sum_0^r b_k z^k$, $b_r = 1$ where $b_k \geq 0$ for all k.

A procedure for finding such an $N_2(z)$ is given. The degree of the lowest-order $N_2(z)$ is found to be r' - (l + 2m + n). A more challenging augmentation problem, encountered in transfer function synthesis when $N_2(z)$ is required to be Hurwitz, is also discussed.

1125

[Illinois U. Electrical Engineering Research Lab., Urbana]

THE TCHEBYSHEFF APPROXIMATION OF A PRESCRIBED IMPULSE RESPONSE WITH RC NETWORK REALIZATION, by D. T. Tang. [1961] [7]p. (AFOSR-3856) [AF 49(638)63] Unclassified

Presented at I. R. E. Internat'l. Convention, New York, Mar. 20-23, 1961.

Also published in I. R. E. Internat'l. Convention Record, Pt. 4: 214-220, 1961.

It is shown that for any desired impulse response f(t), bounded and continuous in the interval $t \geq 0$, there always exists a unique RC 2-port with a set of specified negative real poles such that its impulse response $g(t) = \sum_{i=1}^{n} \lambda_i e^{-a_i t}$ approximates f(t) best in Tchebysheff sense. That is, there exists a set of λ's such that, with respect to the set of a's, there is $\max_{t\geq 0} |e(t)| = \max_{t\geq 0} |f(t) - \sum_{i=1}^{n} \lambda_i e^{-a_i t}|$ is a min. If desired, a certain weighting function, w(t) may be considered such that $\max_{t\geq 0} |e'(t)| = \max_{t\geq 0} |w(t)[f(t) - g(t)]|$ is minimized. An iterative procedure requiring successive equalization of maximum error is used to obtain such an approximation. This procedure is proved to be convergent and g(t) may be in a more general form as a linear sum of a set of functions forming a Tchebysheff's system. (Contractor's abstract)

1126

Illinois U. Electrical Engineering Research Lab., Urbana.

A MICROWAVE TECHNIQUE FOR THE STUDY OF DEVIATIONS FROM OHM'S LAW IN HIGH RESISTIVITY SEMICONDUCTORS, by K. Rose. Jan. 31, 1961, 109p. incl. illus. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research as technical note no. 4 under AF 49(638)417 and Signal Corps as technical rept. no. 1 under DA 36-039-sc-78313) AD 277121 Unclassified

The development of a microwave technique for the study of deviations from Ohm's law in high resistivity semiconductors is presented. A high level microwave field is used to produce the deviations as well as measure them. A semiconductor sample is placed in a resonant cavity and the conductivity of the sample is inferred from measurements of transmission through the cavity. Preliminary measurements on samples of high resistivity silicon at temperatures down to the boiling point of liquid nitrogen are reported. Results indicate that the technique in its present form is applicable to semiconductors with resistivities up to 600 ohm-cm. (Contractor's abstract, modified)

1127

Illinois U. Electrical Engineering Research Lab., Urbana.

DRIFT MOBILITIES OF ELECTRONS AND HOLES AND SPACE-CHARGE-LIMITED CURRENTS IN AMORPHOUS SELENIUM FILMS, by J. L. Hartke. Sept. 1, 1961, 112p. incl. diagrs. tables, refs. (Technical note no. 5) (AFOSR-1416) (AF 49(638)417) AD 267838 Unclassified

Also published in Phys. Rev., v. 125: 1177-1192, Feb. 15, 1962.

The results of drift mobility and space-charge-limited current measurements made on 20 micron thick films of amorphous Se were interpreted using the band model of a semiconducting solid with impurity or imperfection levels in the forbidden energy region between the conduction and valence bands. Drift mobilities were measured in the 220° to 300°K temperature range by determining the time of transit across the films of carriers which were photoinjected at one surface by 10^{-8} sec light pulses. The drift mobilities at 300°K were 0.165 cm^2/v sec for holes and 7.8×10^{-3} cm^2/v sec for electrons. The temperature dependence of hole mobility was exp(-0.14 ev/kT), and that of electrons was exp(-0.285 ev/kT). About 10^{19} cm^{-3} electron traps were present in a 0.285-ev region just below the conduction band edge; about 10^{21} cm^{-3} hole traps occupied a 0.14-ev portion of the gap immediately above the valence band edge. Au and Te electrodes were used to inject holes into amorphous Se, producing space-charge-limited currents at high fields. Electrical conductivities of 10^{-14} to 10^{-16} ohm^{-1} cm^{-1} were obtained at low fields. (Contractor's abstract, modified)

1128

Illinois U. [Electrical Engineering Research Lab.] Urbana.

SURFACE CONDUCTIVITY OF CLEAVED SILICON SURFACES, by P. Handler. [1961] [5]p. incl. diagrs. table, refs. (AFOSR-4465) (AF 49(638)417) AD 295900 Unclassified

Also published in Phys. Rev., v. 126: 971-975, May 1, 1962.

The experimental results of Palmer, Morrison, and Dauenbaugh on the conductivity of cleaved surfaces of silicon are reinterpreted in terms of a large density of states below the center of the forbidden energy gap.

This new interpretation shows that conductivity measurements and the work function and photoelectric threshold measurements are not in disagreement. If a Shockley-type band of surfaces states is present at the surface, it is possible to estimate an upper bound for the mobility of its carriers. The value of the mobility is found to be less than 0.01 cm^2/v sec. (Contractor's abstract)

1129

Illinois U. [Electrical Engineering Research Lab.] Urbana.

GALVANOMAGNETIC PROPERTIES OF GRAIN BOUNDARIES IN GERMANIUM BICRYSTALS FROM 1.25 TO 240°K, by G. Landwehr and P. Handler. [1961] [16]p. incl. diagrs. refs. (AFOSR-4466) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)417 and Office of Naval Research) Unclassified

Also published in Jour. Phys. and Chem. Solids, v. 23: 891-906, July 1962.

Wide angle grain boundaries of germanium with 20° tilt angles and mean {100} planes exhibit a p-type conductivity over the temperature range 1.25°to 240°K. The behavior of the conductivity, Hall coefficient and magnetoresistance in the temperature range 1°-10°K is found to be the same for n-type, p-type and intrinsic bicrystals. The similarity of results for the 3 different types of doping indicates that the p-type conductivity is an intrinsic property of the mean {100} germanium wide angle grain boundary. The number of holes in the space charge region adjacent to the grain boundary and their mobility were found to be 5×10^{12} per cm^2 and 300 cm^2/v sec respectively. The Hall coefficient is both temperature and magnetic field independent while below 10°K the magnetoresistance exhibits both temperature and magnetic field dependence. (Contractor's abstract)

1130

Illinois U. Electrical Engineering Research Lab., Urbana.

MICROWAVE INDUCED CARRIER MULTIPLICATION IN INDIUM ANTIMONIDE, by K. Rose. [1961] [2]p. incl. diagr. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)417] and Signal Corps) Unclassified

Published in Jour. Appl. Phys., v. 33: 761-762, Feb. 1962.

Transmission measurements at 80°K of 8 mm radiation through single crystals of InSb, 0.10-0.13 mm thick, showed that the transmitted power remained practically constant when the input power exceeded about 100 watt. This limiting effect was not observed at room temperature. The most reasonable explanation is the creation of electron hole pairs by impact ionization. The carrier multiplication could be used for microwave duplexing in a reasonable temperature range.

1131

Illinois U. [Electrical Engineering Research Lab.] Urbana.

MICROWAVE MODULATION OF LIGHT USING THE KERR EFFECT, by D. F. Holshouser, H. Von Foerster, and G. L. Clark. [1961] [3]p. incl. illus. diagrs. tables. (AFOSR-701) [AF 49(638)556] AD 611356 Unclassified

Also published in Jour. Opt. Soc. Amer., v. 51: 1360-1365, Dec. 1961.

Modulation of light at 3 and 6 kmc is achieved by applying a superimposed electrostatic and microwave field to a carbon-disulfide Kerr-cell which is incorporated within the high-electric-field region of a resonant cavity. The development of this light shutter requires the analysis of the Kerr effect under circumstances in which the transit time of light is appreciable. A Kerr cell whose length is such that the transit time of light is one-half the period of the modulating microwave field proves to have particular advantages over other designs. The light shutter is realized with a re-entrant microwave cavity with provision for the application of electrostatic as well as microwave fields. At about 26-kv dc and 10-kw pulsed 3-kmc ac power, the system modulates a light beam of several milliwatts radiant power up to 80%. (Contractor's abstract)

1132

Illinois U. Electrical Engineering Research Lab., Urbana.

ANALYSIS OF DYNAMIC CROSSED-FIELD ELECTRON MULTIPLICATION, by O. L. Caddy and D. F. Holshouser. [1961] [158]p. incl. diagrs. refs. (Technical note no. 1) (AFOSR-1693) (AF 49(638)-556) AD 267839 Unclassified

The general solution for single electron motion in alternating uniform electric fields and crossed steady uniform magnetic fields is presented. Several aspects of the motion are discussed when the electrons are assumed to have zero initial velocities, such as phase focusing, arrival energy, etc. The case when initial electron velocity cannot be ignored is considered, and the effects of initial velocities and velocity distribution is investigated. Some practical considerations, such as gain and power requirements, are investigated. A few of the possible applications in addition to high frequency response photomultiplier are discussed. (Contractor's abstract)

1133

Illinois U. [Electrical Engineering Research Lab.] Urbana.

HIGH-GAIN DYNAMIC MICROWAVE PHOTOMULTIPLIER, by O. L. Gaddy and D. F. Holshouser. Dec. 4, 1961 [2]p. incl. illus. (AFOSR-3291) (AF 49(638)-556) AD 613784 Unclassified

Also published in Proc. Inst. Radio Engineers, v. 50: 207-208, Feb. 1962.

The purpose of the note is to report on recent experimental results with a photomultiplier which is capable of microwave response and to briefly describe the multiplication method which is called dynamic crossed-field electron multiplication (DCFEM). This multiplication method is realized by providing a region of 2 spatially uniform fields—a microwave electric field and a crossed steady magnetic field—bounded by 2 electrodes, 1 having a high secondary emission ratio delta (active electrode), and the other a relatively low delta (inactive electrode). An electron which is present at the surface of the active electrode during a portion of the microwave period gains energy from the electric field and has a path which is curved by the magnetic field so that it is returned to the active electrode, producing secondary electrons upon arrival. This trajectory, labelled 'normal', is repeated by the secondary electrons; and after n such multiplication steps, requiring precisely n microwave periods, delta to n power electrons may be collected and delivered to an external circuit.

1134

Indiana U. Dept. of Chemistry, Bloomington.

NOTES ON THE RATE OF GAS PHASE REACTIONS OF NH_2 FREE RADICALS, by M. H. Hanes and E. J. Bair. Feb. 28, 1961 [4]p. incl. illus. (AFOSR-355) (AF 18(603)93) AD 253825; PB 155623 Unclassified

The reaction of NH_2 radicals following an individual RF discharge pulse through NH_3 was investigated using multiple flash apparatus. The apparatus was extended to give a sequence of ten 5-joule flashes through a quartz capillary of 2.5 mm diam and 5 mm long at crystal controlled intervals from 0.2-2.0 msec. The max initial NH_2 concentration was not strongly dependent on the NH_3 pressure. No N-H radicals were detected although they are readily observed following a discharge through a mixture of H and N. The fluorescence which accompanied the discharge can be represented by the equation $NH_3 \rightarrow NH_2 + H$. The average initial rate was 2nd order with respect to NH_2. (Contractor's abstract)

1135

Indiana U. Dept. of Chemistry, Bloomington.

SPECTROMETRIC STUDIES OF FAST REACTIONS, by E. J. Bair. Descriptive summary, Feb. 28, 1961 [9]p. incl. illus. (AFOSR-356) (AF 18(603)93) AD 253826; PB 155624 Unclassified

The project has been directed toward quantitative high resolution measurements of the rate of free radical reactions in the gas phase. Development of new procedures (chemical modulation and multiple flash kinetics measurements), by which absorption measurements can be made are discussed. Preliminary measurements were made of the reaction involving decomposition of ammonia and the formation of NH_2 radicals. Chemical modulation in the oscilloscope patterns of repeated reactions whereby the ammonia was dissociated by a discharge are illustrated. Multiple flash kinetic measurements allow for the measurement of individual fast reactions at high resolution. Oscilloscope photographs are presented to illustrate results of this method. The lamp will operate at intervals as short as 100 microsec.

1136

Indiana U. Dept. of Chemistry, Bloomington.

FIRST EXCITED $^1\Sigma_g^+$ STATE OF THE HYDROGEN MOLECULE, by E. R. Davidson. Mar. 1, 1961 [85]p. incl. diagrs. tables, refs. (AFOSR-483) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)318 and National Science Foundation) AD 254530 Unclassified

Also published in Jour. Chem. Phys., v. 35: 1189-1202, Oct. 1961.

A variation calculation on the first excited $^1\Sigma_g^+$ state of H_2 has been carried out using an expansion in elliptical coordinates. All results are reported in Hartree atomic units. The potential function resulting from this calculation is characterized by having a minima at R = 1.9 and R = 4.3 and a maximum at R = 3.3. The energy obtained at R = 1.9 using a 20-term, open-shell, covalent-type wave function was -0.7162 as compared with the "experimental" value of -0.7181. Due to convergence difficulties, many more configurations are required to improve this result significantly. At R = 4.3, on the other hand, the best result was obtained with an open-shell wave function including nine ionic terms and nine atomic terms. This result of -0.7007 is below the reported "experimental" value of -0.6935 because the two lowest $(2p\sigma)^2\ ^1\Sigma_g^+$ vibrational levels have not been found experimentally. The energy at the top of the barrier was computed to be -0.6844 and probably is as low as -0.6884. The vibrational levels for this potential function have been computed by a numerical integration technique. The fact that these are in one-to-one correspondence with a combination of the experimental 1s2s and $(2p\sigma)^2$ levels indicates that both of these sets of levels belong to the first excited state. (Contractor's abstract)

1137

Indiana U. Dept. of Chemistry, Bloomington.

THE CHEMICAL BOND IN MOLECULAR QUANTUM MECHANICS, by T. L. Allen and H. Shull. July 1, 1961 [28]p. incl. diagrs. refs. (AFOSR-494) (AF 49-(638)318) AD 261910 Unclassified

Also published in Jour. Chem. Phys., v. 35: 1644-1651, Nov. 1961.

It is postulated that a properly antisymmetrized product function over geminals (electron-pair wave functions) is adequate for discussion of the principal chemical properties of molecules. By application of the virial theorem, it is shown that such a wave function has both of the properties essential to the bond energy concept; namely (a) the energy of a molecule is the sum of the energies of its individual bonds and (b) the bond energies are invariant from 1 molecule to another. Within the framework of this approximation, bond energies become identified in magnitude with the kinetic energies associated with the respective geminals. The concepts are sufficiently general to include both localized and non-localized bonds, unshared electron pairs, odd electrons, and states of various multiplicities. (Contractor's abstract)

1138

Indiana U. Dept. of Chemistry, Bloomington.

THE CONCEPT OF PARTIAL IONIC CHARACTER, by H. Shull. [1961] [3]p. (AFOSR-3797) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)318] and National Science Foundation) Unclassified

Presented at Internat'l. Conf. on Chemical Physics of Nonmetallic Crystals, Evanston, Ill., Aug. 28-31, 1961. (AFOSR-2143)

Also published in Jour. Appl. Phys., Suppl., v. 33: 290-292, Jan. 1962.

The theoretical definition of partial ionic character is considered. The basic requirements which the author feels must be met before a satisfactory theoretical definition can be found are outlined. It is shown that current models for defining partial ionic character fall short of meeting these criteria. Suggestions are made as to the directions in which one must look for better models. In particular, it is emphasized that the dual requirements of orthogonal concepts based upon models which are invariant to arbitrary choices of basis functions must be met. (Contractor's abstract)

1139

Indiana U. Dept. of Chemistry, Bloomington.

POTENTIAL CURVES FOR H_2^-, by E. R. Davidson. [1961] [1]p. (AFOSR-3800) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)318] and National Science Foundation) Unclassified

Also published in Jour. Chem. Phys., v. 36: 1080, Feb. 15, 1962.

Recently theoretical calculations on H_2 have been performed by Fischer-Hjalmars (Arkiv Fysik, v. 16: 33, 1959) in an attempt to explain the experimental results for the cross section of formation of H^- by electron impact on H_2. The potential curves found in these theoretical calculations were obtained by applying the variational method to the electronic Hamiltonian for H_2^-. A rather subtle error seems to be present, though, in the results of Fischer-Hjalmars which invalidates most of this author's conclusions. Since at every internuclear distance and for all doublet states this Hamiltonian has a solution corresponding to normal H_2 plus a free electron, no variationally obtained potential curve for a doublet state can lie above the potential curve for H_2 if a complete set of basis functions is used. Even if only a limited basis set is used, an upper bound to the best energy obtainable by variation of scale factors still exists. The author shows that the Fischer-Hjalmars results appear to be substantially correct at internuclear distances sufficiently large that an energy below the energy of H_2 can be obtained. Also, by the same reasoning utilized, the Fischer-Hjalmars results for all of the $^4\Sigma_{u,g}^+$ states can be made to lie at least as low as the valence bond approximation to the potential curve for $^3\Sigma_u^+$ state of H_2 by proper adjustment of scale factors.

1140

Indiana U. Dept. of Chemistry, Bloomington.

CONFIGURATION INTERACTION STUDY OF THE LITHIUM HYDRIDE MOLECULE, by D. D. Ebbing. [1961] [10]p. incl. diagr. tables, refs. (AFOSR-64-1523) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)318] and National Science Foundation) AD 446372 Unclassified

Also published in Jour. Chem. Phys., v. 36: 1361-1371, Mar. 1, 1962.

A set of orbitals in elliptical coordinates has been used as basis in a self-consistent field configuration interaction (SCF-CI) study of the electronic structure of the ground state ($^1\Sigma^+$) of the lithium hydride molecule. The importance of various configurations is studied, and it is found that those configurations are most important which have either the inner-shell molecular orbital or the valence-shell molecular orbital doubly occupied. The results of each configuration interaction calculation have been analyzed into contributions to the inner-shell and outer-shell correlation energies, and in this way the importance of

various orbitals is studied and related to correlation effects. It appears that LiH could be well described by a product of electron-pair wave functions. A study of the numerical stability of the calculations shows that considerable care must be exercised in the choice of a basis in order for the results to be meaningful. Instability of a calculation is due to near linear dependency of the orbital basis. The best total energy obtained, using 53 configurations formed from a basis of 7σ and 3π orbitals, is -8.04128H at an internuclear distance of 2.99B. This should be compared with the experimental energy of -8.0703H. The dipole moment was calculated to be 5.96D, and the ratio of dipole moment to dipole derivative is $\mu_e/(\partial\mu/\partial r)_e r_e = 1.53$ (experimental values are 5.88D and 1.8 ± 0.3 respectively). (Contractor's abstract)

1141

Institute for Advanced Study, Princeton, N. J.

ON $u''+(1+\lambda g(x))u = 0$ FOR $\int_0^\infty |g(x)|\,dx < \infty$, by R. R. D. Kemp and N. Levinson. [1958] [6]p. (AFOSR-J499) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)1109 and Office of Naval Research) AD 407862 Unclassified

Also published in Proc. Amer. Math. Soc., v. 10: 82-86, Feb. 1959.

For abstract see item no. 731, Vol. III.

1142

Institute for Advanced Study, Princeton, N. J.

A THEOREM CONCERNING THE EXISTENCE OF DEFORMABLE CONFORMAL MAPS, by M. Heins. [1957] [6]p. (In cooperation with Brown U., Providence, R. I.) (AF 18(603)118) Unclassified

Published in Analytic Functions; a Conference, Inst. for Advanced Study, Princeton, N. J. (Sept. 2-14, 1957), p. II-32 - II-37.

The theorem: A hyperbolic Riemann surface belongs to the class D (or admits deformable conformal maps into itself) if and only if it admits non-constant bounded analytic functions. Attention is confined to showing that this condition is necessary for hyperbolic functions. The proof is based on the Lindelöf principle and Lindelöfian maps.

1143

Institute for Advanced Study, Princeton, N. J.

MAXIMAL IDEALS IN AN ALGEBRA OF BOUNDED ANALYTIC FUNCTIONS, by I. J. Schark. [1961] [12]p. (AF 18(603)118) Unclassified

Published in Jour. Math. and Mech., v. 10: 735-746, Sept. 1961.

The space H of complex homomorphisms (maximum ideals) of the algebra B, as well as the Gelfand isomorphism $f \to \hat{f}$ of B with a uniformly closed algebra of continuous functions on H is introduced. There is a natural projection π of H onto the closed disc in the plane, obtained by sending each complex homomorphism into its value on the coordinate function Z. This map π is one-one over the open disc D, and shows that the natural injection of D into H, which sends λ into the homomorphism "evaluation at λ", is a homeomorphism of D onto an open subset Δ of H. The remaining closed set of homomorphisms is mapped by π onto the unit circle C. The Silov boundary for the algebra B is identified and described and further results on the fibers H_α are discussed. It is proven that each fiber H_α contains a homeomorphic replica of the entire maximal ideal space H.

1144

[Institute for Advanced Study, Princeton, N. J.]

[ON COMPLEX, COMPACT, LOCALLY SYMMETRIC MANIFOLDS] Sur les variétés complexes compactes localement symétriques, by E. Calabi and E. Vesentini. [1959] [7]p. incl. refs. (AF 49(638)253) Unclassified

Published in Bull. Soc. Math. France, v. 87: 311-317, 1959.

This is a brief study of the cohomology groups of compact Kähler manifolds X which are uniformizable by Cartan domains with coefficients in the sheaf $\mathcal{G}$ of germs of holomorphic tangent vector fields. A more detailed study is presented in another paper (see item no. 1145, Vol. V)

1145

[Institute for Advanced Study, Princeton, N. J.]

ON COMPACT, LOCALLY SYMMETRIC KÄHLER MANIFOLDS, by E. Calabi and E. Vesentini. [1959] [36]p. incl. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)-253] and National Science Foundation) Unclassified

Published in Ann. Math., v. 71: 472-507, May 1960.

Certain aspects of the structure of the compact, complex manifolds X that can be uniformized by bounded, symmetric, homogeneous subdomains of the space C^n of n complex variables (Cartan domains) are studied. The purpose is to gather information on the cohomology groups of these manifolds with coefficients in the sheaf $\mathcal{H}$ of germs of holomorphic tangent vector fields. A brief summary of all the general differential geometric methods applied in the sequel is given. The basic approach to the problem is through the relation between non-existence of nontrivial harmonic tensor fields and the vanishing of certain cohomology groups $H^q(X, \mathcal{H})$. The case of compact Kähler manifolds that are uniformizable by Cartan

domains is considered because for these spaces there are especially simple methods to calculate the curvature tensors. The main result is stated in the following theorem: Let D be a Cartan domain, reducible or not, whose irreducible factors have at least 2 complex dimensions; let G be the group of all holomorphic (isometric) transformations of D, represented as an algebraic group of real matrices, and let Γ be a discrete subgroup of G acting on D with compact quotient space. Then there is an inner automorphism of G, such that the components of all the matrices representing the transform of Γ generate a simple algebraic extension of the rational number field.

1146

[Institute for Advanced Study] Princeton, N. J.

[ON THE HOLOMORPHIC MAP OF PROJECTIVE-ALGEBRAIC MANIFOLDS IN COMPLEX SPACE] Über holomorphe Abbildungen projektiv-algebraischer Mannigfaltigkeiten auf komplexe Räume, by R. Remmert and T. van de Ven. [1960] [34]p. incl. refs. (AF 49(638)213) Unclassified

Published in Math. Ann., v. 142: 453-486, Feb. 15, 1961.

Let A be a d-dimensional complex projective non-singular algebraic variety. Denote by $b_i^a(A)$ its ith analytic Betti number, i.e., the number of independent analytic cycles. Thus $b^a_{2d-2}(A) = \rho(A)$, the Picard number of A. The authors ask when is a non-trivial holomorphic map $\tau: A \to B$ of A onto a connected, normal complex space B a (ramified) covering? They prove the following: (1) If $\rho(A) = 1$, then dimB = dimA. (2) If $\rho(A) = 1$ and $b_1(A) = 0$, the degeneration (or fundamental) locus on A is at most (d-2) dimensional. (3) If in addition to the above, $b_2^a(A) = 1$ and B is not singular, then τ is a covering and B is projective algebraic. The proofs are simple, and come more or less from the fact that if τ has fibers of positive dimension, these will give analytic cycles on A which must be independent of the standard linear sections, since they have different intersection properties. Examples are given of (3) by taking in turn for A a Grassmannian, a complete intersection of dimension ≥ 3, a general surface in P_3 of order ≥ 4, and, by a different argument, a general abelian variety. Another example shows that B must be non-singular: a hypersurface of order 5 in P_4 is given which contains a line that can be collapsed to a point — the point will be singular and the image B will not be algebraic. Other examples are given where A is a surface and B an algebraic curve. For instance, if A is in P_3 and it contains a line, one can project it from this line to get a holomorphic $\tau: A \to P_1$. With respect to (1), it is shown that quadratic transforms of a wide class of surface in P_3 cannot be mapped onto a curve, yet have $\rho(A) \to 1$.

1147

Institute for Advanced Study, Princeton, N. J.

ON STABILITY OF COMPACT SUBMANIFOLDS OF COMPLEX MANIFOLDS, by K. Kodaira. July 1961 [20]p. (AFOSR-1147) (AF 49(638)253) AD 261355 Unclassified

Also published in Amer. Jour. Math., v. 85: 79-94, [Jan.] 1963.

Stability of compact submanifolds of complex manifolds and some related topics are discussed. A compact submanifold V of a complex manifold W is said to be stable if any small deformation W_t of W contains a small deformation V_t of V. Let ψ be the sheaf over V of germs of holomorphic sections of the normal bundle of V in W. If the first cohomology group $H^1(V, \psi)$ vanishes then V is a stable submanifold of W. A fiber structure of a compact fibered complex manifold M is said to be stable if any small deformation M_t of M retains a fiber structure. If each fiber of M is regular then the fiber structure of M is stable. Some examples illustrating the theorems are discussed. (Contractor's abstract)

1148

Institute for Advanced Study, Princeton, N. J.

THE PIECEWISE-LINEAR STRUCTURE OF EUCLIDEAN SPACE, by J. Stallings. [1961] [8]p. incl. refs. (AFOSR-3304) (AF 49(638)253) Unclassified

Also published in Proc. Cambridge. Philos. Soc., v. 58: 481-488, July 1962.

A space X is 1-connected at infinity if for every compact $C \subset X$, there is a compact D where $C \subset D \subset X$ such that X-D is 1-connected. The main theorem is that if a contractible piecewise linear manifold M^n, $n \geq 5$, is 1-connected at infinity, then it is piecewise linearly homeomorphic to Euclidean space R^n. Corollary 1: R^n has a unique piecewise linear structure if $n \geq 5$ (previously this known only for $n \geq 3$). Corollary 2: If X, Y are contractible piecewise-linear manifolds of dimension x, y, where x, $y \geq 1$ and $x + y \geq 5$, the X x Y is piecewise linearly homeomorphic to R^{x+y}. Using a theorem of Munkres the same results hold for differential theory. The proof depends on the following "engulfing theorem": Let M^n be a piecewise linear manifold, U an open subset, and P^p a subpolyhedron such that $p \leq n - 3$, (M, U) is p-connected, $P \cap (M-U)$ is compact. Then there is a piecewise linear homeomorphism $h: M \to M$ with compact support such that $hU \supset P$. In other words U can move amoeba-like so as to engulf P. The "engulfing theorem" has become a key tool in the subject, and the author has used it to prove other notable results including the Poincaré conjecture, $n \geq 5$, and the topological unknotting of spheres of codimension ≥ 3. In this paper he gives a concise and elegant proof of the engulfing theorem.

1149

Institute for Advanced Study, Princeton, N. J.

A PRIORI ESTIMATES FOR THE SOLUTIONS OF DIFFERENCE APPROXIMATIONS TO PARABOLIC PARTIAL DIFFERENTIAL EQUATIONS, by M. Lees. [1959] [15]p. incl. refs. (AFOSR-3841) (AF 49(638)-253) AD 408218 Unclassified

Also published in Duke Math. Jour., v. 27: 297-311, Sept. 1960.

For abstract see item no. 945, Vol. IV.

1150

Institute for Advanced Study, Princeton, N. J.

A BOUNDARY VALUE PROBLEM FOR NONLINEAR ORDINARY DIFFERENTIAL EQUATIONS, by M. Lees. [1961] [8]p. incl. refs. (AF 49(638)253) Unclassified

Published in Jour. Math. and Mech., v. 10: 423-430, May 1961.

The following theorem is proved: Let $f(x, z, p)$ be a continuous function defined in the region $0 \leq x \leq 1$, $-\infty < z, p < +\infty$. Assume that (1) $f(x, z_1, p) \geq f(x, z_2, p)$ for $z_1 \geq z_2$ and (2) $|f(x, z, p_1) - f(x, z, p_2)| \leq K|p_1 - p_2|$. Then there exists a unique twice continuously differentiable function $z(x)$, defined for $0 \leq x \leq 1$, such that (3) $z(0) - z_0 = z(1) - z_1 = 0$ and (4) $z''(x) = f(x, z(x), z'(x))$ $\left(' = \frac{d}{dx}\right)$. With the aid of certain a priori estimates, standard compactness arguments are used to prove that, as the mesh is refined to zero, the solutions of the finite-difference problems converge to a solution of 3 and 4.

1151

Institute for Advanced Study, Princeton, N. J.

SOME HILBERT SPACES OF ENTIRE FUNCTIONS. III, by L. de Branges. [1961] [43]p. incl. refs. (AF 49(638)253) Unclassified

Published in Trans. Amer. Math. Soc., v. 100: 73-115, July 1961.

A study of generalizations of the Paley-Wiener Theorem on entire functions of exponential type which are in $L^2(-\infty, \infty)$ is continued (see item no. 949, Vol. IV). In theorem 1, the concept of a one-parameter family of Hilbert spaces of entire functions in analogy with the family $E(a, z) = \exp(-iaz)$ is developed. In theorem 2, it is shown that such a family is present whenever a single Hilbert space of entire functions and a measure which determines its norm are given. The theorem 3 is the proper generalization of the Fourier transform in the Paley-Wiener fashion. It also describes the significance of this transformation for the underlying self-adjoint transformation H. Thus, from a single Hilbert space of entire functions, a whole family of such Hilbert spaces with isometric inclusions are to be extrapolated. A series of theorems are stated and their proofs are given.

1152

Institute for Advanced Study, Princeton, N. J.

ON FOURIER TRANSFORMS OF MEASURES WITH COMPACT SUPPORT, by A. Beurling and P. Malliavin. [1961] [19]p. (AF 49(638)253) Unclassified

Published in Acta Math., v. 107: 291-309, 1962.

Let $\mathfrak{M}$ be the set of (non-identically zero) measures with compact support defined on the real line, and let $\mathfrak{M}_a$ be the set of those (non-identically zero) measures whose support is contained in $[-a, a]$. $\hat{\mathfrak{M}}$ denotes the set of Fourier transforms $\hat{\mu}$ for $\mu \in \mathfrak{M}$. Let $w(x) \geq 1$ be a measurable function on the reals and define L_w^p to be the space of measurable functions $f(x)$ with the norm defined by $\|f\| = \{\int_{-\infty}^{\infty} |f(x)|^p w(x)^p dx\}^{1/p}$. The first main result of this paper is concerned with the determination (for given p) of the set W_p of all weight functions $w(x) \geq 1$ which satisfy (i) the translation operators $f(x) \to f(x + t)$ are bounded in L_w^p and (ii) for each $a > 0$, L_w^p contains elements of $\hat{\mathfrak{M}}_a$. Theorem 1: The sets W_p are independent of p and consist of all weight functions $1 \leq w(x) = \exp \omega(x)$ which satisfy the following conditions: (1) true max $\{\omega(x + t) - \omega(x)|$ for $-\infty < x < \infty\}$ is finite; (2) $J(\omega) = \int_{-\infty}^{\infty} \omega(x)/(1 + x^2)\, dx < \infty$. The next important result is Theorem 2: Let $g \not\equiv 0$ be an entire function of exponential type such that $J(\log^+ |g|) < \infty$; then each $\hat{\mathfrak{M}}_a$ contains an element $\hat{\mu}$ such that $\hat{\mu}(x)g(x) \in \hat{\mathfrak{M}}$. A more striking formulation of Theorem 2 is that the set $\{f(x)$: f entire, $f = \hat{\nu}/\hat{\mu}$, $\hat{\nu}$, $\hat{\mu} \leq \hat{\mathfrak{M}}\}$ and the set $\{f(x)$: f entire of exponential type, $J(\log|f|) < \infty\}$ are identical. This version of Theorem 2 exhibits the analogy to a classical result of R. Nevanlinna to the effect that a meromorphic function with bounded characteristic in the unit disc can be represented as the quotient of two bounded analytic functions. The proofs leading to Theorems 1 and 2 are powerful, elegant and function-theoretic, i. e., some deep results on harmonic functions, Poisson integrals and Dirichlet integrals are the effective tools. Especially noteworthy among the new techniques which are introduced in this paper is the solution of a variational problem in a certain Hilbert space of functions. (Math. Rev. abstract)

1153

Institute for Advanced Study, Princeton, N. J.

APPLICATION OF NUCLEON-NUCLEON

DISPERSION RELATIONS TO NUCLEAR MANY-BODY PROBLEMS, by I. Hamamoto and H. Miyazawa. [1961] [5]p. incl. diagr. table, refs. (AFOSR-1453) [AF AFOSR-61-19] Unclassified

Also published in Phys. Rev., v. 123: 1860-1864, Sept. 1, 1961.

A method is given of obtaining the nucleon-nucleon scattering amplitude within nuclear matter, when the nucleon-nucleon dispersion relations are known. This is attained by establishing the dispersion relation for the scattering amplitude under the influence of the Pauli exclusion principle in intermediate states. With this modified amplitude the binding energy of the nucleus is calculated using Brueckner's method. The binding energy per nucleon turned out to be -13.2 mev, if the contribution of the 3-pion exchange potential is adjusted to give the correct nuclear density. The implication of these results is discussed. (Contractor's abstract)

1154

Institute for Advanced Study, Princeton, N. J.

ON THE SYMPLECTIC SYMMETRY, by A. Salam and J. C. Ward. [1961] [3]p. incl. table. (AFOSR-2781) [AF AFOSR-61-19] Unclassified

Also published in Nuovo Cimento, Series X, v. 20: 1228-1230, June 16, 1961.

The Salam-Polkinghorne theory (Nuovo Cimento, Series X, v. 2: 685-690, Oct. 1, 1955) admits of a unitary symplectic group in 4-dimensions. There are 10 bosons and 10 fermions corresponding to its representations, and 10 vector mesons associated with it by gage transformation.

1155

Institute for Advanced Study, Princeton, N. J.

L. EULER, THE PRINCIPLE OF RELATIVITY AND THE FUNDAMENTALS OF CLASSICAL MECHANICS, by D. Speiser. [1961] [6]p. (AFOSR-2782) [AF AFOSR-61-19] Unclassified

Also published in Nature, v. 190: 757-759, May 27, 1961.

Attention is drawn to the significance of Euler's derivation of aberration formulas in early discussions of absolute space and time and of the principle of relativity.

1156

Institute for Advanced Study, Princeton, N. J.

INELASTIC COLLISIONS AND THRESHOLD EFFECTS, by L. Fonda. [1961] [30]p. incl. diagrs. refs. (AFOSR-2783) (AF AFOSR-61-19) D 612313 Unclassified

Also published in Nuovo Cimento, Series X, Suppl., v. 20: 116-145, 1961.

The many-channel problem has been discussed with particular emphasis on the anomalous energy dependence which is observed in the scattering and reaction cross-sections at the threshold of a new inelastic process. The phenomena is reviewed by introducing a method based on thorough investigation of the properties of the complete Green's function which describes the multi-channel system. The method is used to describe both non-Coulomb and Coulomb effects. The general time-independent scattering theory, which covers the case of Coulomb forces and many channels, is considered in detail. The low energy properties of scattering and reaction cross-sections are reviewed. Threshold effects are discussed with reference to the importance of such phenomena for the determination of relative parities and spins of the reaction products, of scattering phase shifts, of cross-sections which are not often feasible experimentally, and in the search for new particles.

1157

Institute for Advanced Study, Princeton, N. J.

ISOSCALAR NUCLEON STRUCTURE, by R. Blankenbecler and J. Tarski. [1961] [9]p. incl. diagrs. refs. (AFOSR-2784) [AF AFOSR-61-19] Unclassified

Also published in Phys. Rev., v. 125: 782-790, Jan. 15, 1962.

The 3-pion contribution to the isoscalar nucleon structure is examined in dispersion theory. It is assumed that the amplitudes (photon → 3 pions) and (3 pions → nucleon pair) are characterized by the pions interacting in pairs. This interaction is taken to be the low energy $J = T = 1$ resonance, which consequently dominates the picture. The effects of a 3-pion interaction are included so as to satisfy an extended unitarity condition. The lowest mass singularities, including the complex ones, are discussed and interpreted. If the π-π resonance is at $10\mu^2$, then a reasonable radius can be easily obtained. On the other hand, if the resonance is at $20\mu^2$ or higher, then a strong intrinsic 3-pion resonance or a bound state seems to be needed for agreement with experiment. (Contractor's abstract)

1158

Institute for Advanced Study, Princeton, N. J.

THE DISTRIBUTION AND MOTION OF INTERSTELLAR MATTER IN GALAXIES; PROCEEDINGS OF A CONFERENCE, Princeton, N. J., Apr. 10-20, 1961, ed. by L. Woltjer. New York, W. A. Benjamin, Inc., 1962, 330p. incl. illus. diagrs. tables, refs. (AF AFOSR-61-46 and AF AFOSR-62-150) Unclassified

This conference is concerned with the characteristics

of interstellar matter in galaxies (ours and others) and with small- and large-scale dynamics of interstellar matter.

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.

1159

Institute of the Aerospace Sciences, Inc., New York.

PROCEEDINGS OF AN AEROSPACE SCIENTIFIC SYMPOSIUM OF DISTINGUISHED LECTURES, Washington, D. C., May 11, 1961, New York, Institute of the Aerospace Sciences, Inc., 1962, 135p. incl. illus. diagrs. refs. (AFOSR-4072) (AF AFOSR-61-47) AD 631336 Unclassified

The one-day symposium was carried out in honor of Dr. Theodore von Kármán, the free world's senior statesman in the aerospace sciences, on his 89th birthday. The following 5 papers were presented: (1) Buckling of thin shells, by N. J. Hoff (Stanford U.); (2) On the Kármán vortex street in magnetofluid-dynamics, by A. Busemann (NASA); (3) International cooperation in science, by J. Kaplan (Calif. U.); (4) Flame propagation phenomena in solid rocket propellants, by M. Summerfield (Princeton U.); and (5) Toward new horizons — 1961, by J. V. Charyk (Air Force). Paper (4) is not available in this publication.

1160

Instituto de Investigación de Ciencias Biológicas, Montevideo (Uruguay).

CONSIDERATIONS ON THE HISTOLOGICAL BASES OF NEUROPHYSIOLOGY, by C. Estable. [1959] [26]p. incl. illus. diagr. (AFOSR-1192) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)585 and Rockefeller Foundation) Unclassified

Also published in Brain Mechanisms and Learning; A Symposium, Montevideo (Uruguay) (Aug. 2-8, 1959), Oxford, Blackwell Scientific Publications, 1961, p. 309-334. (AFOSR-1191)

The purpose of this report is to insist upon the frequent presence, in many species, and centers, of interneuronal contacts that (1) are as close as classically accepted synapses and (2) exhibit the same variable submicroscopic structure. These contacts are dendro-dendritic, dendro-somatic, somato-somatic and axo-axonic. No valid morphological reason enables one to deny that these contacts are operant and, to accept that regular axo-dendritic contacts are functional. Two formulae sum up the facts: (1) Pre- and post-synaptic pars of a different nature are functionally polarization synapses; and (2) Pre- and post-synaptic pars of a similar nature are reversibility synapses, which means functional alternance between the receptor and the effector pars. No submicroscopic entity (chondrioma, microvesicules, etc.) is typical of a functional contact. Only discontinuity and contiguity are always present.

1161

Instituto de Matematica Pura e Aplicada, Rio de Janeiro (Brazil).

STRUCTURAL STABILITY ON TWO-DIMENSIONAL MANIFOLDS, by M. M. Peixoto. [1961] [20]p. incl. diagrs. refs. (AFOSR-J44) [AF AFOSR-61-75] AD 610671 Unclassified

Abstract published in Bol. Soc. Matem. Mexicana, v. 5: 188-189, 1960.

Also published in Topology, v. 1: 101-120, Apr.-June 1962.

Let M^2 be a compact differentiable two-manifold and let B be the Banach space of all C^1-vector fields on M^2, using the C^1-topology. A vector field $X \in B$ is structurally stable whenever for each $\epsilon > 0$ there is a neighborhood U of X in B such that for each $Y \in U$ there exists an ϵ-homeomorphism of M^2 onto itself carrying the trajectories of X onto those of Y. The author announces the following theorem characterizing structurally stable vector fields. Theorem: A necessary and sufficient condition for X to be structurally stable on M^2 is that (1) X has only simple singularities, the real parts of the characteristic roots being different from zero; (2) X has only a finite number of closed orbits and the stability index of each of these is different from zero; (3) no trajectory joins saddle points; (4) the α- and the ω-limit set of each trajectory is either a singular point or a closed orbit. Using this characterization, the author finds that the set Σ of all structurally stable vector fields is open in B and proposes the problem of proving that Σ is dense in B. (Math. Rev. abstract)

1162

Instituto de Neurologia, Montevideo (Uruguay).

CHANGES ON EEG BACKGROUND ACTIVITY DURING PHOTOC HABITUATION IN MAN, by E. García-Austt, J. Bogacz and A. Vanzulli. [1961] [9]p. incl. diagrs. (AFOSR-1369) (AF AFOSR-61-65) AD 449991 Unclassified

Also published in Acta Neurol. Latinoamer., v. 7: 82-90, 1961.

A study was conducted of changes in background activity of EEG in a group of normal subjects during

continuous flicker stimulation and discontinuous flicker stimulation. Background activity was modified in a definite fashion in every single case, according to a sequence described in detail. The changes in the levels of wakefulness and sleep are correlated with habituation to luminuous stimulation and the period of darkness (perception of time). The variations experienced by the visual evoked potential during habituation are more marked and faster than those of background activity. It is shown that the afterdischarge is due to triggering of alpha rhythm, always at the same point of the cycle. (Contractor's abstract)

1163

Instituto de Neurologia, Montevideo (Uruguay).

EVOKED RESPONSES IN MAN. III. AUDITORY RESPONSES, by A. Vanzulli, J. Bogacz, and E. García-Austt. [1961] [7]p. incl. diagrs. refs. (AFOSR-3933) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-65 and Rockefeller Foundation) AD 416597 Unclassified

Also published in Acta. Neurol. Latinoamer., v. 7: 303-309, 1961.

A study was carried out of the scalp auditory evoked response (AER) in 44 normal adults, awake and asleep. The AER was recorded by an averaging photo-optico-electronic method. The electrode placement of the 10/20 system was used. In wakefulness AER was made up of a succession of waves with varying amplitude and duration. The most frequent pattern was negative-positive-negative. The response was recorded only from T2, T4, T6 tympanic, pharyngeal and nasal electrodes when Fz was employed as a common reference. The amplitude was frequently higher in the tympanic electrode. Continuous auditory stimulation provoked sleep in nearly every subject. Sleep determined the appearance of AER or increased the amplitude of all its components, particularly of positive waves. The significance of AER is discussed and differences are established with the visual evoked response. (Contractor's abstract)

1164

Instituto de Química Física, Madrid (Spain).

SULPHURATION OF COPPER AND SILVER WITH BENZENE SOLUTIONS OF SULPHUR, by J. Llopis, J. M. Gamboa, and L. Arizmendi. [1960] [12]p. incl. illus. diagrs. tables, refs. [AF 61(514)1330] Unclassified

Published in Electrochim. Acta, v. 7: 294-305, Aug. 1961.

The surface reactions of copper and silver with benzene solutions of sulfur have been studied. In the first case the rate of corrosion is high and corrosion takes place by pitting, giving porous films that easily scale off. However, the reaction of silver is much slower and yields coherent films showing interference colors; the kinetic law is linear with time and the experimental energy of activation is rather high, $\Delta H_r^* = 20.6$ kcal/mol. (Contractor's abstract)

1165

Instituto de Química Física, Madrid (Spain).

SEMICONDUCTIVITY AND CATALYTIC ACTIVITY. THE DEHYDROGENATION OF ISOPROPYL ALCOHOL ON ZnO-Cr_2O_3 CATALYSTS, by J. F. García de la Banda. [1961] [15]p. incl. diagrs. tables, refs. (AFOSR-3753) [AF 61(514)1330] Unclassified

Also published in Jour. Catalysis, v. 1: 136-150, May 1962.

Kinetics of isopropyl alcohol dehydrogenation on Cr_2O_3 prepared by decomposition of the corresponding hydroxide in air at 400°C has been studied. Experimental results point to a change in the semiconductor type of the Cr_2O_3 catalyst during the reaction. In order to confirm this hypothesis, the H_2 and O_2 adsorption on both types of Cr_2O_3, as well as the modification of the electrical resistance, at constant temperature, versus hydrogen pressure and versus feed during the reaction have been studied. Results are in agreement with the existence of 2 forms of Cr_2O_3 which, in principle, behave as p (oxidized form) and n (reduced form) semiconductors. The study of isopropyl alcohol dehydrogenation kinetics on $ZnCr_2O_4$ leads us to the conclusion that this possible p → n transition is not a quality which is exclusive for Cr_2O_3. These points are discussed and their importance and possible implications on future work duly considered. (Contractor's abstract)

1166

Instituto de Química Física, Madrid (Spain).

THE SULPHURATION OF COPPER WITH SOLUTIONS OF DIPHENYLTHIOUREA, by J. Llopis, J. M. Gamboa, and L. Arizmendi. [1959] [8]p. incl. diagrs. tables, refs. (AFOSR-4316) (AF 61(514)1330) Unclassified

Presented at Eleventh meeting of the Comité Internat'l. Thermodynamique et de Cinétique Electrochimiques, Vienna (Austria), Sept. 1959.

Also published in Electrochim. Acta, v. 3: 75-82, July 1960.

The kinetics of the copper corrosion with solutions of diphenylthiourea labeled with S^{35} in xylene was followed by the isotopic exchange method. The reaction yields coherent sulfide films, showing uniform interference colors. The reactivity of the diphenylthiourea with copper is lower than that of thiourea in aqueous

solution. The rate of film growth is constant; the experimental energy of activation is 14.2 kcal/mol. It is suggested that adsorption of diphenylthiourea at the sulfide film surface plays a major role in the kinetics of this sulfuration reaction. (Contractor's abstract. modified)

1167

Instituto de Química Física, Madrid (Spain).

SURFACE REACTION OF COPPER WITH SOLUTIONS OF METHYLTHIOUREA, by J. Llopis, J. M. Gamboa, and L. Arizmendi. [1960] [10]p. incl. diagrs. tables. (AFOSR-4317) (Sponsored jointly by Air Force Office of Scientific Research under [AF 61(514)1330] and Fundación Juan March) Unclassified

Also published in Anal. Real Soc. Espan. Fís. y Quím., v. 56B: 499-508, May 1960.

The surface reaction of Cu with aqueous solution of methylthiourea was studied radiochemically by means of $C^{35}S_2$. A large effect of dissolved O on the kinetics of the reaction is noted. With aerated solutions, the rate goes through a min with increasing methylthiourea concentration. At low methylthiourea concentration the kinetics is approximately linear except at low temperature; at high concentrations the kinetics is 2nd order in temperature range (10°C-70°C) studied. The activation energy is 7.4 kcal/mol, independent of methylthiourea concentration.

1168

Instituto Nacional de Tecnica Aeronautica Esteban Terradas, Madrid (Spain).

ON THE INTERNAL STRUCTURE OF LAMINAR DIFFUSION FLAMES, by A. Linán. Nov. 10, 1961 [67]p. incl. diagrs. refs. (Technical note no. 3) (AFOSR-2111) (AF 61(052)221) AD 273069 Unclassified

A study was carried out on the influence of chemical kinetics on laminar diffusion flames. In most of the flames of practical interest, the reaction zone is of negligible thickness, making it possible to obtain a solution of the boundary layer type. At each side of the reaction zone the temperature and concentration distributions may be determined by using the Burke-Schumann assumption of infinitely fast reaction rate. In the reaction zone, or chemical boundary layer, the convection effects may be neglected as compared with chemical reaction, conduction and diffusion effects. The equations governing this layer take then a simple form; and from their solution a criterion for the validity of Burke-Schumann assumption and for flame extinction may be obtained. (Contractor's abstract)

1169

Instituto Nacional de Tecnica Aeronautica Esteban Terradas, Madrid (Spain).

COMBUSTION OF BROMINE AND NITRIC ACID DROPLETS IN A HYDROGEN ATMOSPHERE, by C. S. Tarifa, P. Pérez del Notario, and F. G. Moreno. Nov. 15, 1961 [36]p. incl. illus. diagrs. (Technical note no. 4) (AFOSR-2112) (AF 61(052)221) AD 289105 Unclassified

A theoretical study is performed on the combustion of bromine droplets in hydrogen considering finite chemical kinetics, by using the reaction model proposed by Campbell and Hirschfelder. An experimental investigation is also carried out by burning bromine and nitric acid droplets in hydrogen at pressures ranging from 1 to ~10 atm. Several important conclusions are obtained on the influence of chemical kinetics on the combustion of droplets. (Contractor's abstract)

1170

International Business Machines Corp., Yorktown Heights, N. Y.

TIME ESTIMATION IN BOOLEAN INDEX SEARCHING, by E. Wong. Dec. 1961 [16]p. (AFOSR-1987) (Also bound with its AFOSR-2817; AD 285255) (AF 49(638)-1062) AD 285255 Unclassified

In many document retrieval systems, the retrieval operation consists of 3 steps. First, the query is represented as a sequence of index terms connected by logical connections. Secondly, the lists of documents indexed by the terms in the query are found. Thirdly, these lists are operated upon according to the logical connectives in the query. The average processing time required for a query is estimated here. Explicit expressions for the average processing time are obtained in terms of the complexity of the query and the parameters of the indexing system. (Contractor's abstract)

1171

International Business Machines Corp., Yorktown Heights, N. Y.

A SAMPLING PROCEDURE FOR CLUSTERING SIMILAR DOCUMENTS, by C. T. Abraham. Dec. 1961 [46]p. incl. diagrs. tables. (AFOSR-1988) (Also bound with its AFOSR-2817; AD 285255) (AF 49(638)-1062) AD 285255 Unclassified

Certain sampling procedures for clustering of documents are presented. Minimum variance unbiased estimates for similarity coefficients are derived. Considerable savings in matching time by sampling procedure as opposed to exhaustive search, is indicated. (Contractor's abstract)

1172

Iowa State U. Dept. of Mathematics, Iowa City.

OSCILLATION CRITERIA FOR SELF-ADJOINT DIFFERENTIAL SYSTEMS, by W. T. Reid. Jan. 1961. 21p. incl. refs. (Technical rept. no. 1) (AFOSR-132) (AF 49(638)994) AD 254704 Unclassified

Also published in Trans. Amer. Math. Soc., v. 101: 91-106, Oct. 1961.

For a differential system with complex coefficients, that is of the general form of the accessory differential equations for a calculus of variations problem of Lagrange or Bolza type that is identically normal, variational methods are employed to establish certain oscillation criteria involving associated two-point boundary problems. In particular, application of these general results to special systems which are equivalent to self-adjoint scalar quasi-differential equations of even order yields corresponding criteria for these scalar equations. It is to be emphasized that for such scalar equations the definitions of conjugate point and oscillation employed here are the restrictive ones arising from the corresponding concepts for the associated system, and they lack the generality corresponding to the definitions introduced by Leighton and Nehari, (Trans. Amer. Math. Soc., v. 89: 325-377, 1958) for real fourth order differential equations (1) $(r(x)u'')'' - p(x)u = 0$. In view of a result of the cited paper of Leighton and Nehari, however, application of a criterion of the present paper does provide a variational proof of a recent result of H. Howard, (Trans. Amer. Math. Soc., v. 96: 296-311, 1960), to the effect that if $r(x)$ and $p(x)$ are real-valued positive functions with $r(x) \in C'(o, \infty)$, $p(x) \in C(c, \infty)$, and for $a > o$ we have $\int_a^\infty [r(x)]^{-1}dx = \infty$, then (1) is non-oscillatory on (a, ∞) if and only if for $b > a$ the smallest proper value λ_b of the boundary problem $(r(x)u'')'' - \lambda p(x)u = 0$, $u = u' = o$ at $x = a$, $ru'' = (ru'')' = o$ at $x = b$, satisfies $\lambda_b > 1$. The criteria here derived also include as special cases some of the results for a fourth order quasi-differential equation $[(r(x)u'')' + q(x)u']' - p(x)u = o$ recently established by J. H. Barrett, (Mathematical Reserve Center Technical Summary Report no. 150, April 1960). (Contractor's abstract)

1173

Iowa State U. [Dept. of Mathematics] Iowa City.

ORDINARY LINEAR DIFFERENTIAL OPERATORS OF MINIMUM NORM, by W. T. Reid. [1961] [16]p. incl. refs. (AFOSR-3735) (AF 49(638)994) Unclassified

Also published in Duke Math. Jour., v. 29: 591-606, Dec. 1962.

This paper is concerned with linear vector ordinary differential operators of the form $L[y] = A_1(t)y'(t) + A_0(t)y(t) + b(t)$, $t \in I = [a, b]$, where $y(t)$ is in the set $\mathfrak{A}(I)$ of absolutely continuous vector functions on I, $A_1(t)$ is non-singular, and $A_1^{-1}(t)A_0(t)$ and $A_1^{-1}(t)b(t)$ are Lebesgue integrable on I. For a given measurable matrix function $B(t)$ on I, and any of several Lebesgue normed linear spaces $\mathfrak{B}$, the problem considered is that of characterizing the elements $x(t) \in \mathfrak{B}$ of minimum norm $\mathfrak{N}[x]$ and belonging to the set $\Gamma = \{x(t) \mid \exists\ y(t) \in \mathfrak{A}(I)$ with $L(y) = B(t)x(t)$, $y(a) = \xi^a$, $y(b) = \xi^b\}$, ξ^a and ξ^b being constant vectors. The author shows that this problem is equivalent to the determination of an "extremal" solution of a finite moment problem, and obtains an explicit solution for this moment problem. Several particular cases of the problem are also examined, among them that in which $B(t)$ is such that $B_{ij}(t) = 0$ $(i \neq j)$, $B_{ii}(t) = \delta(t, J^i)$ $(i = 1, \ldots, n)$, where $\delta(t, J^i)$ is the characteristic function of the measurable subset of J^i of I.

1174

Iowa State U. [of Science and Tech. Dept. of Physics] Ames.

VIBRATIONAL RELAXATION TIMES FOR GAS MIXTURES, by L. M. Valley and S. Legvold. [1960] [1]p. incl. tables. [AF 49(638)731] Unclassified

Published in Phys. Fluids, v. 3: 831, Sept.-Oct. 1960.

A relationship is derived for the vibrational relaxation times of gas mixtures which exhibit single dispersion of sound. This relationship is then tested against the data of several experiments. Consider a mixture of 2 singly dispersive gases A and B. Let k_{10}^{AA} and k_{01}^{AA} be the number of transitions, $1 \to 0$ and $0 \to 1$, per A molecule per second occuring in this mixture due to AA collisions. It is known that the number of transitions per molecule per second in a gas is proportional to the pressure. It is also known that $1/\theta_{AA} = k_{10}^{AA} - k_{01}^{AA}$, where θ_{AA} is the relaxation time of the pure gas A at 1 atm pressure. So in a mixture with mole fraction X of gas B present $k_{10}^{AA} - k_{01}^{AA} = (1 - X)/\theta_{AA}$. The final form of the equation is:

$$\frac{1}{\theta} = \frac{(1 - X)^2}{\theta_{AA}} + \frac{(1 - X)X}{\theta_{AB}} + \frac{X^2}{\theta_{BB}} + \frac{X(1 - X)}{\theta_{BA}}.$$

In the limit where the number of transitions in gas B goes to zero, the last 2 terms drop out. Thus for various mixtures of 2 dispersive gases the quantity $(1/\theta_{AB} + 1/\theta_{BA})$ should be constant, or if gas B is nondispersive θ_{AB} should be constant. The relationship derived is given strong support by the data provided by other research.

1175

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. July 1961, 2p. (AFOSR-1077) (AF 49(638)731) AD 289435; AD 611364 Unclassified

The examination and interpretation of the dispersion of sound in heavy vapors is presented using the polar gases, CH_2F_2, CHF_3 and C_2H_4 which have a high medium and zero dipole moment respectively. The gases were examined in various electric field strengths with the maximum field being 9000 v/cm. Argon, which has no dipole moment and no dispersion, was examined to insure that the electric field produced no other effect on the velocity than that due to molecular alignment. No measurable effect on the velocity was found for any of the gases examined, hence, it is concluded that an electric field of this strength has no effect on the relaxation times of heavy polar gases.

1176

Iowa State U. of Science and Tech. [Statistical Lab.] Ames.

MOMENTS OF THE ABSOLUTE DIFFERENCE AND ABSOLUTE DEVIATION OF DISCRETE DISTRIBUTIONS, by S. K. Katti. [1959] [8]p. (AF 49(638)43) Unclassified

Published in Ann. Math. Stat., v. 31: 79-85, Mar. 1960.

The evaluation of $\Delta_r = E|X_1 - X_2|^r$, where X_1 and X_2 are 2 independent variables with distributions, possibly different, within 1 of the following families is discussed: Poisson, Pascal, and Binomial. Methods are also given to evaluate Δ_r when X_2 is a fixed constant and when X_1 is distributed as a Poisson, a Pascal, a Binomial, a Hypergeometric and a Logarithmic random variable.

1177

Iowa State U. of Science and Tech. [Statistical Lab.] Ames.

A FITTING PROCEDURE FOR SOME GENERALIZED POISSON DISTRIBUTIONS, by R. Shumway and J. Gurland. [1960] [22]p. (AF 49(638)43) Unclassified

Published in Skand. Aktuarietidsk., v. 43: 87-108, 1960.

The authors discuss further developments in their work on compound and generalized distributions (see Biometrika, v. 44: 265-268, 1957). The present paper outlines a method for avoiding the iterative computation of probabilities required for practical fitting procedures. The probabilities are obtained directly from a matrix scheme based on stirling number expansions. Two numerical examples are given to illustrate the method. Numerical aids are also provided.

1178

Iowa State U. of Science and Tech. [Statistical Lab.] Ames.

SMALL SAMPLE BEHAVIOR OF SLOPE ESTIMATORS IN A LINEAR FUNCTIONAL RELATION, by M. Dorff and J. Gurland. Feb. 1961 [29]p. incl. tables, refs. (MRC technical summary rept. no. 214) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)43 and U. S. Army under DA 11-022-ORD-2059) AD 253141 Unclassified

Also published in Biometrics, v. 17: 283-298, June 1961.

The slope parameter is estimated in a linear functional relation between 2 variables which are not observable since both are subject to error. Such problems occur in many contexts. As a matter of fact, in virtually all applications of fitting a functional relation errors of observation occur in all variables. Very frequently errors can be neglected in the independent variables in comparison with the errors in the dependent variable, but it is always the case. In particular, it is often desirable to use a relatively inexpensive technique in place of a very costly one, where the results given by the 2, apart from errors, are linearly related. For example, the evaluation of rocket grains by static test techniques is relatively inexpensive compared to the procedure of utilizing dynamic or flight testing. (Contractor's abstract)

1179

Iowa State U. of Science and Tech. [Statistical Lab.] Ames.

THE POISSON PASCAL DISTRIBUTION, by S. K. Katti and J. Gurland. [1961] [12]p. incl. tables, refs. [AF 49(638)43] Unclassified

Published in Biometrics, v. 17: 527-538, Dec. 1961.

The aim is to study what may be called the Poisson Pascal distribution which includes the Neyman Type A and negative binomial as particular limiting cases and serves as a natural complement of the Poisson binomial. Some properties of the Poisson Pascal distribution are discussed. Several ad hoc methods used to estimate the efficiency in fitting Poisson Pascal distribution are evaluated. It is observed that the Poisson Pascal distribution acts as a bridge between the Neyman Type A and the negative binomial distributions and may be used with advantage when the latter distributions are inadequate to represent the population accurately. Techniques for choosing one of the many ad hoc methods on the basis of the sample will be discussed.

1180

Iowa State U. of Science and Tech. [Statistical Lab.] Ames.

ESTIMATION OF THE PARAMETERS OF A LINEAR

FUNCTIONAL RELATION, by M. Dorff and J. Gurland. [1961] [11]p. [AF 49(638)43]
Unclassified

Published in Jour. Roy. Stat. Soc., v. 23B: 160-170, 1961.

(X_i, Y_i) are pairs of sure unobservable variables related by $Y_i = \alpha + \beta X_i$ and $x_{ih} = X_i + e_{ih}$, $y_{ik} = Y_i + f_{ik}$ $(i = 1, 2, \ldots, n; h = 1, 2, \ldots, r_i; k = 1, 2, \ldots, s_i)$ are observed values of random variables, the e's and f's being errors of observation with zero means. Four estimates of β, based on sum of squares, which are available when replication is present ($r_i > 1$, $s_j > 1$ for some i, j), some of which also require $r_i/s_i = g =$ constant are considered. They determine the asymptotic ($n \to \infty$) variances of the estimates, when the errors are independent, and remark that these depend on the spacing of the X's. In many cases they all have the same value, but with other spacings the max likelihood estimate has the least asymptotic variance. There is also some discussion of the case of correlated errors. Estimates of the form $\Sigma w_i y_i / \Sigma w_i x_i$ are also considered, where w_i are weights. It is concluded that for best estimation, it needs an extra assumption about the spacing of the X's.

1181

Israel Inst. of Applied Social Research, Jerusalem.

THE MATRICES OF LINEAR LEAST-SQUARES IMAGE ANALYSIS, by L. Guttman. [1960] [10]p. incl. refs. (Sponsored jointly by [Air Force Office of Scientific Research under AF 61(052)121] and Lucius N. Littauer Foundation) Unclassified

Published in Brit. Jour. Stat. Psychol., v. 13: 109-118, Nov. 1960.

By the 'image' of a variable is meant the multiple regression of that variable on all the other variables in the data to be analyzed, and its 'anti-image' the error of estimate. It is then shown that an expression for R, the ordinary matrix of covariances or correlations, can be obtained in terms of the covariance matrices of the images and anti-images respectively. Various theorems and identities are deduced which lead to new structural theories for R and for data in the social sciences generally. In particular, fresh light is thrown on the problems of parsimony and rank. (Contractor's abstract)

1182

Israel Inst. of Applied Social Research, Jerusalem.

INEQUALITIES FOR SIGN FREQUENCIES OF LATENT ROOTS, by L. Guttman. May 1961 [19]p. (Technical note no. 7) (AFOSR-886) (AF 61(052)121) AD 262036
Unclassified

Inequalities for Gramian matrices, for Hermitian matrices, for the sum of Hermitian matrices, and for products are studied. The general case is given.

1183

Israel Inst. of Applied Social Research, Jerusalem.

THE STRUCTURING OF SOCIOLOGICAL SPACES, by L. Guttman. Dec. 1961 [15]p. incl. tables. (Technical note no. 3) (AFOSR-2835) (AF 61(052)121) AD 284326 Unclassified

The concept of level in social theory is discussed by participants (Professors Guttman, Suppes, Lazarsfeld, and Langerhans) at a seminar on the mathematics of social theory. The existence of a common space for the ordering of theories is questioned, and various approaches to the problem of relating social theories to empirical data are presented. (Contractor's abstract)

Israel Inst. of Tech., Haifa.
see Technion - Israel Inst. of Tech., Haifa.

1184

Istituto Elettrotecnico Nazionale "Galileo Ferraris". Turin (Italy).

ON THE NATURE OF RADIATION DAMAGE DUE TO FAST NEUTRON BOMBARDMENT IN FERROMAGNETIC MATERIALS: VERY HIGH PERMEABILITY PURE IRON AND NICKEL, by G. Biorci, A. Ferro, and G. Montalenti. [1961] [21]p. incl. diagrs. table, refs. [AF 61(514)1331] Unclassified

Published in Nuovo Cimento, Series X, v. 20: 617-637, May 16, 1961.

The effects of fast neutron irradiation with doses of 10^{18} nvt on permeability, coercive force and approach to saturation of very high permeability pure iron and nickel were studied. No significant changes were noted on nickel (max permeability 5000). On iron (max permeability about 150 000, H_c 2.5 A/m) coercive force increased by about 0.8 A/m, max permeability decreased by about 30%, and no change was noted in the curve of approach to saturation and hence in the anisotropy energy. After annealing the irradiated iron specimens at 100°C, a further increase of coercive force was observed, and after annealing at 200°C, on 1 of the specimens a loop with strong wasp-waisted form was noted. Finally most of the changes in magnetic properties due to irradiation were almost completely recovered below 250°C. The possible theoretical interpretations of the results are discussed. The kinetics of the annealing leads to exclude that the effects are due to free iron interstitials and probably also to dislocation loops. Hence it is thought that these are anisotropic point defects which interact with the magnetization vector and move with an activation energy of about 1.2 ev at temperatures of (100 - 200°C. (Contractor's abstract)

1185

Istituto Elettrotecnico Nazionale "Galileo Ferraris", Turin (Italy).

EXPERIMENTS ON MAGNETIC VISCOSITY DUE TO DIFFERENT SOLUTE ATOM PAIRS IN IRON ALLOYS, by A. Ferro, P. Mazzetti, and G. Montalenti. [1961] [12]p. incl. diagrs. table, refs. [AF 61(514)1331] Unclassified

Published in Nuovo Cimento, Series X, v. 23: 280-291, Jan. 16, 1962.

This work covers measurements of the interaction energy with magnetization of couples of solute atoms in several iron alloys. (This value is the last unknown factor in the theories of magnetic viscosity and of annealing in a magnetic field). The values of the interaction energy are obtained from measurements of magnetic viscosity field at about 450°C. The alloys considered are: Fe-V; Fe-Co; Fe-Cr; Fe-Ni; Fe-Al; Fe-Si; Fe-Mo. The interaction energy of a couple of solute atoms with vector J_s results to be little dependent upon the nature of the solute atoms, and at about 450°C, is of the order $(1 - 2) \cdot 10^{16}$ erg/atom for all types of solute. It is pointed out that in iron binary solid solutions, many other magnetic properties only depend upon the number of solute atoms and not upon their nature. (Contractor's abstract)

1186

Istituto Elettrotecnico Nazionale "Galileo Ferraris", Turin (Italy).

ELECTRON MICROSCOPE INVESTIGATION ON THE NATURE OF TRACKS OF FISSION PRODUCTS IN MICA, by G. Bonfiglioli, A. Ferro, and A. Mojoni. May 1961 [17]p. incl. illus. diagr. table, refs. (Technical note no. 3) (AFOSR-981) (AF 61(052)328) AD 262178 Unclassified

Also published in Jour. Appl. Phys., v. 32: 2499-2503, Dec. 1961.

Specimens of biotite, muscovite, artificial fluorophlogopite, and muscovite annealed at 900°C were examined using an electron microscope after having been covered with a uranium layer and irradiated in a reactor. Tracks due to fission products appeared on every specimen except biotite, and the respective diameters were put into correspondence with the resistance of the various micas to thermal decomposition. The tracks were larger in muscovite (240 A), thinner in fluorophlogopite (150 A), and still more in dehydrated muscovite (115 A). The writers believe that the mechanism of damage has its origin in the heat released by the heavy ionizing particles. Peculiar recovery effects were often observed. (Contractor's abstract)

1187

Istituto Elettrotecnico Nazionale "Galileo Ferraris", Turin (Italy).

FURTHER EXPERIMENTS ON SURFACE CONDUCTIVITY OF METALLIC THIN FILMS, by G. Bonfiglioli and R. Malvano. July 1961 [19]p. incl. diagrs. tables. (Technical note no. 5) (AFOSR-1505) (AF 61(052)328) AD 266537 Unclassified

The following points are considered: (1) improvement of the ac bridge used to measure the effect of conductivity modulation caused by transverse electric field (TEFE); (2) preliminary measurements of the TEFE on other metal films, than those already investigated, i.e.: Al, Ni, Cu, Ag; (3) repetition of the TEFE measurements in Au and Bi vs temperature extending the temperature range as low as to liquid nitrogen temperature; (4) discussion of possible application of TEFE; and (5) discussion of a model advanced to interpret in a purely phenomenological way the TEFE in simple metals, as Au. (Contractor's abstract)

1188

Istituto Elettrotecnico Nazionale "Galileo Ferraris", Turin (Italy).

PRELIMINARY EXPERIMENTS ON ELECTROLUMINESCENCE OF ZINC SULFIDE, by G. Bonfiglioli, P. Brovetto, and C. Cortese. [1961] [23]p. incl. diagrs. refs. (Technical note no. 4) (AFOSR-1835) (AF 61(052)328) Unclassified

A short literature review is given on the subject. The analysis is limited to phosphors of (activated) ZnS type and to so called "intrinsic" electroluminescence (EL) (EL excited in condenser type cells, filled with powder phosphors embedded in a good dielectric medium). A new technique is suggested for studying the behavior of the EL. It consists of applying to the cells single transients of voltage (respectively rising or falling) with a constant rate of variation vs time. This, roughly speaking, allows the separation of the effect of the electric field and of its time derivative by changing independently the max voltage and its rate of variation. The circuits used are described. The results obtained with commercial EL cells are also given and are of rather good quantitative character and may be more suited to a physical investigation of the basic phenomena involved in EL than the results of the studies reported in the literature and obtained by conventional techniques. Some final remarks concerning the technical improvements of the equipment and further experiments are given. (Contractor's abstract, modified)

1189

Istituto Elettrotecnico Nazionale "Galileo Ferraris", Turin (Italy).

SEARCH FOR AN EFFECT OF SURFACE CHARGING ON THE SUPERCONDUCTING TRANSITION

TEMPERATURE OF TIN FILMS, by G. Bonfiglioli, R. Malvano, and B. B. Goodman. Oct. 1961 [12]p. incl. diagrs. tables. (Technical note no. 6) (AFOSR-2012) (AF 61(052)328) AD 272233 Unclassified

Also published in Jour. Appl. Phys., v. 33: 2564-2566, Aug. 1962.

An attempt has been made to measure the rate of change of superconducting transition temperature T_c, as a function of surface charge density σ, in tin films. For films having thicknesses of 190, 670 and 1460A $|dT_c/d\sigma|$ was found in all cases to be less than 30° cm^2. $coulomb^{-1}$, the limit of sensitivity of the present apparatus. This negative result is compared with Glover and Sherrill's finding that in a tin film 70A thick $dT_c/d\sigma = -460°$ cm^2 $coulomb^{-1}$. (Contractor's abstract)

1190

Istituto Elettrotecnico Nazionale "Galileo Ferraris", Turin (Italy).

APPARATUS FOR THERMOLUMINESCENCE, by G. Bonfiglioli, P. Brovetto, and C. Cortese. Summary rept. Part A, Dec. 1961 [30]p. incl. diagrs. illus. (AFOSR-2321, Pt. A) (AF 61(052)328) AD 274007 Unclassified

Also published in Rev. Scient. Instr., v. 33: 1095-1100, Oct. 1962.

A detailed description is given of an apparatus for thermoluminescence (above room temperature, i. e. up to about 350°C), having the following peculiar features: the linear rate of warming is obtained through a cam-actuated Variac transformer; the light detection makes use of phase rectification; the apparatus is provided with a special furnace for recording glow current curves. The possibility of rendering flat the spectral response of the photomultiplier between 2000- 6000A through a composite filter is investigated and the method of calculating such a filter is developed. The performances of the apparatus were satisfactory.

1191

Istituto Elettrotecnico Nazionale "Galileo Ferraris", Turin (Italy).

FIELD EFFECT IN METALLIC FILMS, by G. Bonfiglioli and R. Malvano. [1961] [8]p. incl. diagrs. table. (AFOSR-4580) [AF 61(052)328] Unclassified

Also published in [Electric and Magnetic Properties of Thin Metallic Layers] Elektrische en Magnetische Eigenschappen van Dunne Metaallaagjes; a Symposium, Liege (Belgium) (Sept. 4-7, 1961), Brussels, Paleis der Acad., 1961, p. 50-57.

It is well known that the application of a transverse electric field (TEFE) to a sheet of a semiconductor changes appreciably its conductivity. The effect is extensively used to study some features of the interface between semiconductor and dielectric, and in particular the electronic surface states. The same effect has been found here in various metals (Au, Bi, Al, Ag, Sb). The thin film technique has been used to detect the effect which is many orders of magnitude smaller than in semiconductors. Measurements have been carried out in several different metals, the sign and the magnitude of the effect varying from one metal to another. Also the behavior vs temperature has been studied, clearly evidencing in this way a complete difference between the behavior of the film as a whole and of the surface conductivity. A schematic model is introduced to explain qualitatively the effect, at least of monovalent metals. Many points however need deeper insight, before getting definite answers about TEFE in metals; they are points of technical concern (such as improvements as to the reproducibility of the specimens)--or of theoretical concern (such as better knowledge of surface states in metals). (Contractor's abstract)

1192

Istituto Elettrotecnico Nazionale "Galileo Ferraris", Turin (Italy).

APPARATUS FOR THERMOLUMINESCENCE MEASUREMENTS, by G. Bonfiglioli, P. Brovetto, and C. Cortese. [1961] [6]p. incl. diagrs. (AFOSR-J367) (AF 61(052)328) AD 408591 Unclassified

Also published in Rev. Scient. Instr., v. 33: 1095-1100, Oct. 1962.

For abstract see item no. 1190, Vol. V.

1193

Istituto Nazionale di Ottica, Florence (Italy).

BASIC RESEARCH IN THE FIELD OF VISION, by A. Fiorentini, L. Ronchi and others. Annual summary rept. no. 1, Oct. 31, 1960 [20]p. incl. diagrs. refs. (AFOSR-235) (AF 61(052)80) AD 251238 Unclassified

The results are summarized of various investigations on some basic characteristics of vision. The subjects of the investigations are the following: (1) disappearance of a stabilized image with intermittent illumination; (2) influence of a vibrating movement on the vision of an image with fuzzy contours; (3) some methods for improving the perception of signals in extrafoveal vision; (4) is the pulsating illumination actually advantageous, in practice, with respect to steady illumination; (5) blue-green interaction at mesopic levels; (6) blue-green electroretinographic responses; and (7) the perception of size in ambients of different color and by correcting the chromatic aberration of the eye. (Contractor's abstract)

1194

Istituto Nazionale di Ottica, Florence (Italy).

ON THE COURSE OF PERCEIVED PATTERN AT TWILIGHT LUMINANCES. I. SMALL CIRCULAR GREEN SPOT IN EXTRAFOVEAL VISION, by L. Ronchi and G. F. Mori. [1961] [9]p. incl. diagrs. refs. (AFOSR-1198) (AF 61(052)80) AD 262264 Unclassified

Also published in Atti Fondazione G. Ronchi, v. 16: 139-147, Mar.-Apr. 1961.

A small green circular spot (12 min arc) was projected 7° nasal in the center of an adapting field 2(1/2)° diam. The exposure time relative to the spot was limited (60 msec), while that relative to the adapting field was unlimited. The task consisted in specifying the perceived pattern under the impoverishment of viewing conditions. The transition from the perception of the circle as such to the mere light perception corresponds to the appearance either of an irregular pattern with fuzzy contours, or of a small point. Just in this transition range, the double patterns are likely to occur, consisting of a pair of the above described patterns well separated in space. In addition, the said patterns may appear either as steady or as (illusory) moving, and often they are localized out of the center of the adapting field. (Contractor's abstract)

1195

Istituto Nazionale di Ottica, Florence (Italy).

ON THE RELIABILITY OF THE ELECTRORETINOGRAM AS A RESPONSE TO A LIGHT STIMULUS, by L. Ronchi and A. M. Ercoles. [1961] [7]p. (AFOSR-1256) (AF 61(052)80) AD 262265 Unclassified

Presented at Thirty-second annual meeting of the Aerospace Med. Assoc., Chicago, Ill., Apr. 24-27, 1961.

Also published in Aerospace Med., v. 33: 69-74, Jan. 1962.

A number of cases are reported where the shape of the human ERG appears as distorted and its size either enhanced or depressed, independently from the physical characteristics of the light stimulus and from the adaptation state of the retina. The results are interpreted by suggesting that unusual factors such as training and expectation may affect the ERG response. (Contractor's abstract)

1196

Istituto Nazionale di Ottica, Florence (Italy).

TRAINING AND ELECTRORETINOGRAPHIC RESPONSES, by L. Ronchi and A. M. Ercoles. [1961] [6]p. incl. diagrs. (AFOSR-1257) (AF 61-(052)80) AD 262266 Unclassified

Presented at Symposium of the Internat'l. Soc. for Clinical Electroretinography, Stockholm (Sweden), June 1-3, 1961.

Also published in Atti Fondazione G. Ronchi, v. 16: 518-531, Sept.-Oct. 1961.

A number of records are reported which seem to show a paradoxical influence of "expectation" on the electroretinographic responses. In particular, the initial records obtained from an untrained subject show a negative feature which tends to disappear during the various successive experimental sets, while the size of the positive feature tends to increase. It is tentatively suggested that the above reported changes correspond to the release, during incoming training, of central suppression which is known to counteract the stimulation produced by intraocular scatter. (Contractor's abstract)

1197

Istituto Nazionale di Ottica, Florence (Italy).

ON THE INFLUENCE OF HOMATROPINE ON THE ADAPTATIONAL PROCESSES OF THE PERIPHERAL RETINA, by A. M. Ercoles. [1961] [2]p. incl. diagr. (AFOSR-1258) (AF 61(052)80) Unclassified

Also published in Atti Fondazione G. Ronchi, v. 16: 130-131, Mar.-Apr. 1961.

Experiments were carried out in order to study whether the absorption of a few drops of drug might affect the capacitance value so that as a result the fading rate is modified. Following a 30 min darkness adaptation, the subject was presented with a 2.5° diam field centered 7° nasal surrounded by dark while a dim red point was centrally fixated. The fading time was recorded by the robotimer. A plot of the fading time T against the time t elapsed after the conjunctival sac received 2 drops of homatropine. The fading time decreases soon after instillation followed by a slow recovery.

1198

Istituto Nazionale di Ottica, Florence (Italy).

NOTE ON THE EFFICIENCY OF TRIANGULAR LIGHT PULSES, by M. Bittini. [1961] [2]p. incl. diagr. (AFOSR-1259) (AF 61(052)80) Unclassified

Also published in Atti Fondazione G. Ronchi, v. 16: 47-48, Jan.-Feb. 1961.

Experiments described in 2 previous works (see item nos. 1000 and 1014, Vol. IV) were repeated by a 3rd observer. The obtained results to a green square stimulus and a triangular stimulus presented at 7° from the fovea are analyzed and confirmed the previous ones. It is concluded that for green light the effectiveness of a triangular stimulus differs with

respect to that of a square stimulus of equal physical energy and equal duration, at luminances where the transition from rod to cone dominance occurs.

1199

Istituto Nazionale di Ottica, Florence (Italy).

ON THE DICHOTOMY OF THE VISUAL SYSTEM, by L. Ronchi and [G.] F. Mori. [1961] [8]p. incl. diagrs. refs. (AFOSR-1260) (AF 61(052)80) Unclassified

Also published in Atti Fondazione G. Ronchi, v. 16: 69-76, Jan.-Feb. 1961.

The dichotomy of the visual system is represented by the aid of a schematic 2-channel model. When the responses given by various subjects have to be compared, care must be taken to ascertain that the responses are all recorded from the same channel, in spite of the differences in gain at the various outputs. Some practical examples are adduced and discussed. (Contractor's abstract)

1200

Istituto Nazionale di Ottica, Florence (Italy).

MAY A SINGLE STIMULUS EVOKE TWO SENSATIONS SEPARATE IN SPACE? by L. Ronchi. [1961] [4]p. incl. diagrs. (AFOSR-1261) (AF 61(052)80) Unclassified

Also published in Atti Fondazione G. Ronchi, v. 16: 77-80, Jan.-Feb. 1961.

There are some experimental conditions where there is a certain likelihood that 2 contemporaneous and distinct patterns are perceived, in spite of the fact that the retina is stimulated by a single flash. An explanation of such an apparently paradoxical effect is difficult to be drawn, partly because of the limited number of available experimental data. The attempt is made of inserting the reported effect in the frame of the retinal organization on the basis of some recent findings. (Contractor's abstract)

1201

Istituto Nazionale di Ottica, Florence (Italy).

NOTE ON THE ELECTRORETINOGRAPHIC INTENSITY FUNCTION, by A. M. Ercoles. [1961] [2]p. incl. diagr. (AFOSR-1260) (AF 61(052)80) AD 262267 Unclassified

Also published in Atti Fondazione G. Ronchi, v. 16: 49-50, Jan.-Feb. 1961.

The variation of the height of the b-wave as a function of the intensity of the stimulating light has been studied previously (see item no. 772, Vol. III; and item nos. 999, 1003, and 1008, Vol. IV). The main result obtained is that the intensity function may be considered as consisting of a sequence of linear branches of various slopes. Here, however, a hump should be expected also at those levels where the saturation of the intensity curve begins to appear. The results obtained from 2 well trained and normal subjects are analyzed by means of the Maxwellian view. The presence of the expected hump has been tested in all recorded intensity functions. The behavior of the electroretinographic human intensity function extends over a very wide intensity range.

1202

Istituto Nazionale di Ottica, Florence (Italy).

ON THE FLUCTUATION OF VISUAL RESOLUTION, by M. Conticelli. [1961] [5]p. incl. diagrs. table. (AFOSR-2016) (AF 61(052)80) Unclassified

Also published in Atti Fondazione G. Ronchi, v. 16: 257-261, May-June 1961.

A figure viewed under a small viewing angle is seen to fluctuate in shape under poor illumination. The number of fluctuations/min is found to decrease with increasing luminance, if fixation is not obliged. When fixation is obliged, in a slightly extrafoveal point, fluctuation seems to be independent from the luminance level, in the range considered by the author. In addition, by the aid of a suitable effort, the observer is able to exert a sort of control on the peripheral factors responsible for fluctuation, so as to reduce its amount. (Contractor's abstract)

1203

Istituto Nazionale di Ottica, Florence (Italy).

ON THE INFLUENCE OF SPECTRAL COMPOSITION OF THE STIMULUS ON THE ELECTRORETINOGRAPHIC INTENSITY FUNCTION, by A. M. Ercoles. [1961] [11]p. incl. diagrs. (AFOSR-2017) (AF 61-(052)80) Unclassified

Also published in Atti Fondazione G. Ronchi, v. 16: 262-272, May-June 1961.

The spectral composition of the light is known to affect the slope of the electroretinographic intensity function recorded by stimulating a dark-adapted eye with a series of single flashes. The slope of the minus red function is found to be intermediate between the slope of the green function and that of the blue function, respectively. The minus green curve shows some unexpected irregularities in the neighborhood of the 200 μv response. The minus blue function shows a regular linear behavior. (Contractor's abstract)

1204

Istituto Nazionale di Ottica, Florence (Italy).

SPEED OF READING AND DIFFERENTIAL

BINOCULAR ADAPTATION. I. PRELIMINARY REPORT, by M. Conticelli. [1961] [7]p. incl. diagrs. (AFOSR-2018) (AF 61(052)80) Unclassified

Also published in Atti Fondazione G. Ronchi, v. 16: 381-387, July-Aug. 1961.

The speed of reading, a test above the threshold of visibility in monocular vision, is found to be influenced by the state of adaptation of the other eye. Such an effect is tested for luminances of the target falling in the range where a decrease in luminance corresponds to a decrease in the speed of reading. The individual differences are correlated with eye dominance and discussed. (Contractor's abstract)

1205

Istituto Nazionale di Ottica, Florence (Italy).

ON THE COURSE OF PERCEIVED SHAPE AT TWILIGHT LUMINANCES. II. BLUE, RED, GREEN SPOTS IN EXTRAFOVEAL VISION, by L. Ronchi. [1961] [7]p. incl. diagrs. tables. (AFOSR-2019) (AF 61(052)80) Unclassified

Also published in Atti Fondazione G. Ronchi, v. 16: 388-394, July-Aug. 1961.

The threshold of perception relative to a small circular patch viewed, in extrafoveal vision, for a brief time, upon a background of mesopic luminance, implies the transition from the perception of the circular patch as such to a vague light sensation; the intermediate patterns consist of a small point (as if the circle would be concentrated in its center), or of a thin streak, or of an irregular figure with fuzzy contours. Sometimes the said figures are seen to move across the background, and often they are seen as decentered, in spite of the fact that they are actually steady and projected just in the center of the background. Last, the stimulus sometimes appears as consisting of 2 patterns well separate in space, of the singleness of the physical stimulation. The above reported effects do not differ substantially when the spectral composition of light is changed from red to blue. As differences of higher order, we might emphasize that the frequency of occurrence of the < illusory motion > for green light is slightly greater than for the other 2 colors (steadiest patterns are seen under blue stimulation); in addition, the percent number of double responses is slightly greater for blue than for green, while red stimulation is in an intermediate position. (Contractor's abstract)

1206

Istituto Nazionale di Ottica, Florence (Italy).

BASIC RESEARCH IN THE FIELD OF VISION, by L. Ronchi, M. Bittini and others. Final rept. Oct. 31, 1961, 10p. incl. refs. (Technical rept.-Part I) (AFOSR-2238, Pt. I) (AF 61(052)80) Unclassified

Summaries are given for (1) research on visual performance at twilight luminances; and (2) research on visual performance under illuminations of various spectral compositions. A list of 50 references on the subject is included.

1207

Istituto Nazionale di Ottica, Florence (Italy).

BASIC RESEARCH IN THE FIELD OF VISION, by A. Fiorentini and M. Bittini. Oct. 31, 1961 [15]p. incl. diagrs. (Technical rept. - Part II) (AFOSR-2238, Pt. II) (AF 61(052)80) Unclassified

As has been previously reported, the subjective brightness of a field viewed by one eye decreases soon after strong illumination of a non-corresponding retinal area of the opposite eye (inducing eye). This binocular interaction effect can be prevented if the objective luminance of the first field is increased by a suitable amount synchronously with the illumination of the inducing eye. In the present work the apparent brightness decrement occurring at illumination of the inducing eye has been compared with the brightness decrement produced by an objective luminance decrease in the field viewed by the first eye, when the other eye is not stimulated. Next, it has been ascertained that the illumination of one eye does not impair detectability of a small test patch by the other eye, when the test patch is flashed against a steady background synchronously with the onset of illumination in the opposite eye. Last, some time characteristics of the binocular interaction effect have been investigated. (Contractor's abstract)

1208

Istituto Nazionale di Ottica, Florence (Italy).

BASIC RESEARCH IN THE FIELD OF VISION, by A. Fiorentini and A. M. Ercoles. Oct. 31, 1961 [12]p. incl. diagrs. (Technical rept. - Part III) (AFOSR-2238, Pt. III) (AF 61(052)80) Unclassified

Some dynamic characteristics of vision are studied with respect to the following aspects: (1) role of eye movements on some phenomena connected with contour perception, (2) role of intermittent illumination in preventing disappearance of a stabilized image, and (3) dynamic factors influencing the perception of form at threshold. (Contractor's abstract)

1209

Istituto Nazionale di Ottica, Florence (Italy).

THE "FADING OUT" OF A FIXATED TEST-FIELD. MONOCULAR AND BINOCULAR EXPERIMENTS, by L. Ronchi and M. Conticelli. [1961] [11]p. incl. illus. diagrs. tables, refs. (AFOSR-2879) (AF 61-(052)80) Unclassified

Also published in Atti Fondazione G. Ronchi, v. 16: 643-653, Nov.-Dec. 1961.

A centrally fixated 10° diam luminous field, surrounded by dark, is seen to fade out rhythmically in monocular vision, while the same does not happen in binocular vision, where only a faint fluctuation of the apparent brightness is tested. When presented with an unlimited uniformly illuminated test-field (empty field, Ganzfeld) in general the monocular rhythm persists for a few min only, after the beginning of exposure. Then, the field seems to become more-or less uniform, apart from the presence of small patches varying both in size and in shape. Note that such a final situation in general for 1 eye is strongly different with respect to that of the other eye. Binocular vision in an empty field first of all is found to be characterized by a narrowing of the visual field, presumably as a consequence of the fact that the overlapping of the 2 monocular fields is only partial. (Contractor's abstract)

1210

Istituto Nazionale di Ottica, Florence (Italy).

SPECTRA OF LIGHT SCATTERED IN THE ATMOSPHERE AT THE HEIGHTS OF 5 AND 16 km, by G. Noci. [1961] [4]p. incl. diagrs. table. (AFOSR-2881) (AF 61(052)80) Unclassified

Also published in Atti Fondazione G. Ronchi, v. 16: 625-628, Nov.-Dec. 1961.

The spectral distribution of the scattered sunlight, at 5000 and 16000 m above sea level has been calculated on the basis of some simplifying hypothesis. The approximations used are discussed and justified, and the method adopted for calculations is described. No considerable differences are found between the spectrum at 5000 m and the one at 16000 m, respectively; in addition, these spectra do not agree with the blackbody spectra. Such a comparison is shown graphically. (Contractor's abstract)

1211

Istituto Nazionale di Ottica, Florence (Italy).

SPEED OF READING UNDER RED AND WHITE ILLUMINATIONS, by M. Conticelli. [1961] [9]p. incl. diagrs. tables. (AFOSR-2899) (AF 61(052)80) Unclassified

Also published in Atti Fondazione G. Ronchi, v. 16: 509-517, Sept.-Oct. 1961.

A card-board where some rows of figures are typewritten is presented in monocular vision at a suitable viewing distance, and the speed of reading is determined. If the subject is dark-adapted and performs, say, 10 readings, each one lasting about 30 sec, and intervalled from one another by dark periods of 30 sec, the behavior of the speed of reading shows a sort of rhythm, which corresponds to a subjective impression of greater or lesser weariness. Such a rhythm is found to differ under red illumination with respect to white illumination, and, in addition noticeable troubles are tested when light-adapting the eye as described in the text. (Contractor's abstract)

1212

Istituto Nazionale di Ottica, Florence (Italy).

ON THE ELECTRORETINOGRAPHIC "PERSONAL EQUATION", by L. Ronchi and G. Bottai. [1961] [11]p. incl. illus. diagrs. tables, refs. (AFOSR-2902) (AF 61(052)80) Unclassified

Also published in Atti Fondazione G. Ronchi, v. 16: 532-542, Sept.-Oct. 1961.

The causes of artifact commonly affecting the ERG response are analyzed and the attempt is made of expressing quantitatively the ability of subjects to give reliable responses. (Contractor's abstract)

1213

Istituto Nazionale di Ottica, Florence (Italy).

ON THE SIZE OF THE HUMAN ERG AFTER BLOOD DONATION "ONE CASE REPORT", by G. Abbozzo. [1961] [2]p. incl. diagr. (AF 61(052)80) Unclassified

Published in Atti Fondazione G. Ronchi, v. 16: 51-52, Jan.-Feb. 1961.

The subject was a young male trained to give electroretinographic responses every other day, for a period of 3 yr. The standard deviation of his responses is about 20 μv. However, his electroretinographic response was found to be significantly decreased with respect to the norm whenever he had given about 300 cc of blood. The height of the scotopic b-wave is plotted against the log of stimulus intensity about 36 hr after the blood donation.

1214

Istituto Nazionale di Ottica, Florence (Italy).

PERIPHERAL DIFFERENTIAL THRESHOLD UNDER PROLONGED FIXATION, by A. M. Ercoles. [1961] [3]p. incl. diagr. (AF 61(052)80) Unclassified

Published in Atti Fondazione G. Ronchi, v. 16: 477-479, Sept.-Oct. 1961.

A plot is given of the perception probability against the time during which fixation was prolonged by avoiding as far as possible eye movements (average of 25 responses). The main result is that if the luminance of the test field is not too low, the sensitivity to brightness differences is in some way impaired when the test field is just disappearing by virtue of the "fading" process, and it is again restored when the test field has disappeared, so that the patch is seen

as it would be projected on a dark background. The following test was given to check the ability of the subject to keep his eye in fixed position and to intentionally avoid any voluntary eye movement: the subject fitted a contact lens wearing a small plane mirror; a light beam, reflected at this mirror impinged on a graduate scale placed at the distance of 1 m with respect to the eye. By taking as zero the position of the reflected beam at the beginning of fixation, no deflections greater than ± 15 min of arc were tested during prolonged fixations lasting about 20 sec. It is concluded that the incoming refractoriness accompanying the peripheral fading relative to a given test field decreases the probability of perception relative to a small patch projected on it; hence, in current experiments devoted to threshold determination, care should be taken in order to maintain the "normal" fixation of the eye.

1215

Istituto Superiore di Sanità, Rome (Italy).

A NEUROPHARMACOLOGICAL INVESTIGATION OF THE CONVULSANT ACTION OF 4-PHENYL-4-FORMYL-N-METHYL PIPERIDINE (1762 IS), by V. G. Longo and A. P. Corrado. Annual summary rept. July 1, 1961 [10]p. incl. diagrs. (AFOSR-1200) (AF 61(052)399) AD 264820 Unclassified

Also published in Proc. Soc. Exper. Biol. and Med., v. 107: 272-274, June 1961.

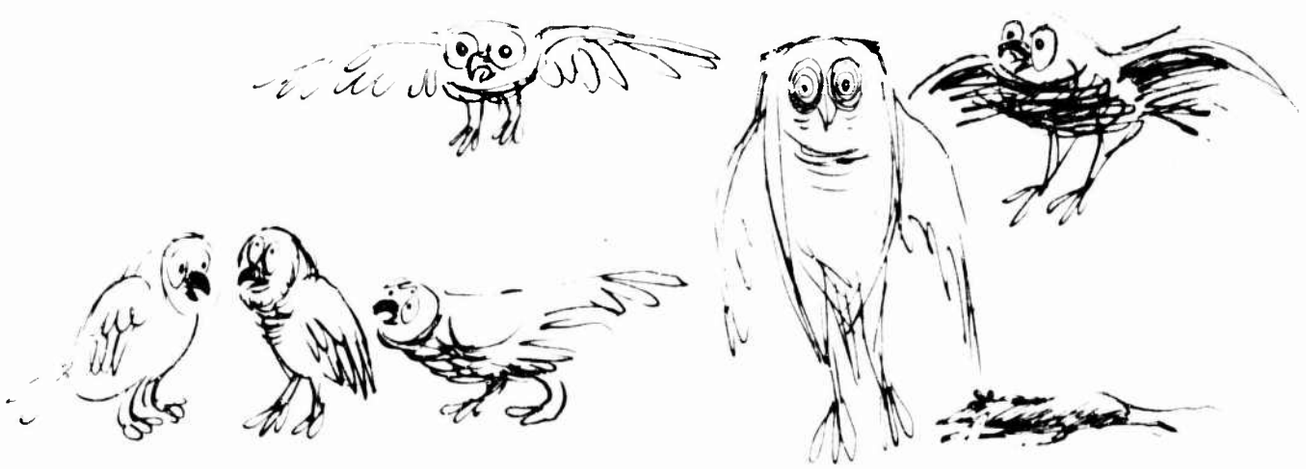
A detailed analysis of the action of 1762 IS was made. The usual pharmacological procedures were used as well as a more specific technique which included a study of the modifications of the electrical activity at the various levels of the cerebro-spinal axis, the effects of the application to the cerebral and cerebellar cortex of the substance on the cortical electrical activity and its action on spinal integratory mechanisms. In preliminary toxicity studies, a synthetic compound, 4-formyl-4-phenyl-N-methyl-piperidine (1762 IS) showed convulsant properties very similar to those of strychnine. More detailed neuropharmacological investigations dealing with the action of 1762 IS on the cerebral electrical activity, on the mono-and polysynaptic reflexes and on the 'primary' spinal inhibition have confirmed the similarities between this compound and strychnine. Some relationships between structure and pharmacological properties are discussed. (Contractor's abstract)

1216

Istituto Superiore di Sanità, Rome (Italy).

CENTRAL ACTION OF ADRENERGIC-BLOCKING DRUGS, by F. R. Domer. Oct. 1, 1961 [22]p. incl. diagrs. refs. (AFOSR-1726) (AF 61(052)469) AD 272419 Unclassified

Intravenous infusion of 5-hydroxytryptophan in the rabbit caused a flattening of the electrocorticogram and the development of a 30-40 c/sec discharge in the rhinencephalon. Premedication with β-methyl dihydroxyphenylalanine or chlorpromazine delayed the onset of this action while premedication with the monoamine oxidase inhibitors JB 516 or 2596 IS or with reserpine or atropine did affect the onset of full development of the rhinencephalic discharge. After the discharge activity was fully developed, it was greatly depressed or abolished by administration of pentobarbitone or myanesin. Strychnine caused the hippocampal spiking to be replaced for a short time. Agents which had no effect on the existing discharge were: 5-hydroxytryptamine, adrenaline, d-amphetamine and eserine. Intravenous injection of tryptamine also caused a cortical flattening and rhinencephalic discharge similar to that provoked by 5-hydroxytryptophan. Microelectrode recordings from the rabbit hippocampus are also described. Preliminary experiments studying the potentiation of neuromuscular blocking agents by SKF 525A indicate that the circulating C^{14} level of C^{14} labeled 1815 IS is increased following premedication with the potentiating agent. (Contractor's abstract)



1217

Johns Hopkins U. Dept. of Chemistry, Baltimore, Md.

APPEARANCE AND IONIZATION POTENTIALS OF SELECTED FRAGMENTS FROM DECABORANE, $B^{11}{}_{10}H_{14}$, by J. J. Kaufman, W. S. Koski and others. [1960] [8]p. incl. diagr. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18-(600)1526] and Office of Naval Research) Unclassified

Presented in part at 138th Nat'l. meeting of the Amer. Chem. Soc., Sept. 1960.

Published in Jour. Amer. Chem. Soc., v. 84: 4198-4205, Nov. 20, 1962.

The appearance potentials of selected ions from decaborane $B^{11}{}_{10}H_{14}$ (99.68% B^{11}) were measured by mass spectroscopy. A set of apparently self-consistent ionization potentials for decaborane and various $B_{10}H_n$ fragments were 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. An IBM 7090 computer program to calculate monoisotopic fragmentation patterns from mass spectral raw data was written. From the mass spectrum of $B^{11}{}_{10}H_{14}$ at 70 ev the monoisotopic fragmentation pattern of decaborane was calculated. For comparison, from mass spectral raw data at 70 ev of decaborane containing normal isotopic abundances of B^{10} and B^{11}, several different monoisotopic fragmentation patterns of decaborane were calculated which varied depending upon the method of choice of the original percentage of B^{10} in the molecule. (Contractor's abstract)

1218

Johns Hopkins U. Dept. of Chemistry, Baltimore, Md.

B^{11} QUADRUPOLE COUPLING CONSTANTS IN TRIMETHOXYBOROXINE AND N-TRIMETHYLBORAZOLE, by M. A. Ring and W. S. Koski. [1961] 4p. incl. diagrs. table. (Technical note no. 15) (AFOSR-926) (AF 18-(600)1526) AD 259310 Unclassified

Also published in Jour. Chem. Phys., v. 35: 381-382, July 1961.

NMR (nuclear magnetic resonance) broad-band spectra of trimethoxyboroxine (I) and N-trimeth...borazole (II) were obtained from precooled samples as they warmed to just below their melting points. From these spectra the B^{11} nuclear electrical quadrupole interaction was measured. In both compounds the quadrupole interaction split the central transition $m = \frac{1}{2} \rightarrow \frac{3}{2}$. The distances between the derivative max(mc) for I was 0.0434, II, 0.0278; ν_0 values were 13.70 mc for both compounds.

1219

Johns Hopkins U. Dept. of Chemistry, Baltimore, Md.

THE ISOTOPIC-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-927) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)1526 and Atomic Energy Commission) AD 259311 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 3037-3040, July 20, 1961.

The isotope effects in the diborane-hydrogen exchange and in the pentaborane-diborane exchange reactions were studied using deuterium and tritium as tracers. In the former reaction an inverse isotope effect was observed, whereas in the latter a normal isotope effect was obtained. The effects are interpreted in terms of previously proposed mechanisms. (Contractor's abstract)

1220

Johns Hopkins U. Dept. of Chemistry, Baltimore, Md.

THE CRYSTAL STRUCTURE OF BORON TRIIODIDE, by M. A. Ring, J. D. H. Donnay, and W. S. Koski. [1961] [9]p. incl. diagr. tables. (AFOSR-928) (AF 18(600)1526) AD 259312 Unclassified

Also published in Inorg. Chem., v. 1: 109-111, Feb. 1962.

The crystal structure of boron triiodide has been determined by the powder method. The structure is hexagonal with a = 7.00 ± 0.01, c = 7.46 ± 0.02A, and 2 molecules per cell. The boron-iodine bond distance has been found to be 2.10 ± 0.04A. (Contractor's abstract)

1221

Johns Hopkins U. Dept. of Chemistry, Baltimore, Md.

BORON HYDRIDE CHEMISTRY, by W. S. Koski. Final rept. July 1961, 23p. incl. refs. (AFOSR-1458) (AF 18-(600)1526) Unclassified

The research of this project is reported in 4 parts. The first part involves isotopic exchange in the boron hydrides. These studies demonstrate the important intermediates involved in the reactions of boron hydrides, especially the role played by borane. The second phase of the work deals with the measurement of appearance

potentials and fragmentation patterns of various molecules under electron bombardment. The influence of substitution on ionization potentials was studied and the average bond energy of the B-I bond in BI_3 was determined. In the third part, the work on nuclear quadrupole resonances is summarized. In the final phase of the report, a summary is given of 2 new analytical techniques developed during this study: application of thermal conductivity to the isotopic analysis of such materials as diborane, and application of neutron absorption to the B^{10} isotopic analysis in boron-containing compounds. A cumulative list of publications resulting from the work is included.

1222

Johns Hopkins U. [Dept. of Chemistry] Baltimore, Md.

STUDY OF THE HYDROGENATION OF ETHYLENE OVER HOMOGENIZED COPPER-NICKEL ALLOY FILMS, by M. K. Gharpurey and P. H. Emmett. [1961] [3]p. incl. diagr. table. (AFOSR-J558) (AF 18(603)129) AD 409294 Unclassified

Also published in Jour. Phys. Chem., v. 65: 1182-1184, July 1961.

Heating thin films of copper on nickel or nickel on copper at 300° in hydrogen overnight produced homogeneous films having the same color and the same activity for ethylene hydrogenation regardless of the order in which the metals were deposited. The relative reaction rates for ethylene hydrogenation per unit area at 0° were 9.3, 13.9, 8.3, 8.8, 9.7, and 6.6 for pure Ni, and alloys containing 87.4, 74.2, 67.0, 63.0 and 18.3% nickel, respectively. (Contractor's abstract)

1223

Johns Hopkins U. Dept. of Chemistry, Baltimore, Md.

FAR INFRARED SPECTRA OF SOLID METHYL HALIDES, by W. J. Lafferty and D. W. Robinson. [1961] [4]p. incl. diagrs. table, refs. (AFOSR-1221) (AF 49(638)468) AD 453607 Unclassified

Also published in Jour. Chem. Phys., v. 36: 83-86, Jan. 1, 1962.

The infrared spectra of solid CH_3Cl, CH_3Br, CH_3I, CD_3Cl, CD_3Br, and CD_3I have been measured in the spectral region from 130 to 30 cm^{-1} at 78°K. Two sharp bands were found in the cases of the chloride and bromide, and 3 in the case of the iodide. These absorptions are interpreted as arising from lattice vibrational modes. The isotopic shifts exclude libration about the symmetry axis as a possible assignment for any of the bands, however, definite assignments to B-axis librations or translational modes cannot be made with confidence.

1224

Johns Hopkins U. [Dept. of Chemistry] Baltimore, Md.

THE FAR INFRARED SPECTRUM OF TETRAHYDROFURAN, by W. J. Lafferty and D. W. Robinson. [1961] 8p. (AFOSR-2366) (AF 49(638)468) AD 611193 Unclassified

An examination of the vapor-phase spectrum of tetrahydrofuran between 30/cm and 400/cm revealed a series of fairly broad bands at 34.25, 40.5, 47.5, 54.0, 59.6, 66.8, and 81.2/cm. The absorption peaks are tentatively attributed to the transitions of a pseudo-rotator. An intense broad band with sharp peaks at 233, 243, 276, and 279/cm is assigned to the "ordinary" ring puckering mode and is thought to be the result of the upper stage transitions of this vibration.

1225

Johns Hopkins U. Dept. of Chemistry, Baltimore, Md.

INFRARED SPECTRUM OF CF_3SF_5, by D. F. Eggers, Jr., H. E. Wright, and D. W. Robinson. [1961] [2]p. incl. diagrs. tables, refs. (AFOSR-2821) (In cooperation with Washington U., Seattle) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)-468 and National Science Foundation) AD 295922 Unclassified

Abstract published in Symposium on Molecular Structure and Spectroscopy, Ohio State U., Columbus, June 12-16, 1961, p. 56.

Also published in Jour. Chem. Phys., v. 35: 1045-1050, Sept. 1961.

Abstract also published in Spectrochim. Acta, v. 17: 1129, Oct. 1961.

The infrared spectrum of CF_3SF_5 has been measured and analyzed between 30 and 4000 cm^{-1}. A band found at 218.5 cm^{-1} is believed responsible for satellite lines observed previously in the microwave spectrum; the barrier to internal rotation might then be much lower than obtained previously by assuming these satellites were due to torsional oscillation. Twelve of the 17 fundamentals were assigned in the infrared spectrum and estimates are given for the others. A plausible assignment is given for the overtone and combination bands also observed; this gives no evidence for any of the inactive fundamentals. (Contractor's abstract)

1226

Johns Hopkins U. Dept. of Chemistry, Baltimore, Md.

FAR INFRARED SPECTRA OF SOLID METHYL HALIDES (Abstract), by W. J. Lafferty and D. W. Robinson. [1961] [1]p. [AF 49(638)468] Unclassified

Published in Symposium on Molecular Structure and Spectroscopy, Ohio State U., Columbus, June 12-16, 1961, p. 25-26.

Also published in Spectrochim. Acta, v. 17: 1100, Oct. 1961.

The infrared spectra of methyl halides condensed rapidly from the vapor onto a window held at nitrogen temperature have been examined from 30-130 cm^{-1}. Two sharp bands are found for each compound which are interpreted as arising from the A- and B-axis librational modes of molecules on the C_s crystal sites. Effects of correlation interaction are absent. The behavior of the spectra upon annealing of the deposits will be discussed and interpreted on the basis of possible structures of the rapidly condensed samples.

1227

Johns Hopkins U. Dept. of Chemistry, Baltimore, Md.

NUCLEAR QUADRUPOLE RESONANCE SPECTRA OF BORON-IODINE COMPOUNDS, by W. G. Laurita and W. S. Koski. [1961] [12]p. incl. tables, refs. (AFOSR-4320) [AF 49(638)481] AD 405307 Unclassified

Presented at Colloque; Application à la Biochimie et à la Chimie Structurale de la Spectroscopie des Radiofréquences, Brussels (Belgium), Apr. 6-7, 1961.

Also published in Mem. Acad. Roy. Belg. Cl. Sci., v. 33: 321-332, 1961.

The iodine nuclear quadrupole resonance spectrum of boron triiodide has been studied. The frequencies of the $1/2 \rightarrow 3/2$ and the $3/2 \rightarrow 5/2$ transitions were measured as 212.6 and 340.1 mc/sec, respectively. Each of the resonances was a doublet with a separation of 24 ± 2 mc/sec for the lower frequency transition and 43 ± 3 mc/sec for the higher frequency transition. The quadrupole coupling constant (eQq) was found to be 1176 mc/sec and the asymmetry parameter was 0.456. The large asymmetry parameter was interpreted as due to π-bond character of the boron-iodine bond. The splittings of the iodine resonances in BI_3 were found to be in semi-quantitative agreement with theoretical expectations. The $1/2 \rightarrow 3/2$ iodine nuclear quadrupole transitions in iododecaborane and the iodopentaborane have been observed at 190.8 and 196.2 mc/sec, respectively. The $3/2 \rightarrow 5/2$ transitions were not observed. The splittings of the iodine resonances in the iodoboranes are believed to be smaller than the resolution of the equipment and consequently have not been detected. The quadrupole coupling constants are interpreted in terms of the electronic structure of the boron-iodine bonds in these compounds. (Contractor's abstract)

1228

Johns Hopkins U. Dept. of Mathematics, Baltimore, Md.

ON CERTAIN MONOTONE FUNCTIONS AND PRODUCTS OF INDEPENDENT FUNCTIONS, by P. Hartman. Apr. 1961, 23p. incl. refs. (Technical note no. 21) (AFOSR-515) (AF 18(603)41) AD 254909 Unclassified

Also published in Rend. Circ. Matem. Palermo, v. 10: 193-211, 1961.

Let $\varphi_1(t), \varphi_2(t), \ldots$ be positive functions almost everywhere on $0 \le t \le 1$ which are independent in the sense of Steinhaus and have the expected value 1. Let $f_n(x) = \int_0^x \prod_{k=1}^{n} \varphi_k(t)dt$ and f(x) be a (pointwise) limit of a subsequence of $f_1, f_2, \ldots$. It is shown that if the infinite product of $\varphi_1, \varphi_2, \ldots$ is convergent almost everywhere, then f(x) is absolutely continuous, and that if the infinite product is divergent almost everywhere and the functions φ_n satisfy certain supplementary conditions, then f(x) is purely singular. Corresponding results hold for the inverse function $x = f^{-1}(y)$. (Contractor's abstract)

1229

Johns Hopkins U. [Dept. of Mathematics] Baltimore, Md.

ON GLOBAL ASYMPTOTIC STABILITY OF SOLUTIONS OF DIFFERENTIAL EQUATIONS, by P. Hartman and C. Olech. [1961] [25]p. (AFOSR-2837) (In cooperation with RIAS, Inc., Baltimore, Md.) (Sponsored jointly by Air Force Office of Scientific Research under AF 18-(603)41 and AF 49(638)382, and Army Ballistic Missile Agency under DA 36-034-ORD-3514) AD 298161 Unclassified

Also published in Trans. Amer. Math. Soc., v. 104: 154-178, July 1962.

For abstract see item no. 2521, Vol. V.

1230

Johns Hopkins U. Dept. of Mechanics, Baltimore, Md.

THEORIES OF TURBULENT DISPERSION, by S. Corrsin. [1961] [26]p. incl. diagrs. refs. (AFOSR-1702)

(Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)248 and National Science Foundation) 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: 27-52, 1962.

A survey is made of some past and current analytical work on the problem of turbulent dispersion, ignoring the effects of molecular motion. Various theories are applied to the problems of single particle and two particle dispersion. (Contractor's abstract, modified)

1231

Johns Hopkins U. Dept. of Mechanics, Baltimore, Md.

AN EXPERIMENTAL STUDY OF THE INTERRELATION BETWEEN THE THEORY OF DISLOCATIONS IN POLYCRYSTALLINE MEDIA AND FINITE AMPLITUDE WAVE PROPAGATION IN SOLIDS, by J. F. Bell. Mar. 1961 [43]p. incl. diagrs. refs. (Technical rept. no. 7) (AFOSR-422) (AF 49(638)423) AD 255212 Unclassified

Also published in Jour. Appl. Phys., v. 32: 1982-1993, Oct. 1961.

A detailed verification is given for the G. I. Taylor theory of dislocations (1934) in polycrystalline annealed aluminum. Applying the finite amplitude wave theory, with a theoretical parabolic stress-strain curve obtained from dislocation theory, experimental and theoretical correlations within approx 1% were obtained for the velocities of strain propagation, max strain, largest distance of penetration of max strain, dynamic stress levels in the first diam, time of contact, coefficient of restitution, mushrooming in the first diam, and an energy balance before and after impact. Variations in the plastic wave development and dynamic stress behavior below the Karman critical velocity were considered in terms of a difference in the initial elastic reflection behavior below the critical velocity. Plastic deformation was independent of strain rate, even at experimentally determined values of 2000 in./in./sec. The subsequent development of dispersive plastic wave fronts following the passage of the initial shock, were also in accordance with predictions based upon dislocation theory. The equipartition of energy in the vicinity of the impact face was related to the reflection behavior of these initial shock fronts at the lateral surface of the rod. (Contractor's abstract)

1232

Johns Hopkins U. Dept. of Mechanics, Baltimore, Md.

THE AERODYNAMICS OF MASS LOSS AND MASS GAIN OF STARS, by F. H. Clauser. Nov. 1960, 45p. incl. diagrs. (AFOSR-TN-60-1386) (AF 49(638)496) AD 400358 Unclassified

A star, being a hot object, tends to boil away its mass into interstellar space. The gravitational field of the star acts to check such a mass loss. The aerodynamic "inflow" and "outflow" of mass which is an essential part of the dynamic equilibrium of stellar atmospheres is discussed. The topics include: (1) an illustrative example of aerodynamic flow, (2) the dynamics of spherical flows having a gravitational field, and (3) flows into and away from stars.

1233

Johns Hopkins U. Dept. of Mechanics, Baltimore, Md.

A NONLINEAR THERMOELASTICITY THEORY, by O. W. Dillon, Jr. Aug. 1961 [20]p. incl. diagr. (Technical note no. 1) (AFOSR-1237) (AF 49(638)1031) AD 263248 Unclassified

Also published in Jour. Mech. and Phys. Solids, v. 10: 123-131, Apr./June 1962.

The study is an analysis of the temperature generated by the deviatoric components of strain. After a general formulation of this effect, a specific case of the torsional oscillations of a round bar is considered. The solution of this problem indicates appreciable temperature can be generated at strains which would be considered small in the field of plasticity. (Contractor's abstract)

1234

Johns Hopkins U. Dept. of Mechanics, Baltimore, Md.

AN EXPERIMENTAL STUDY OF THE HEAT GENERATED DURING TORSIONAL OSCILLATIONS, by O. W. Dillon, Jr. Dec. 1961 [27]p. incl. illus. diagrs. (Technical note no. 2) (AFOSR-1824) (AF 49(638)1031) AD 268990 Unclassified

The heat generated during torsional oscillations of round aluminum tubes is reported. Static mechanical data for the material are also presented and a correlation of mechanical and thermal energies is obtained. The experiments demonstrate the necessity of including a coupling effect between the temperature field and the deviatoric components of strain. (Contractor's abstract)

1235

Johns Hopkins U. Dept. of Medicine, Baltimore, Md.

CORPUS CALLOSUM AND ANTERIOR COMMISSURE CONNECTIONS IN THE CAT (Abstract), by F. F. Ebner and R. E. Myers. [1961] [1]p. (AF AFOSR-61-38) Unclassified

Published in Physiologist, v. 4: 32, Aug. 1961.

The cortical distribution of the interconnecting fibers of the forebrain commissures were studied using the

Nauta-Gygax silver impregnation technique. After total commissuratomy the striate cortex or visual area I was remarkably free of degenerating fibers while peristriate or visual area II demonstrated them in dense profusion. The somatic sensory arm area appeared degeneration free while the leg and face areas revealed heavy degeneration. The somatic motor area of the anterior sigmoid gyrus also contained dense degeneration. The auditory areas I and II both showed diffuse and relatively heavy degeneration while auditory area III which is approx coextensive with somatic area II was degeneration free. Cingulate cortex was only very sparsely infiltrated with commissural fibers while the ventral portions of the ectosylvian complex remained entirely free of such fibers. These results will be discussed in relation to similar findings in the raccoon.

1236

Johns Hopkins U. [Dept. of Physics] Baltimore, Md.

CREATION AND DESTRUCTION OF CHARGED PARTICLES AND EXCITED STATES IN HELIUM (Abstract), by D. E. Kerr and C. S. Leffell, Jr. [1961] [1]p. [AF 18(600)363] Unclassified

Presented at meeting of the Amer. Phys. Soc., Schenectady, N. Y., Oct. 11-13, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 131, Feb. 23, 1962.

Consequences of measurements of magnitude and time dependence of electron concentration and of spectrally resolved atomic and molecular radiation at pressures of 0.25 to 20 mm Hg are summarized. These measurements provide better knowledge and control of gas purity, greater dynamic range, and much greater spectroscopic detail than those of previous work. Microwave-cavity measurements of ambipolar diffusion loss rates infer ionic mobility at pressures below 3 mm to be that of the atomic ion, reduced by diffusion cooling, and above that of the molecular ion. The mobilities at 300°K are 10.7 and 16.2 cm^2/v-sec, respectively, agreeing with drift-tube measurements for the atomic ion, but 20% lower for the molecular ion. Limits on recombination coefficient α are: for pressure about 1 mm, $\alpha > 2 \times 10^{-10}$ cm^3/sec; above 15 mm, $3 \times 10^{-10} < \alpha < 2 \times 10^{-9}$. Attempts to reconcile these and other detailed results with currently popular theories of recombination and of processes for production of radiating excited states reveal ambiguities or internal conflicts. Suggestions for additional theory and measurements are given.

1237

Johns Hopkins U. Dept. of Physics, Baltimore, Md.

THE DIFFUSION EQUATION WITH A QUADRATIC LOSS TERM APPLIED TO ELECTRON-ION VOLUME RECOMBINATION IN A PLASMA, by E. P. Gray and D. E. Kerr. [1961] [25]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(600)363] and Office of Naval Research under NOrd-7386) Unclassified

Published in Ann. Phys., v. 17: 276-300, Feb. 1962.

The diffusion equation for charged particles in a plasma, with an additional recombination loss term has been solved numerically for plasmas in containers having the shape of an infinite cylinder and a sphere. This equation applies to a decaying plasma in thermal equilibrium, with no sources of ionization, no loss mechanisms other than diffusion and volume recombination, and containing no negative and only one species of positive ion. The solutions have been used to assess the limits of applicability and the accuracy of the microwave cavity method for determining the recombination coefficient α as the slope of a plot of the reciprocal of the measured electron concentration vs time. It is found that a linear region in this plot can exist even for $\beta = 0$, and that the slope is therefore unrelated to α for sufficiently small β. Only if β is very large, and if the linear region is sufficiently extended, does the slope constitute a reasonable approximation to α. A criterion is established for the validity of this method of determining α, and is applied to a number of previous experiments. It is found that although some experiments satisfy this criterion and presumably yield good values of α, others do not, and yield values that are too large. (Contractor's abstract, modified)

1238

Johns Hopkins U. Dept. of Physics, Baltimore, Md.

COUPLING THE HELIUM CHAMBER TO THE 800 MEV/C K^- BEAM, by P. E. Schlein and T. E. Toohig. Mar. 1961 [17]p. incl. diagrs. (AFOSR-407) (AF 18-(603)143) Unclassified

The problems relevant to positioning the He chamber in the 800 mev/c K^- beam and the problems involved in shielding about the last 4 ft of the beam from the stray field of the Helmholz coils are discussed. Three sections of the field are considered. Region A extends from the 10 gauss field region (~85 in. from chamber center) downstream to the vertical focal plane. Region B extends from this 40 in. point downstream to a point 15.1 in. from chamber center. Region C extends from this field point to the chamber center. The best procedure for positioning the chamber seems to be the following: Decide by means of a bug orbit plot just what x_j (distance of the trajectory measured at the downstream end of

section B) is needed. Then correct to account for the presence of the magnetic shields to decide what x_1 is desired. The chamber is then positioned accordingly. The production of the 2 magnetic shields has been completed and a brief description of them is given.

1239

Johns Hopkins U. Dept. of Physics, Baltimore, Md.

DUKE HELIUM CHAMBER: K^- RUN OPTICAL SYSTEM AND FIDUCIAL MARK DATA, by T. E. Toohig. Mar. 1961 [6]p. incl. tables. (AFOSR-754) [AF 18-(603)143] Unclassified

Optical data for the K^- run are presented with accompanying sketches and film clips. The film clips were taken at room temperature. All glassware measurements are given as mean values of 4 measurements using a vernier caliper. The bubble chamber depth measurement was also made with the vernier. The relative positions of the fiducial marks when mounted on the chamber were determined by mounting the chamber on an optical bench, the telescope of which was aligned relative to the ways to within 20 in. of arc over the entire 2-meter bench. The chamber itself was aligned relative to the x and y motions of the measuring head to within .0001 in. to 1 cm of travel. The measurements are given in tabular form.

1240

Johns Hopkins U. [Dept. of Physics] Baltimore, Md.

EVIDENCE FOR A THREE-PION RESONANCE NEAR 550 MEV, by A. Pevsner, R. Kraemer and others. [1961] [8]p. incl. diagrs. refs. (AFOSR-1754) (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) AD 267986 Unclassified

Also published in Phys. Rev. Ltrs., v. 7: 421-423, Dec. 1, 1961.

Further data for a study of multipion resonances in $\pi^+ + d$ reactions observed in the Lawrence Radiation Lab. 72-in. bubble chamber exposed to a 1.23 bev/c pion beam from the Bevatron indicates the existence of a second neutral 3-pion resonance with a mass of ~550 mev. The reaction $\pi^+ + d \rightarrow p + p + \pi^+ + \pi^- + \pi^0$ in which both protons are visible and at least one proton stops in the chamber with a range less than 15 cm is considered. An ideogram for the first 199 events and a histogram for all 233 events are presented. An average mass uncertainty on a given event is ~ ± 20 mev. A large peak near 770 mev is the ω^0. Another large peak in the 3-pion mass plot is found near 550 mev, which strongly suggests the existence of a second 3-pion resonance, the η.

1241

Johns Hopkins U. [Dept. of Physics] Baltimore, Md.

K^- ABSORPTION IN ^{4}He. I. THE HYPERON-PION RESONANCE, by M. M. Block, E. B. Brucker and others. [1961] [9]p. incl. diagrs. (AFOSR-64-2035) (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(603)143], Atomic Energy Commission, National Science Foundation, and Office of Naval Research) AD 452465 Unclassified

Also published in Nuovo Cimento, Series X, v. 20: 724-732, May 16, 1961.

Results are given on a hyperon-pion resonance. This resonance has been investigated in the absorption of K-mesons in ^{4}He. The experiment was performed, using the Duke helium bubble chamber. Tentative assignments of spin, parity and level width of the Y* state are given. (Contractor's abstract)

1242

Johns Hopkins U. [Dept. of Physics] Baltimore, Md.

HELICITY OF THE PROTON FROM Λ DECAY, by J. Leitner, L. Gray and others. [1961] [5]p. incl. diagrs. table, refs. (AFOSR-64-2055) (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(603)-143], Atomic Energy Commission, and National Science Foundation) Unclassified

Also published in Phys. Rev. Ltrs., v. 7: 264-268, Sept. 15, 1961.

The study of about 2000 Λ's hyperons produced by K^- absorption in He, using the Duke U. helium bubble chamber and the Berkeley low energy K^--beam, indicated a positive helicity for the proton from the Λ decay. The result is based on 105 proton scattering events.

1243

Johns Hopkins U. [Dept. of Physics] Baltimore, Md.

SCATTERING MATRIX APPROACH TO THE Λ - π RESONANCE, by K. C. Wali, T. Fulton, and G. Feldman. [1961] [2]p. incl. refs. (Sponsored jointly by [Air Force] Office of Scientific Research under [AF 18(603)143] and National Science Foundation) Unclassified

Published in Phys. Rev. Ltrs., v. 6: 644-645, June 1, 1961.

An attempt is made to analyze the data involving the 3 channels $\bar{K}N$, $\Sigma\pi$, $\Lambda\pi$, in the I = 1 state in the total energy range $m_\Lambda + m_\pi$ to $m_N + m_K$ by means of an effective-range theory derived from a dispersion approach (analogous to the Chew-Low approximation in the

one-channel case). Assuming that the relative parity is odd, and Λ - K odd, it is shown that there can exist a resonance in the I = 1, J = ($\frac{3}{2}$-) state and all of the known data can be fitted to a reasonable set of renormalized coupling constants. A brief outline of the method of calculation is given.

1244

Johns Hopkins U. [Dept. of Physics] Baltimore, Md.

TEST OF CHARGE SYMMETRY OF K^+ AND K^0 MESONS (Abstract), by R. Kraemer, M. Nussbaum and others. [1961] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(603)143] and Office of Naval Research) Unclassified

Presented at meeting of the Amer. Phys. Soc., Mexico City (Mexico), June 22-24, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 350, June 22, 1961.

A test of the charge symmetry of the K^+ and K^0 mesons has been made by comparing the reactions (a) $\pi^+ + d \rightarrow p + \Lambda$ (or Σ^0) + K^+ and (b) $\pi^- + d \rightarrow n + \Lambda$ (or Σ^0) + K^0. Beams of positive and negative pions at 1.23 bev/c were directed into the 72-in. bubble chamber, and filled with liquid deuterium. About 140 events in the π^+ film and approximately 3 times that many in the π^- film have been measured. The cross sections for processes (a) and (b) were found to be the same within 20%. Distributions in momentum and angle of the lambdas and of the K mesons and also lambda decay asymmetries have been compared. No large deviations from charge symmetry have been observed.

1245

[Johns Hopkins U. Dept. of Physics] Baltimore, Md.

PHOTOELECTRIC EFFECT AND PAIR ANNIHILATION WITH LARGE MOMENTUM TRANSFER, by D. S. Moroi. [1959] [8]p. incl. refs. [AF 18(603)143] Unclassified

Published in Phys. Rev., v. 123: 167-174, July 1, 1961.

Photoelectric effect and pair annihilation in hydrogen with large momentum transfer are studied, taking into account the recoil and anomalous magnetic moment of proton, in an effort to determine whether these processes can be used to probe quantum electrodynamics at small distances. A negative result is obtained. For an incident energy of 100 mev the important term containing the electron propagator, which is sensitive to small distance modifications, is about 0.5% of the term, which is insensitive to them. The proton structure is described by 2 covariant form factors determined by the electron-proton scattering. The differential cross sections are calculated in the Born approximation in the laboratory system. The results are analyzed in the extreme relativistic energy range and in the special case that the outgoing electron (photon) comes off perpendicular to the incident beam. (Contractor's abstract)

1246

Johns Hopkins U. [Dept. of Physics] Baltimore, Md.

TIME RESOLVED STUDIES OF FAST DECAY TIMES (Abstract), by W. A. Hovis, Jr. [1961] [1]p. [AF 18-(603)143] Unclassified

Presented at meeting of the Amer. Phys. Soc., Colorado Springs, Colo., Nov. 15-18, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 157, Feb. 23, 1962.

A method for the time resolved study of decay times as short as 100 nsec of plasma species has been developed using ratio techniques to compensate for fluctuations in intensity in a repetitively pulsed discharge. Pulsed photomultipliers in conjunction with a high resolution monochromator were used as time resolving elements and studies made of the decay times of emission lines of highly ionized rare earth elements. Correlation of decay times with initial energy levels has been used to locate initial energy levels of transitions.

1247

Johns Hopkins U. [Dept. of Physics] Baltimore, Md.

THREE-PION RESONANCES IN $\pi^+ + d$ REACTIONS (Abstract), by A. Pevsner, R. Kraemer and others. [1961] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(603)143], Office of Naval Research, and National Science Foundation) Unclassified

Presented at meeting of the Amer. Phys. Soc., Chicago, Ill., Nov. 24-25, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 433, Nov. 24, 1961.

At the present time, 700 candidates for the reaction $\pi^+ + d \rightarrow p + p + \pi^+ + \pi^- + \pi^0$ with a beam momentum of 1.23 bev/c have been examined in the film from the Alvarez 72-in. chamber. Of these candidates, 160 fit the reaction with a $x^2 < 6$ using the Berkeley PANG and KICK programs. A histogram of the effective mass of the 3-pion system reveals 85 events in the region 740-800 mev. The peak of the resonance is 4 standard deviations above phase space. A Dalitz plot of the events in the peak is presented. The absence of this peak in the $n + p + \pi^+ + \pi^+ + \pi^-$ final state indicates that this is T = 0 resonance. These results corroborate

the 787 ± 15 mev resonance of Maglić, et al. The data also indicate a second bump at about 550 mev, but only 17 events in the bump.

1248

Johns Hopkins U. Dept. of Physics, Baltimore, Md.

THE SPECTRUM OF DOUBLY IONIZED PRASEODYMIUM, by J. Sugar. Dec. 1961, 59p. incl. illus. diagrs. tables, refs. (Spectroscopic rept. no. 22) (AFOSR-4543) (AF 49(638)535) AD 609418
Unclassified

The spectrum of Pr^{2+} (PrIII) produced by a low-energy spark discharge in helium was observed from 2025A to 10716A. The resulting line-list contains about 4,000 entries, some 1600 of which have been classified in an energy level scheme consisting of 118 odd and 130 even levels. Almost all the expected levels of the $4f^3$, $4f^2 5d$, $4f^2 6p$ configurations have been located, as well as some levels of the $4f5d^2$ and $4f^2 6d$ groups. The ground state of the ion was found to be the $^4I_{9/2}$ level of the $4f^3$ configuration. The structure of the $4f^2 6s$ and $4f^2 6p$ groups indicate well developed $J_1 j$-coupling, while the remaining configurations were interpreted in terms of LS-coupling. An ionization potential of 23.2 v was obtained from levels of the 2 member $4f^2 nd$ series. (Contractor's abstract)

1249

Johns Hopkins U. Dept. of Physics, Baltimore, Md.

THE SPECTRA OF DOUBLY AND TRIPLY IONIZED YTTERBIUM, by B. W. Bryant. Sept. 1961, 50p. incl. diagrs. tables, refs. (Spectroscopic rept. no. 21) (AFOSR-4544) (AF 49(638)535) AD 609419
Unclassified

The emission spectrum of ytterbium was photographed under varied conditions from 600A to 11,000A in order to obtain a complete description of the spectra of the doubly and triply ionized species. The main transition arrays of these species were identified, and where feasible, the analysis carried through. All 41 energy levels, 28 odd and 13 even, belonging to the $4f^{14}$, $4f^{13}5d$, $4f^{13}6s$, $4f^{13}6p$ and $4f^{13}7s$ configurations of YbIII were experimentally determined along with the appropriate quantum numbers. Eleven of 20 possible $4f^{13}6d$ levels and their quantum numbers were also determined. One hundred ninety three lines were classified in the YbIII energy level scheme with an average deviation of ± 0.05 cm^{-1}. All the YbIII levels are supported by intermediate coupling calculations. (Contractor's abstract)

The two $4f^{13}$ levels of YbIV were determined in addition to 20 of a possible 107 $4f^{12}5d$ levels, of which a few are expected to be fortuitous. (Contractor's abstract)

1250

Johns Hopkins U. [Dept. of Physics] Baltimore, Md.

EMISSION SPECTRA OF THE DOUBLY AND TRIPLY IONIZED RARE EARTHS, by G. H. Dieke, H. M. Crosswhite, and B. Dunn. [1961] [8]p. incl. illus. diagrs. table. (AFOSR-J99) (AF 49(638)535) AD 400083
Unclassified

Also published in Jour. Opt. Soc. Amer., v. 51: 820-827, Aug. 1961.

The spectra of the rare earths have been photographed under controlled excitation so that either the spectra of the double or triply ionized elements are brought out with maximum intensity. A mild excitation is used in addition to give the first and second spectra for comparison. Some regularities are immediately apparent and vary very gradually through the rare-earth group. The general features of the spectra are also discussed. (Contractor's abstract)

1251

Johns Hopkins U. Dept. of Physics, Baltimore, Md.

STRUCTURE OF f^n CONFIGURATIONS. II. f^5 AND f^9 CONFIGURATIONS, by B. G. Wybourne. Sept. 29, 1961, 11p. incl. diagrs. tables, refs. (AFOSR-J100) (AF 49-(638)535) AD 400160
Unclassified

Also published in Jour. Chem. Phys., v. 36: 2301-2311, May 1, 1962.

The complete energy matrices of the f^5 configuration have been calculated using the methods of Racah. Energy level schemes have been constructed for the trivalent samarium, dysprosium, and plutonium ions. A preliminary analysis of the observed spectra of these ions is made. (Contractor's abstract)

1252

Johns Hopkins U. Dept. of Physics, Baltimore, Md.

STRUCTURE OF f^n CONFIGURATIONS. I. CALCULATION OF THE ENERGY LEVELS, by B. G. Wybourne. Sept. 29, 1961, 6p. incl. tables, refs. (AFOSR-J101) (AF 49(638)535) AD 400129
Unclassified

Also published in Jour. Chem. Phys., v. 36: 2295-2300, May 1, 1962.

In the first of a series of papers on the structure of f^n electron configurations, the calculation of the energy

matrices and the construction of the energy level schemes are discussed together with the approximations that such calculations involve. Several new calculations are reported. (Contractor's abstract)

1253

Johns Hopkins U. [Dept. of Physics] Baltimore, Md.

TIME-RESOLVED SPECTRA OF RARE-EARTH IONS, by W. A. Hovis, Jr. [1961] [7]p. incl. diagrs. (AFOSR-J103) [AF 49(638)535] AD 400070 Unclassified

Also published in Jour. Opt. Soc. Amer., v. 52: 649-655, June 1962.

An apparatus has been developed for the study of the afterglow of a rare-earth spark with a time resolution of 0.1 μsec. A hydrogen thyratron controls a rapidly firing spark gap and the spectrum of the afterglow is recorded with pulsed photomultipliers and ratio techniques. Tests with praseodymium have shown that it is possible to separate lines according to the ion of origin for the second, third, and fourth spectra, according to confirmation of origin in the third spectrum of praseodymium, for example, the emission lines of the $4f^2 6p$-$4f^2 6s$ and $4f^2 5d$-$4f^3$ transitions. In the case of the $4f^2 5d$-$4f^3$ transition, some terms of the $4f^2 5d$ configuration are indicated from the more intense lines. The methods developed with praseodymium have been applied to neodymium, and some preliminary results are reported. (Contractor's abstract)

1254

Johns Hopkins U. [Dept. of Physics] Baltimore, Md.

SPIN-ORBIT INTERACTIONS IN f^n ELECTRON CONFIGURATIONS, by B. G. Wybourne. [1960] [6]p. incl. tables. [AF 49(638)535] Unclassified

Published in Jour. Chem. Phys., v. 35: 334-339, July 1961.

Simple relationships can be shown to exist between the spin-orbit matrix elements of different f^n electron configurations. These relationships allow a great reduction in the labor of calculating the spin-orbit interaction matrices for f^n electron configurations. Several examples are given. (Contractor's abstract)

1255

Johns Hopkins U. [Dept. of Physiology] Baltimore, Md.

[SINGLE UNIT CORTICAL AND SUBCORTICAL FUNCTION IN UNRESTRAINED ANIMALS] by V. B. Mountcastle. Final technical rept. [1961] [13]p. incl. table. (AFOSR-1691) (AF 49(638)499) AD 267093 Unclassified

A study of the second somatic area of the cerebral cortex in the cat was made using the method of single unit analysis. Cells of the anterior portion of this area possess properties that are lemniscal in nature, resembling those of the first somatic area. Cells of more posterior parts of this area possess properties similar to those of the posterior nuclear group of the thalamus; they are neither mode nor place specific; and auditory and somatic inputs interact upon them. Clear evidence was obtained that the somatic sub-mode of pain projects upon the second somatic area. Part of the study dealt with the design and construction of an automatic data-reducing system for neurophysiological investigations. The system allows automatic measurement of intervals between nerve impulses, preserves the temporal order of the data, labels each interval measured in re its relation to sensory stimuli, and presents data readout ready for computer input. (Contractor's abstract)

1256

Johns Hopkins U. Dept. of Physiology, Baltimore, Md.

AN AUTOMATIC SYSTEM FOR PROCESSING MICRO-ELECTRODE DATA, by E. M. Glaser. [1961] [5]p. incl. diagrs. (AFOSR-64-1078) (AF AFOSR-62-31) AD 441466 Unclassified

Also published in I.R.E. Trans. on Bio-Med. Electronics, v. BME-9: 190-194, July 1962.

A data processing system has been designed and built which converts single unit microelectrode recordings obtained on analog magnetic tape into a punched paper tape record. The conversion process preserves the exact time sequence in which the neurological events occur. The punched paper tape record can be used to obtain hard copy via a "flexowriter" and to punch IBM cards for computation on any one of a number of digital computing machines. It thereby permits detailed study by digital computers of such phenomena as spontaneous activity and adaptive cell processes during and after periods of stimulation. The basic method for obtaining the paper tape record is to slow down the playback of the original tape record by a factor of 50 or 100. This permits continuous analog to digital conversion of the intervals by a compact digital subsystem designed for this purpose. The measurements are encoded and presented to a tape perforator operating at 110 characters/sec. A code character is inserted at the end of each interval measurement to identify the intervals as: stimulus-response, response-response, response-stimulus, stimulus-stimulus. Other uses of this coding symbol are possible. (Contractor's abstract)

1257

Johns Hopkins U. [Inst. for Cooperative Research] Baltimore, Md.

UNSTEADY INTERACTION OF A SHOCK WAVE WITH A CELLULAR VORTEX FIELD, by J. E. Werner. [1960] [14]p. incl. diagrs. (AF 18(600)757) Unclassified

Published in Jour. Fluid Mech., v. 10: 195-208, Mar. 1961.

The transient effects generated when a shock wave is suddenly disturbed by a field of cellular vortices have been studied. Both the pressure disturbance on the shock and the local shock velocity are found to be strong functions of the cell geometry. Disturbances are resolved into transient components and sinusoidal components of constant amplitude. The transients are found to die out as $t^{-3/2}$, t being the interaction time, except for one particular case of the cell geometry for which they diminish as $t^{-1/2}$. Furthermore, the analysis indicates that the initial magnitude of the transient components may be quite appreciable in comparison with the sinusoidal component. The theory is extended to treat the convection through the shock of a single column of vortex cells. (Contractor's abstract)

1258

Johns Hopkins U. Lab. of Astrophysics and Physical Meteorology, Baltimore, Md.

FAR-INFRARED INTERFEROMETRIC MODULATION AT THE JOHNS HOPKINS UNIVERSITY (Abstract), by G. A. Vanasse. [1959] [1]p. [AF 18(600)1307] Unclassified

Presented at Symposium on Molecular Structure and Spectroscopy, Ohio State U., Columbus, June 15-19, 1959.

Published in Spectrochim. Acta, No. 9: 773, 1959.

Interferometric modulation is a technique for obtaining spectral information in the far-infrared region of the spectrum, where detector noise limits the resolution that can be obtained with diffraction gratings. The observations consist of obtaining a plot of the illumination resulting from the interference of 2 coherent beams of radiation as a function of their path difference. The transformation from observed data to spectra is discussed, and the "scanning" function for an interferometric modulator, similar to the diffraction grating "scanning" function is arrived at. The resolving power to be expected from this interferometric technique is shown to be proportional to the maximum path difference between the interfering beams. The lamellar-grating type interferometer and auxiliary apparatus is described. Far-infrared spectra, obtained with the instrument, indicating $\sim (1/4)\ cm^{-1}$ resolution, are presented.

1259

Johns Hopkins U. Lab. of Astrophysics and Physical Meteorology, Baltimore, Md.

IRIDESCENT $KClO_3$ CRYSTALS AND INFRARED REFLECTION FILTERS, by J. Strong. [1961] [3]p. incl. diagrs. tables. (AFOSR-215) (AF 18(600)1307) AD 262659 Unclassified

Also published in Jour. Opt. Soc. Amer., v. 51: 853-855, Aug. 1961.

Measurements of the sharp reflection peaks of 2 iridescent potassium chlorate crystals are presented, together with theoretical calculations based on Lord Rayleigh's model that the reflection is due to a stratified grating-in-depth, formed by evenly spaced layers of low reflectance. The possibility of such structures for filters useful in the far infrared is indicated. (Contractor's abstract)

1260

Jonker Business Machines, Inc., Gaithersburg, Md.

OUTLINE OF A GENERAL THEORY OF INDEX TERMINOLOGY AND INDEXING METHODS, by F. Jonker. Oct. 1961, 1v. incl. diagrs. (AFOSR-1911) (AF 49(638)961) AD 272820 Unclassified

In indexing it is necessary to distinguish between the problem of index terminology, and that of index methods. The former pertains to the choice of terms without regard to any connection between the terms. The latter pertains to connections between terms. The present theory is based upon 2 insights; namely, that all terminology forms a continuum and that all modes of connections between terms form a continuum. It analyzes the problems of index terminology and index methods separately, and then unites them into a 2-dimensional continuum.



1261

Kansas U. Dept. of Chemistry, Lawrence.

PHOTOMETRIC TITRATION OF CERTAIN ALDEHYDES WITH SODIUM BOROHYDRIDE, by E. Cochran and C. A. Reynolds. [1961] [2]p. incl. table. (AFOSR-1820) (AF 49(638)472) Unclassified

Also published in Anal. Chem., v. 33: 1893-1894, Dec. 1961.

A procedure has been developed for the direct photometric titration of certain aldehydes with sodium borohydride. The titration is carried out in an isopropyl alcohol-water mixture with a standard solution of sodium borohydride in dimethylformamide. Aliphatic aldehydes and aromatic aldehydes which are unsubstituted or substituted with electron-withdrawing groups can be determined with an accuracy of ± 1% or better and with a precision of less than ± 0.4%. (Contractor's abstract)

1262

Kansas U. Dept. of Chemistry, Lawrence.

SPECTROPHOTOMETRIC TITRATION OF PRIMARY ALIPHATIC AMINES, by Y.-L. G. Liu and C. A. Reynolds. [1961] [3]p. incl. diagr. table. (AFOSR-1821) [AF 49(638)472] AD 613789 Unclassified

Also published in Anal. Chem., v. 34: 542-544, Apr. 1962.

A spectrophotometric titration method for the determination of primary aliphatic amines in the presence of secondary and tertiary amines and other basic substances has been developed. The amine is titrated in dioxane solvent with glacial acetic acid added as catalyst and a standard solution of 2-ethylhexanal as titrant. (Contractor's abstract)

1263

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. [AF 49(638)472] Unclassified

Published in Trans. Kansas Acad. Sci., v. 64: 315-320, 1961.

This paper presents a method of spectrophotometric determination of ketones based on an adaptation of a borohydride reaction to a simple photometric determination of a wide variety of ketones. The procedure goes as follows: An aliquot of the sample to be determined, in an appropriate solvent, is treated with a large excess of $Na\,BH_4$ (sodium borohydride). The solution is allowed to stand for a while to permit the reaction to proceed. This solution and a blank containing only the sample are then heated to reflux. A comparison of the optical density of the ketone blank solution with that of the reaction solution at the wavelength of maximum absorption of the ketone, λ max, then gives a measure of the concentration of ketone which has disappeared in the latter solution by reaction with borohydride. From this net optical density, the optical density of the ketone blank minus that of the reaction solution at λ max, the concentration of ketone in the sample can be calculated.

1264

Kansas U. Dept. of Chemistry, Lawrence.

ELECTROLYTIC GENERATION OF RADICAL IONS IN AQUEOUS SOLUTION, by L. H. Piette, P. Ludwig, and R. N. Adams. [1961] [2]p. incl. diagr. table. (AFOSR-1596) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)822] and Atomic Energy Commission) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 3909-3910, Sept. 20, 1961.

This paper reports the successful generation of both cation and anion radicals and especially negative ions from aliphatic nitro compounds in ordinary aqueous solutions. The electrolysis vessel consisted of a rectangular aqueous cell inserted in the cavity of a standard Varian V-4500 EPR spectrometer using 100 kc field modulation. The supporting electrolyte was 0.1 M lithium perchlorate or 0.5 M potassium chloride or acetate buffer. The mono-negative ions of o-, m-, and p-nitroanisole; o-, m-, and p-nitrophenol, p-nitroanisole, p-nitrodimethylaniline and nitrobenzene itself were generated and detected at a mercury pool electrode. It was observed that the radical ions decayed by a first order reaction when the current was turned off. Such a decay strongly suggests reaction with the solvent and not with another ion. The spectra of the mono negative ions of aliphatic nitro compounds show a very strong N^{14} coupling and, in addition, coupling of the unpaired electron with protons on the carbon adjacent to the nitrogen. The widespread feeling that radical anions are too unstable per se to be observed by electrogeneration in aqueous media is rendered untenable by the present studies.

1265

Kansas U. Dept. of Chemistry, Lawrence.

ON THE MOLECULAR BASIS OF SOME CURRENT THEORIES OF DIFFUSION, by R. J. Bearman. [1961] [8]p. incl. refs. (AFOSR-1367) [AF AFOSR-61-7] Unclassified

Also published in Jour. Phys. Chem., v. 65: 1961-1968, Nov. 1961.

The equations of Eyring and his collaborators, of Hartley and Crank, and of Gordon for the concentration dependence of diffusion coefficients in liquid solutions are examined from the point of view of statistical mechanics. Although there are some ambiguities in the original derivations, the equations are basically equivalent and are valid for solutions which are regular. It is shown that the concept of intrinsic diffusion coefficient is unnecessary for the understanding of diffusion processes. (Contractor's abstract)

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Kansas U. Dept. of Chemistry, Lawrence.

RATIO OF SELF-DIFFUSION COEFFICIENTS IN LIQUID ARGON-KRYPTON MIXTURES, by R. J. Bearman. [1961] [1]p. incl. table. (AFOSR-2861) [AF AFOSR-61-7] Unclassified

Also published in Jour. Phys. Chem., v. 66: 379, Feb. 1962.

A statistical mechanical theory of diffusion in binary liquid solutions is developed. This theory predicts that the ratio of the self-diffusion coefficients of the 2 species should be in the inverse ratio of their molar volumes, providing that the intermolecular potentials are spherically symmetric and similar, the volumes are additive, and the sizes of the molecules are sufficiently close that radical distribution functions are independent of composition. The published measurements of Cini-Castagnoli and Ricci (Nuovo Cimento, Series X, v. 15: 795, 1960) on self-diffusion data for argon and krypton in pure argon are used with an estimated experimental error of 6%. It was decided to evaluate the molar volume ratios from thermodynamic data in the liquid phase for comparison with the theory and also to re-estimate the atomic radii for comparison with predictions from the Stokes-Einstein equation. Density data for liquid argon exist in the neighborhood of the temperatures utilized in the diffusion experiments. For krypton, values are extrapolated to 90.0°K giving liquid argon at 1.37 g/cc and liquid krypton as 2.61 g/cc. The atomic radius values r of 1.91A for argon and 2.01A for krypton are used. The diameters σ calculated from gas phase properties for argon are used (3.41A); for krypton the diameter depends on whether second virial data or gas phase transport data are used. For this calculation it is averaged between the two. 3.59A. For a third measure of the ratio of the radii, the cube root of the ratio of the molar volumes in the liquid phase is used. It appears that the inverse ratio of the molar volumes agrees with the ratio of diffusion coefficients within experimental error. The 3 reasonable estimates of the inverse ratio of the atomic radii are in substantial agreement and differ from the ratio of the diffusion coefficients by an amount which appears to be slightly beyond experimental error. It is concluded that the data of Cini-Castagnoli and Ricci do provide a verification of the proposed theory.

1267

Kansas U. Dept. of Chemistry, Lawrence.

NONEQUILIBRIUM THERMODYNAMICS OF THE SIMPLE MOVING BOUNDARY EXPERIMENT, by R. J. Bearman. [1961] [5]p. incl. diagrs. (AFOSR-3757) (AF AFOSR-61-7) Unclassified

Also published in Jour. Chem. Phys., v. 36: 2432-2436, May 1, 1962.

The usual equations for the moving boundary experiment are derived from the equations of the thermodynamics of irreversible processes. It is shown that the assumption that the partial molar volumes are constant through the liquid junction is implicit in the Lewis correction for the solvent velocity. The use of the correction has doubtful validity when there are appreciable volume changes upon mixing. (Contractor's abstract)

1268

Kansas U. Dept. of Chemistry, Lawrence.

EXPERIMENTAL EVALUATION OF LIQUID-JUNCTION POTENTIAL, by L. V. Nelson and R. T. Iwamoto. [1961] [2]p. incl. table. (AFOSR-1563) [AF AFOSR-61-8] Unclassified

Also published in Anal. Chem., v. 33: 1795-1796, Nov. 1961.

The half-wave potential of the 4,7 dimethyl-1-10-phenanthroline ferric-ferrous couple at a rotating Pt electrode was used to measure the liquid-junction potential between various non-aqueous solvents and a saturated calomel electrode. Potentials of at most 0.15 v and on the average 0.05 v were found for MeCN, $MeNO_2$, MeOH, EtOH, Ac_2O, Ac_2CH_2, PrOH, iso-PrOH, BuOH, Me_2CO allyl alc. and pyridine.

1269

Kansas U. [Dept. of Physics] Lawrence.

LIFETIME OF POSITRONS IN LIQUIDS AT HIGH PRESSURE, by R. K. Wilson, P. O. Johnson, and R. Stump. Final rept. [1961] [33]p. incl. diagrs. tables, refs. (AFOSR-1588) (AF AFOSR-60-17) AD 264957 Unclassified

The progress made under this contract is briefly reviewed. The examination of the microscopic nature of a liquid by the use of positronium lifetime is unique in that the positronium lifetime depends on the size of regions of low density whereas x-ray and neutron diffraction depend on where the molecules are most dense. The reversal of the sign of the temperature effect on the lifetime is the most unusual effect observed. Further work

on x-ray diffraction at high pressure on liquids would help in the interpretation of the present results.

1270

Kansas U. [Dept. of Physics] Lawrence.

INFLUENCE OF PRESSURE ON THE MEAN LIFE-TIME OF POSITRONS IN LIQUIDS (Abstract), by R. Stump. [1961] [1]p. [AF AFOSR-60-17] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phyz. Soc., Series II, v. 6: 240, Apr. 24, 1961.

The mean life of positrons forming positronium has been measured in a number of liquids as a function of pressure and temperature. Liquids used include water, isopropyl alcohol, benzene, and glycerine. Pressure ranged from 1-6000 atm, temperatures from 0° to 300° C. The results may be summarized as follows: the number of positrons in the long lived-component (o-positronium) is essentially independent of pressure, whereas the lifetime decreases linearly with the volume of the liquid.

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Karolinska Inst., Stockholm (Sweden).

EFFECTS OF DIFFERENT TYPES OF VASODILATOR MECHANISMS ON VASCULAR TONUS AND ON TRANS-CAPILLARY EXCHANGE OF DIFFUSIBLE MATERIAL IN SKELETAL MUSCLE, by E. M. Renkin and S. Rosell. [1961] [11]p. incl. diagrs. refs. (AFOSR-J464) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)502 and National Institutes of Health) AD 407117 Unclassified

Also published in Acta Physiol. Scand., v. 54: 241-251, 1962.

Pressure-flow curves, representing various states of vascular tonus were obtained in isolated skeletal muscles of dogs and cats perfused with blood at constant flow. The arteriovenous (A-V) extraction of rubidium^{86} was also continuously recorded. Metabolic vasodilatation and vasodilation due to inhibition of the activity in the vasoconstrictor nerves induced a decrease of vascular tonus and an augmented blood-tissue transport. Vasodilatation due to excitation of cholinergic vasodilator nerves produced a decrease in peripheral resistance amounting to about 70% of the decrease caused by metabolic vasodilatation. Vasodilator nerve activity did not produce any consistent change in blood tissue transport. It is considered that vasodilator nerve activity produces an arteriolar dilatation, whereas vasodilatation due to inhibition of vasoconstrictor nerve impulses or followed by muscular contraction induces relaxation of smooth muscles in both arterioles and precapillary sphincters. (Contractor's abstract)

1272

Karolinska Inst., Stockholm (Sweden).

THE INFLUENCE OF SYMPATHETIC ADRENERGIC VASOCONSTRICTOR NERVES ON TRANSPORT TO DIFFUSIBLE SOLUTES FROM BLOOD TO TISSUES IN SKELETAL MUSCLE, by E. M. Renkin and S. Rosell. [1961] [18]p. incl. diagrs. tables, refs. (AFOSR-J465) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)502, National Institutes of Health, and Swedish National Association against Heart and Chest Diseases) AD 407118 Unclassified

Also published in Acta Physiol. Scand., v. 54: 223-240, 1962.

Arteriovenous (A-V) extraction of rubidium^{86} was continuously recorded in isolated skeletal muscles of dogs and cats perfused with blood at constant flow. In a few experiments, A-V extraction of oxygen was measured also. The sympathetic trunk, still connected to the muscle, was stimulated electrically under various conditions. Excitation of sympathetic adrenergic vasoconstrictor nerves produced an increase in vascular resistance and a decrease in Rb^{86} and O_2 transport. These effects were graded in relation to stimulus frequency, persistent throughout continued stimulation and large enough to be of importance at low, physiological frequencies. The changes in vascular resistance and blood-tissue transport are mechanically independent. Both are mediated by preganglionic fibers of similar properties, but it is not possible to tell if the same or different fibers are involved. The reduction in transport is considered to result mainly from restriction of the number of open capillaries, due to closure of precapillary sphincters, with some contribution from a decrease in the uniformity of circulation through those parts of the capillary network remaining open. (Contractor's abstract)

1273

Karolinska Inst. [Dept. of Medical Physics] Stockholm (Sweden).

ELECTRICAL ACTIVITY AND CELL DENSITY IN THE CLAUSTRO-INSULAR AREA OF THE RABBIT, by P. Valleala. [1961] 61p. incl. illus. diagrs. tables, refs. (AFOSR-2132) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)21, Emil Aaltonen Foundation, and Swedish Institute) Unclassified

Also published in Acta Physiol. Scand., v. 52, Suppl. 152: 1-61, 1961.

In the present investigation the distribution of the spike and slow wave activities was studied with an extracellular microelectrode technique in different layers throughout the entire cortical depth. The spike and slow wave activity was led off with a KCl-filled glass capillary electrode which was inserted in stepwise fashion to different depths in the claustro-insular area of the rabbit. The slow potentials at each electrode position were integrated electronically during fixed intervals of time, and the probability of the appearance of positive spike potentials during the same time periods was estimated. Diagrams of time integral values for the slow wave activity plotted against the probability of appearance of positive spike potentials show a distribution in depth of these 2 types of cortical activity. On the basis of the electrophysiological data obtained, a significant negative correlation was found between the appearance of slow activity and spike potentials both in light and in deep anesthesia. On the basis of the electrophysiological and the histological material the distribution of the spike and slow wave activities was correlated with the density of claustro-insular cells. A positive correlation between spike activity and cell density was found to be highly significant in the animals under deep anesthesia. This positive correlation was non-significant in the animals under light anesthesia. The difference between light and deep anesthesia as regards the distribution of spike activity and slow activity seems not to concern the superficial and deep cortical layers uniformly, since it is found that the large insular pyramidal cells in layer V C did not react to changes in anesthesia as critically as the large claustral cells. On the basis of the results obtained, the dendritic origin of the slow wave activity was discussed.

1274

Karolinska Inst. [Dept. of Medical Physics] Stockholm (Sweden).

[BIOPHYSICAL AND ELECTROPHYSICAL STUDIES OF SENSORY MECHANISMS] by C. G. Bernhard. Final technical rept. Dec. 21, 1961, 8p. incl. refs. (AFOSR-2176) (AF 61(052)21) AD 271776 Unclassified

This report reviews the results obtained under this contract. The research falls into 2 general categories: Research within the field of functional neuroembryology and Research within the field of sense organ physiology. The following 3 subjects were investigated in relation to the former: (1) Neuromuscular functions, (2) Spinal reflexes, and (3) Afferent cortical projection and cortical activity. The latter area included (1) Compound eye receptor function and (2) Olfactory functions. The report is followed by a list of publications which resulted from the contract.

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Karolinska Inst. [Dept. of Medical Physics] Stockholm (Sweden).

STUDIES ON THE RELATION BETWEEN THE PIGMENT MIGRATION AND THE SENSITIVITY CHANGES DURING DARK ADAPTATION IN DIURNAL AND NOCTURNAL LEPIDOPTERA, by C. G. Bernhard and D. Ottoson. [1960] [11]p. incl. illus. diagrs. refs. (AFOSR-2852) (AF 51(052)21) AD 275803 Unclassified

Also published in Jour. Gen. Physiol., v. 44: 205-215, Sept. 1960.

The functional significance of the pigment migration in the compound insect eye during dark adaptation has been studied in diurnal and nocturnal Lepidoptera. Measurements of the photomechanical changes were made on sections of eyes which had been dark-adapted for varying periods of time. In some experiments the sensitivity changes during dark adaptation were first determined before the eye was placed in the fixation solution. No change in the position of the retinal pigment occurred in Cerapteryx graminis until the eye had been dark-adapted for about 5 min. The start of the migration was accompanied by the appearance of a break in the dark adaptation curve. During longer periods of dark adaptation the outward movement of the pigment proceeded in parallel with the change in sensitivity, the migration as well as the adaptive process being completed within about 30 min. In the diurnal insects chosen for the present study (Erebia, Argynnis) the positional changes of the retinal pigment were insignificant in comparison with the movement of the distal pigment in Cerapteryx graminis. On the basis of these observations the tentative hypothesis is put forward that the second phase of adaptive change in nocturnal Lepidoptera is mediated by the migration of the retinal pigment while the first phase is assumed to be produced by the resynthesis of some photochemical substance. In diurnal insects which have no appreciable pigment migration the biochemical events alone appear to be responsible for the increase in sensitivity during dark adaptation. (Contractor's abstract)

1276

Karolinska Inst. [Dept. of Medical Physics] Stockholm (Sweden).

COMPARATIVE STUDIES ON DARK ADAPTATION IN THE COMPOUND EYES OF NOCTURNAL AND DIURNAL LEPIDOPTERA, by C. G. Bernhard and D. Ottoson. [1960] [9]p. incl. diagrs. refs. (AFOSR-2853) (AF 61-(052)21) Unclassified

Also published in Jour. Gen. Physiol., v. 44: 195-203, Sept. 1960.

A comparative analysis has been carried out of the time course and range of dark adaptation in the compound eyes of some common butterflies and noctuid moths (Lepidoptera). The change in sensitivity of the eye during dark adaptation was determined by measurements of the intensity of illumination necessary to elicit an electrical response of a given magnitude of the eye. It was found that the curve for dark adaptation in the diurnal species was smooth. The range of adaptive change varied in different species but usually did not cover more than 1 to

1.5 log units. In the nocturnal species the dark adaptation was found to proceed in 2 phases. The first phase was usually completed in less than 10 min and covered a range of 1 to 1.5 log units. The second phase was more prolonged and covered a range of 2 to 3 log units. In some of the experiments on nocturnal species the second phase failed to appear. Measurements of the size of the response at different intensities showed that the intensity/amplitude relationship was the same in the light-adapted eye as in the dark-adapted eye. In the nocturnal insects the response of the eye in the light-adapted condition was about 20% of that in the dark-adapted eye, while in diurnal insects it was about 60%. (Contractor's abstract)

1277

Karolinska Inst. [Dept. of Medical Physics] Stockholm (Sweden).

THE STRUCTURE OF α-KERATIN, by G. Swanbeck. [1961] [3]p. incl. diagr. refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 61-(052)21, National Institutes of Health, and Office of Naval Research) Unclassified

Published in Exper. Cell Research, v. 23: 420-422, Mar. 1961.

A model for the structural arrangements of the protein chains in α-keratin has been proposed on the basis of the differential pattern of porcupine quill tips. The model implies that the protein chains are basically of the α-helix configuration but are supercoiled and packed in 5 concentric layers. The supercoiling in the different layers makes 1 turn in 198A along the axis of the tonofilament. The number of chains in the different layers are 3, 7, 10, 16, and 19. This arrangement that is based on the diffraction pattern gives a diameter of the tonofilament that is in agreement with electron microscopic data.

1278

Karolinska Inst. Dept. of Medical Physics, Stockholm (Sweden).

CORRELATION OF ION EXCHANGE COLUMN WITH MOLECULAR STRUCTURE OF BONE, by D. Carlström. Annual summary rept. no. 1, Nov. 1, 1960-Oct. 31, 1961. Dec. 19, 1961, 2p. (AFOSR-2089) (AF 61(052)-386) AD 272230 Unclassified

During the past year of the contract period, the work on the ultrastructural organization of calcified tissues and related compounds has advanced satisfactorily. Special attention has been paid to the nature of the inorganic salts in bone and teeth and among the unsolved problems in this connection, the question of the state of the carbonate has been most thoroughly investigated. By means of x-ray diffraction the small changes in unit cell dimensions have been studied and these changes have been compared to those in synthetic apatites where certain ions have been replaced by the introduction of foreign ions. Single crystals of mineral apatites containing carbonate groups have for the first time been analyzed with single crystal x-ray methods. The unique collection of carbonate containing apatites has also been investigated with other physical methods such as polarized light microscopy and in some cases also x-ray absorption. Infrared absorption spectra on the whole material have been compared with spectra from a great number of other carbonate containing compounds in order to elucidate the state of the carbonate. A unique interpretation of the data has so far not been possible but it is anticipated that calculations from the single crystal data will give the final answer to the question of the state of the carbonate. Besides this work, minor investigations within the scope of this contract have also been undertaken. A brief description of each is given.

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Karolinska Inst. Dept. of Medical Physics, Stockholm (Sweden).

STUDIES ON THE ULTRASTRUCTURE OF DENTAL ENAMEL. II. THE ORIENTATION OF THE APATITE CRYSTALLITES AS DEDUCED FROM X-RAY DIFFRACTION, by J.-E. Glas. [1960] [15]p. incl. diagrs. refs. (AFOSR-J210) (AF 61(052)386) AD 400435 Unclassified

Also published in Arch. Oral Biol., v. 7: 91-104, 1962.

Small volumes of human enamel along a thin bundle of straight prisms have been investigated by polarized light microscopy, microradiography and micro x-ray diffraction. By a special technique, diffraction patterns could be recorded from the same part of the enamel in different angular positions. This permitted a complete 3-dimensional analysis of the arrangement of the apatite crystallites in enamel of different anatomical localization. The results are discussed in the light of earlier findings. The influence of crystallite arrangement on polarization microscopy data are also considered. (Contractor's abstract)

1280

Karolinska Inst. Dept. of Physiology, Stockholm (Sweden).

NORADRENALINE RELEASE FROM ISOLATED NERVE GRANULES, by U. S. von Euler and F. Lishajko. [1960] [11]p. incl. diagrs. tables, refs. (AFOSR-1240) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)309 and Swedish Medical Research Council) AD 262056 Unclassified

Also published in Acta Physicl. Scand., v. 51: 193-203, 1961.

Some properties of isolated transmitter granules obtained by high g centrifugation of press juice from bovine

splenic nerves have been studied. Of the total noradrenaline present in the press juice 20-35% was recovered in the sediment. The granules are stable for several hours at + 4°C but rapidly lose their noradrenaline on incubation in isotonic neutral media at 37°C. Noradrenaline is rapidly released even at low temperature at pH 4 and below, and by detergents. Hypo- and hyperosmotic solutions and freezing and thawing had a moderate releasing effect. Acetylcholine, nicotine, serotonin and GABA had no detectable effect on the noradrenaline release from the granules. Nerve granules are more sensitive to temperature than adrenal medullary granules but show higher resistance to freezing and thawing and osmotic changes. (Contractor's abstract)

1281

Karolinska Inst. Dept. of Physiology, Stockholm (Sweden).

IMPROVED TECHNIQUE FOR THE FLUORIMETRIC ESTIMATION OF CATECHOLAMINES, by U. S. von Euler and F. Lishajko. [1960] [8]p. incl. diagrs. tables. (AFOSR-1241) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)309 and Swedish Medical Research Council) AD 262289 Unclassified

Also published in Acta Physiol. Scand., v. 51: 348-355, 1961.

By the addition of small amounts of ethylene diamine (EDA) to the alkali-ascorbic acid mixture used in the trihydroxyindole (THI) method the discoloration of reaction mixture and instability of fluorescence can be prevented, allowing blanks to maintain their fluorescence values for several hours. The lutines obtained from adrenaline and noradrenaline standards and from alumina eluates are stable over a period of at least 1 hr. Optimal fluorescence values are obtained when the volume of alkali-ascorbic-acid—EDA exceeds the volume of the sample by 1 ml. A proportional increase in fluorescence is observed with sample volumes up to 3 ml. The technique used for estimation of catecholamines in urine and organ extracts is described. The importance of the acidity for the release of catecholamines from conjugates in urine at room temperature is emphasized. (Contractor's abstract)

1282

Karolinska Inst. Dept. of Physiology, Stockholm (Sweden).

ADRENALINE EXCRETION DURING RESTING CONDITIONS AND AFTER INSULIN IN ADRENALECTOMIZED HUMAN SUBJECTS, by U. S. von Euler, D. Ikkos, and R. Luft. [1961] [8]p. incl. tables, refs. (AFOSR-2088) (AF 61(052)309) AD 611470 Unclassified

Also published in Acta Endocrinol., v. 38: 441-448, 1961.

The effect of insulin on the urinary excretion of adrenaline was studied in 10 bilaterally adrenalectomized patients receiving cortisone and in 8 healthy volunteers. The resting excretion of adrenaline was the same in both groups. Insulin administration to the adrenalectomized patients led to an increase in adrenaline excretion from the control level (mean ± S.E.) of 2.42 ± 0.33 to 5.01 ± 0.98 ng per min ($P < 0.02$) during the second hr, and 6.61 ± 0.82 ng per min ($P < 0.001$) during the third hr. In the normal subjects the maximum adrenaline excretion (21.7 ± 3.49 ng per min) was observed during the first hr. The response of the blood glucose level to insulin was the same in both groups. It is concluded that extra-adrenal chromaffin cells produce adrenaline and respond to insulin. It is suggested that hypoglycaemia may not be the principal cause of this response. (Contractor's abstract)

1283

Karolinska Inst. Dept. of Physiology, Stockholm (Sweden).

CATECHOLAMINE PRODUCTION AND RELEASE IN EXPOSURE AND ACCLIMATION TO COLD, by J. Leduc. 1961, 101p. incl. diagrs. tables, refs. (AFOSR-2336) [AF 61(052)309] AD 611475 Unclassified

Also published in Acta Physiol. Scand., v. 53, Suppl. 183: 1-101, 1961.

Warm- and cold-acclimated rats could not withstand prolonged exposure to cold after restriction of food. Their catecholamine excretion rapidly attained maximal values and animals died in hypothermia. The same happened with warm-acclimated rats whose insulation has been reduced by removal of the fur. Cold-acclimated clipped rats survived in the cold, but their catecholamine response was much more intense than that of intact cold-acclimated animals. These two series of experiments strongly support the view that acclimation to cold is limited by the finite capacity of the organism to produce and/or secrete sufficient amounts of catecholamines to maintain thermal balance. They also emphasize the necessity for cold-acclimation when conditions are changed. The previous degree of acclimation increases the chances to attain that new state of equilibrium by virtue of an increased sensitivity of cold-acclimated rats to catecholamines, thus extending the time at which the catecholamine production and/or secretion becomes saturated. Finally, the importance of adrenaline as a supplementary hormone of defense against cold is shown by the lower ability that adrenalectomized corticoids maintained rats to support cold exposure under severe conditions. (Contractor's abstract)

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Karolinska Inst. Dept. of Physiology, Stockholm (Sweden).

OCCURRENCE AND DISTRIBUTION OF CATECHOLAMINES IN THE FISH BRAIN, by U. S. von Euler. [1961] [3]p. incl. tables. (AFOSR-2337) (Sponsored jointly by

Air Force Office of Scientific Research under AF 61-(052)309 and Swedish Medical Research Council) AD 611297 Unclassified

Also published in Acta Physiol. Scand., v. 52: 62-64, 1961.

Relatively high amounts of catecholamines were found in the brains of an elasmobranch, Squalus acanthias and a teleost, Gadus callarias. Only small quantities could be demonstrated in the brain of a cyclostome, Myxine glutinosa. Both adrenaline and noradrenaline occurred in the brains of Squalus and of Gadus although noradrenaline was predominant. A characteristic distribution of the catecholamines in the brain of Squalus was observed. The highest amount of noradrenaline was found in the diencephalon, hypothalamus, and hypophysis, while the cerebellum contained only very small quantities. (Contractor's abstract)

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Karolinska Inst. Dept. of Physiology, Stockholm (Sweden).

EFFECT OF RESERPINE ON THE RELEASE OF CATECHOLAMINES FROM ISOLATED NERVE AND CHROMAFFIN CELL GRANULES, by U. S. von Euler and F. Lishajko. [1960] [9]p. incl. diagrs. tables, refs. (AFOSR-2338) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)309 and Swedish Medical Research Council) AD 611296 Unclassified

Also published in Acta Physiol. Scand., v. 52: 137-145, 1961.

In a suspension of bovine splenic nerve granules, reserpine in concentrations of $10^{-8} - 10^{-5}$ M strongly inhibits the spontaneous release of noradrenaline. The catecholamine releasing action of tyramine on nerve granules is unaffected by low concentrations of reserpine, but is almost completely blocked by concentrations of 10^{-5} M. Reserpine is less active as inhibitor on suprarenal medullary granules from the rabbit and still less on cats' medullary granules. The spontaneous release occurs at a lower rate in rabbit's medullary granules than in those from the cat. No difference in the rate of release was found between adrenaline and noradrenaline from the cat's medullary granules. After administration of dopa 100 mg/kg i.v. in the rabbit the rate of release from the medullary granules was greatly enhanced. The possible action of reserpine as enzyme inhibitor is briefly discussed. (Contractor's abstract)

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Karolinska Inst. Dept. of Physiology, Stockholm (Sweden).

UPTAKE OF CATECHOLAMINES BY ADRENERGIC NERVE GRANULES, by U. S. von Euler and F. Lishajko. [1961] [1]p. (AFOSR-3447) (AF 61(052)309) Unclassified

Also published in Acta Physiol. Scand., v. 53: 196, 1961.

Nerve granules were prepared from bovine splenic nerves and incubated at room temperature and pH 7.0 in isotonic potassium phosphate to which catecholamines had been added in different concentrations. In the presence of 10 μg noradrenaline (NA) per ml in the incubation fluid no spontaneous loss of the granule-bound NA was noted in 60 min at 20°C as against a loss of 67% when the NA concentration was 1 μg/ml or less in the incubation fluid. No loss was observed after incubation even for 120 min in NA 20 μg/ml; with 5 μg/ml NA the loss was 50% during the same time. After previous incubation of the granules for 120 min, causing a depeletion of about 80%, and subsequent incubation for 60 min with NA after sedimentation and resuspension of the granules, an uptake of NA was observed. With 20 μg/ml NA in the incubation fluid the granules were repleted up to 95% of the original amount whereas the controls had lost over 80% of their NA. Reserpine 10 μg/ml did not prevent the uptake of NA by depleted granules. Adrenaline was taken up by nerve granules in similar amounts as NA. The results show that isolated nerve granules can take up catecholamines, which had previously been shown to occur for dopamine in adrenal medullary granules. Assuming similar conditions in vivo as in vitro, it might be hypothesized that while NA is retained in the storage granules when the concentration in the axoplasm is about 10 μg/ml as actually found in vivo, it may be released from the granules at lower extragranular concentrations following NA flux through the axon membrane during nerve stimulation.

1287

Karolinska Inst. Dept. of Physiology, Stockholm (Sweden).

STUDIES ON CATECHOLAMINE-CONTAINING GRANULES OF SPECIFIC CELLS IN CYCLOSTOME HEARTS, by G. Bloom, E. Östlund and others. [1961] [34]p. incl. illus. diagrs. tables, refs. (AFOSR-3448) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)309, Public Health Service, and Swedish Medical Research Council) Unclassified

Also published in Acta Physiol. Scand., v. 53, Suppl. 185: 1-34, 1961.

Heart tissue of cyclostomes Petromyzon fluviatilis (lamprey) and Myxine glutinosa (hagfish) contains large amounts of adrenaline and noradrenaline which are characteristically distributed in the different parts of the heart. A combined light and electron microscopical study of the hearts of the 2 cyclostomes has revealed the presence of a large number of specific granular cells similar to those of the adrenal medulla in higher vertebrates. The cell granules which are regarded as storage sites for catecholamines are strongly osmiophilic and have a diam of about 0.15 μ. The specific cells and the

granules are described in detail as well as their appearance after various staining procedures. Isolated granules show properties similar to those of adrenal medullary cells but differ in some respects from those of adrenergic nerves. The distribution of noradrenaline and adrenaline in the different parts of the heart of Myxine and Petromyzon has been verified by chromatographic separation. Only small amounts of other catechol compounds have been found in extracts of these hearts. Tests for 5-HT and histamine in extracts of the cyclostome hearts showed that these amines were not present in significant amounts. Reserpine treatment of the animals causes considerable depletion of the catecholamine stores of the heart. On isolated granules reserpine causes increased release in higher and inhibition of release in lower concentrations. The hearts from reserpine treated animals show only a very weak staining of the granular cells. Cyclostome hearts are almost insensitive to catecholamine but after pretreatment with reserpine a stimulating action of these amines could be demonstrated. (Contractor's abstract)

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Karolinska Inst. Dept. of Physiology, Stockholm (Sweden).

URINARY EXCRETION OF CATECHOLAMINES IN ENDOTOXIN-INDUCED FEVER IN RABBITS, by N. Serafimov. [1961] [5]p. incl. table, refs. (AFOSR-4174) (AF 61(052)309) Unclassified

Also published in Acta Physiol. Scand., v. 54: 354-358, 1962.

The urinary excretion of adrenaline and noradrenaline has been measured in rabbits after induction of fever with Salmonella Aequi endotoxin (Pyrexal). This treatment greatly increased the adrenaline excretion as compared with the control period. Noradrenaline excretion was only slightly increased. Splanchnectomy prevented the catecholamine release, but not the temperature increase following administration of endotoxin. The increase of catecholamine excretion was considered as a concomitant adreno-medullar response phenomenon to endotoxin, not indispensable for the increase of body temperature. (Contractor's abstract)

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Karolinska Inst. Dept. of Physiology, Stockholm (Sweden).

INHIBITION BY GANGLIONIC BLOCKING AGENTS OF THE MOTOR RESPONSE OF THE ISOLATED GUINEA-PIG VAS DEFERENS TO HYPOGASTRIC NERVE STIMULATION, by N. O. Sjöstrand. [1961] [10]p. incl. diagrs. refs. (AFOSR-4175) (AF 61(052)309) Unclassified

Also published in Acta Physiol. Scand., v. 54: 306-315, 1962.

The effect of nerve stimulation was studied on the isolated nerve-vas deferens preparation from the guinea-pig suspended in Tyrode solution to which various drugs were added. Azamethonium, hexamethonium, tetraethylammonium, lobeline and nicotine in ganglionic blocking concentrations inhibited the response to hypogastric nerve stimulation. The block caused by nicotine was generally preceded by a period of potentiation. The other substances produced inhibition without potentiation. The site of action of the ganglionic blocking agents is discussed and it is considered that they may act on (1) a synapse proper, (2) chromaffin cells, or (3) "non-specifically" on the nerve terminals. (Contractor's abstract)

1290

Karolinska Inst. Dept. of Physiology, Stockholm (Sweden).

EFFECT OF SOME DRUGS ON THE RELEASE OF NORADRENALINE FROM ISOLATED NERVE GRANULES, by U. S. von Euler and F. Lishajko. 1961 [8]p. incl. diagrs. refs. (AFOSR-J416) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)309 and Swedish Medical Research Council) AD 427579 Unclassified

Also published in Proc. First Internat'l. Pharmacological Meeting, Stockholm (Sweden) (Aug. 22-25, 1961), New York, Pergamon Press, v. 5: 77-84, 1963.

The rate of spontaneous release of noradrenaline from a suspension of nerve catecholamine storage granules at 20°C, can be readily influenced by a number of drugs. It is noteworthy that autonomic drugs like acetylcholine, nicotine and histamine have no effect in this respect and thus presumably do not exert their action on the granules. Other drugs like reserpine, xylocholine and others have, at least in lower concentrations, an effect which may be regarded as specific and possibly related to the known pharmacodynamical effect of these substances on the transmitter release in vivo. On the other hand it appears probable that the effects, seen on incubation with, for example, reserpine and cocaine in higher concentrations, are to a large part unspecific and presumably of limited significance. (Contractor's abstract)

1291

Karolinska Inst. Nobel Inst. for Neurophysiology, Stockholm (Sweden).

ALPHA TYPES OF RELEASE STUDIED IN TENSION-EXTENSION DIAGRAMS FORM CAT'S FORELIMB TRICEPS MUSCLE, by O. Pompeiano. [1960] [26]p. incl. illus. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 61(052)115], Rockefeller Foundation, and Swedish Medical Research Council) Unclassified

Published in Arch. Ital. Biol., v. 98: 92-117, Feb. 20, 1960.

The relation between active tension and extension was observed when stretch was applied at both slow and fast constant rates. This relation tended to be linear. Postbrachial section of the spinal cord, deafferentation of the contralateral forelimb and complete cerebellectomy or bilateral destruction of the fastigial nuclei, made on a background of Sherringtonian rigidity, produced an increase of the tonic stretch reflex. These changes in the slope of the curve were sometimes accompanied by slight lowering of the threshold of the reflex so that the muscle already at zero extension developed some tension. All the effects on the tension-extension curve were present with slow stretch and emphasized by increasing the rate of pull. All varieties of release added to the stretch reflex of the triceps by augmenting gain as judged by the slope of the curve. The effects of postbrachial section of the spinal cord and of cerebellectomy on the tension-extension curves of triceps could also be obtained against a background of pure α rigidity. However, the release of the stretch reflex from cerebellar and spinal cord ascending inhibition is tied to the integrity of the afferent input. In the acutely spinal animal the stretch reflex of the triceps was absent but could be obtained after postbrachial section of the spinal cord or contralateral deafferentation.

1292

Keele U., Staffordshire (Gt. Brit.).

HEATS OF FORMATION OF ORGANO-METALLIC COMPOUNDS, TRIETHYL ALUMINUM, by C. T. Mortimer. Annual summary rept. no. 2, Dec. 31, 1961 [12]p. incl. diagr. (Technical scientific note no. 2) (AFOSR-2087) (AF 61(052)307) AD 271785
Unclassified

The heat of hydrolysis of triethyl aluminum has been measured. A known weight of water vapor was allowed to react with an excess of liquid triethyl aluminum in an isothermal calorimeter at 25°C. The measured heat, $\Delta H = 154.8 \pm 2.0$ kcal/mol, is taken to refer to the reaction

$(C_2H_5)_3Al$ (liq) + $3H_2O$ (g) → $Al(OH)_3$ (amorph) + $3C_2H_6$ (g). The heat of formation $\Delta Hf°[(C_2H_5)_3Al, liq] = -36.5 \pm 5.5$ kcal/mol is calculated. (Contractor's abstract)

1293

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] [1]p. (AFOSR-1320) (AF 49(638)49) AD 445073
Unclassified

Also published in Jour. Org. Chem., v. 27: 676, 1962.

The use of solutions of sulfur dioxide in dimethylformamide in place of sulfurous acid was investigated and found to be a convenient method for preparing 2,1,3-benzothiadiazole, 5-methyl- and 5-chloro-2,1,3-benzothiadiazole and 2', 3'-naphtho-2,1,3-thiadiazole in yields of 15-40%. While the yields are not high, the method has the convenience of being carried out in ordinary, open apparatus at temperatures of 70-115° and of being easy to work up. From 3,3'-diamino-benzidine no bis-2.1,3-benzothiadiazole was obtained but 5-(3', 4'-diaminophenyl)-2,1,3-benzothiadiazole was isolated in 2.5% yield. This compound is of particular interest since it represents an important type of starting material for preparing certain heterocyclic analogs of steroids. (Contractor's abstract)

1294

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] [2]p. (AFOSR-1368) [AF 49-(638)49] AD 613796
Unclassified

Also published in Jour. Org. Chem., v. 27: 692-693, Feb. 1962.

The reaction of Pb Mg Br (I) with 2 N-sulfinylamines, each of which may be considered to possess a certain amount of hindrance around the functional group, was studied. I (from 4g Mg) treated slowly with 9.65 g N-sulfinylmesidine in 50 ml Et_2O in the cold, mixture stirred 3 hr, refluxed 0.5 hr, cooled, treated with dilute NH_4Cl, the Et_2O layer separated and evaporated giving 9.2 g N-mesitylbenzene-sulfinamide, m p = 134-134.5°. I (from 14.7 g Ph Br) treated in the cold with 10 g N-sulfinyl-tert-butylamine in 40 ml Et_2O during 45 min, stirred 1 hr, poured over 100 g ice, treated with 10% NH_4Cl, the layers separated, the aqueous layer extracted with Et_2O, the combined Et_2O extracts dried, and distilled, giving 1.3 g N-tert-butylbenzenesulfinamide, m p = 70-70.5°.

1295

Kentucky U. Dept. of Chemistry, Lexington.

PREPARATION OF PHENYL-N-SULFYINYLHYDRAZINES USING DIMETHYLFORMAMIDE-SULFUR DIOXIDE REAGENT, by W. T. Smith, Jr. and W.-Y. Chen. [1961] 3p. (AFOSR-1572) [AF 49(638)49]
Unclassified

Phenyl-N-sulfinylhydrazines were prepared by the reaction of phenylhydrazines with thionyl chloride, with sulfur dioxide in benzene, and with N-sulfinylaniline. It is found that a solution of sulfur dioxide in dimethylformamide provides a convenient reagent for the preparation of these compounds. The method is simple and direct

and is used to prepare phenyl-, 4-carboxyphenyl-, 2- and 4-nitrophenyl-, and 4-bromophenyl-N-sulfinylhydrazines in yields of 16—55%. The phenylhydrazine (2.2 g, 0.02 mol) and 60 ml of a saturated solution of sulfur dioxide in dimethylformamide are placed in a flask fitted with stirrer, condenser and calcium chloride tube. The solution is heated at 75—80° for 5 hr, cooled, diluted with 30 ml of benzene and sufficient water to give 2 layers. The benzene is separated and the aqueous layer is extracted with 2 additional 30 ml portions of benzene. The combined benzene extracts are washed with water and evaporated to dryness to give 1.7 g (55%) of product, m p 104-106°.

1296

Kentucky U. [Dept. of Physics] Lexington.

ENERGY GAPS IN BISMUTH TRIOXIDE, by D. M. Mattox and L. Gildart. [1960] [3]p. incl. diagrs. table. [AF 49(638)90] Unclassified

Published in Jour. Phys. and Chem. Solids, v. 18: 215-217, Feb. 1961.

A unique method of preparing polycrystalline films of Bi_2O_3 having thicknesses in the range 10 to 100 μ is is presented. Using these films temperature vs resistance measurements give a thermal energy gap of 2.07 ± 0.07 ev in the temperature range 400 to 550°K. Optical transmission studies at room temperature and liquid nitrogen temperature give optical energy gaps of 3.1 ev at 77°K and 2.85 ev at 300°K. This gives an apparent temperature dependence of - 1.1 x 10^{-3} ev/°K in this temperature range assuming a linear variation. (Contractor's abstract)

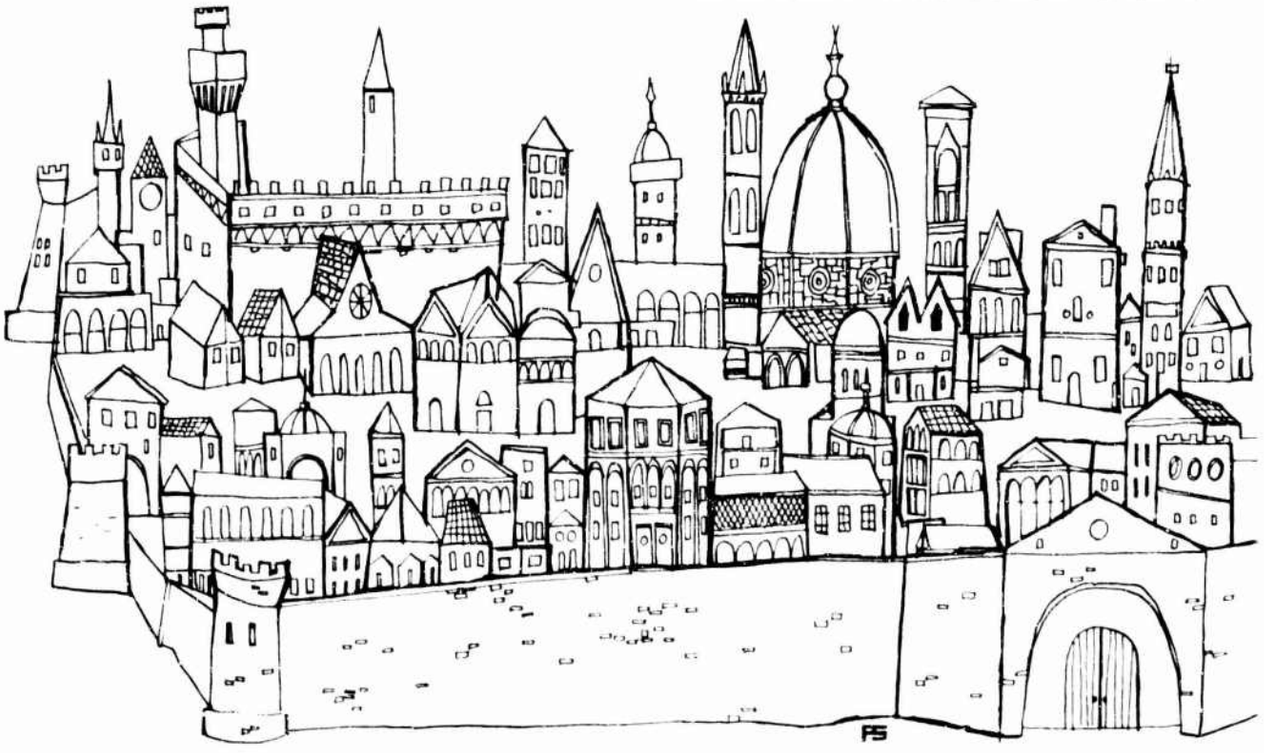
1297

Kentucky U. [Dept. of Physics] Lexington.

SOME SEMICONDUCTING PROPERTIES OF BISMUTH TRISULFIDE, by L. Gildart, J. M. Kline, and D. M. Mattox. [1960] [12]p. incl. diagrs. refs. [AF 49(638)90] Unclassified

Published in Jour. Phys. and Chem. Solids, v. 18: 286-289, Mar. 1961.

Single crystals, dendrites, and crystalline films of bismuth trisulfide, Bi_2S_3, have been prepared and studied. From the films a thermal energy gap of 0.72 ev is found, in the range 300-400°K. From the single crystals, optical energy gaps of 1.4 ev at 77°K and 1.2 ev at 300°K, are found; and resistivity, carrier concentration and mobility at 300°K are 0.85 ohm cm, 3 x 10^{17} cm^{-3} and 50 cm^2/vsec, respectively. Thermal conductivity and Seebeck coefficient are found to be 0.0206 w/cm°C, and 550 μv/°C, for single crystal samples in a direction parallel to the principal cleavage planes at 300°K. Preparation techniques, and the apparatus used in the thermal conductivity and Seebeck coefficient measurements, are described. (Contractor's abstract)



1298

Laval U. Dept. of Physiology, Quebec (Canada).

ADENOHYPOPHYSIS AND ADRENAL CORTEX, by C. Fortier. [1961] [36]p. incl. refs. (AFOSR-1478) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-15 and National Institutes of Health) AD 449985 Unclassified

Also published in Ann. Rev. Physiol., v. 24: 223-253, 1962.

A survey of developments in the pituitary-adrenal field is given with 309 references in open literature. The following topics pertaining chiefly to methodology, clinical pathology, pharmacology, and therapeutics are given: (1) Biochemistry of ACTH; (2) ACTH release and its control; (3) ACTH and corticoidogenesis; (4) Catabolism of corticosteroids; (5) Metabolic effects of corticosteroids; and (6) Regulation of aldosterone secretion.

1299

Laval U. [Dept. of Physiology] Quebec (Canada).

IN VITRO PRETREATED GUINEA PIG THYROID ASSAY, by C. Fortier and W. J. Schindler. [1960] [23]p. incl. illus. diagrs. tables. (AFOSR-J701) (AF AFOSR-61-15) Unclassified

Presented at First Internat'l. Congress of Endocrinology, Copenhagen (Denmark), July 1960.

Also published in Proc. Conf. on Thyrotropin, Arden House, Harriman, N. Y. (1962), Springfield, Charles C. Thomas, 1962, p. 258-273.

This project was aimed at finding a parameter of in vitro thyroid function suitable for thyrotropin assay. To summarize, uptake or organic binding of I-131 by incubated thyroid segments from the thyroxine-pretreated guinea pig provides the basis for a simple, specific and accurate assay for thyrotropin, particularly well suited for work with pituitary extracts. However, its low sensitivity (0.64 mu/10 mg of incubated tissue) and the small allowable volume (0.2 ml) of the material to be tested preclude its utilization with blood, unless it first be fractionated by an appropriate procedure. Further work with this system or a modification thereof involving a different medium and a longer period of incubation, and resulting in greater sensitivity, revealed, in addition to considerable differences in the responsitivity to TSH of guinea pigs obtained from various breeders, the presence of a factor, as yet unidentified, in hypophysectomized rat serum or plasma which, though inactive by itself, markedly influences the PBI^{131} response to TSH.

1300

Leyden U. Lorentz Inst. (Netherlands).

ON THE QUANTUM STATISTICAL BASIS OF NON-EQUILIBRIUM THERMODYNAMICS. I, by J. Vlieger, P. Mazur, and S. R. de Groot. [1960] [20]p. incl. refs. (AFOSR-1040) (AF 61(052)16) AD 262070 Unclassified

Also published in Physica, v. 27: 353-372, Apr. 1961.

The quantum statistical theory of Wigner distribution functions is developed to serve as a basis for the derivation of the Onsager reciprocal relations in non-equilibrium thermodynamics. The theory is closely analogous to the classical treatment, given by de Groot and Mazur. The present paper is concerned with the following topics: (1) Time dependence of Wigner distribution functions, which is described by means of a propagator. The properties of this propagator are studied. (2) Equilibrium distribution function of a set of extensive state variables, which provide a macroscopic description of the system, assuming that these variables are represented by commuting operators in quantum theory. This probability distribution function is expressed in terms of the Wigner distribution function of the microcanonical ensemble, representing thermodynamic equilibrium. The properties of distribution functions of extensive variables, in particular those with regard to the even or odd character of these variables, are studied. (3) Definition of a set of intensive thermodynamic variables, conjugate to the extensive state variables, by means of Boltzmann's entropy postulate. The theory is developed in the present paper only for Maxwell-Boltzmann statistics.

1301

Leyden U. Lorentz Inst. (Netherlands).

RESEARCH ON STATISTICAL MECHANICS AND THERMODYNAMICS OF IRREVERSIBLE PROCESSES, by S. R. de Groot. Annual summary rept. no. 1, June 1, 1960 - May 31, 1961. June 22, 1961, 6p. (AFOSR-1041) (AF 61(052)16) Unclassified

A summary of the investigations conducted under this contract are reviewed. The investigations involved 2 problems: properties of the Wigner distribution function and statistical mechanics of irreversible processes: chemical kinetics. The quantum statistical theory of Wigner distribution functions is developed to serve as a basis for the derivation of the Onsager reciprocal relations in non-equilibrium thermodynamics. The properties of ordinary Wigner distribution functions and their propagations and the equilibrium distribution function of a set of extensive state variables are discussed. It is shown that joint equilibrium distribution functions, which do not in general represent a probability, are joint probabilities, if the set of quantum mechanical operators, which correspond to the extensive state variables, is of a special class. The purpose of the statistical mechanics of irreversible processes study is the formulation of some deductions from a formal theory of chemical kinetics for homogeneous, bimolecular gas phase reactions. The model adopted consists of an iso-thermal ideal gas phase in which a chemical reaction as well as its reverse reaction proceeds. It is shown that the zeroth order solution leads to the usual phenomenological

rate expression with a rate coefficient independent of time or affinity, and hence to the law of mass action. Higher order solutions, however, introduce an affinity and time dependence in the rate coefficient and the law of mass action becomes inadequate to the extent of the contribution of the effects of the perturbations. Similar results are obtained for reacting systems with internal degrees of freedom. The entropy production for chemically reacting systems to the various orders of the perturbation solution is derived.

1302

Leyden U. Lorentz Inst. (Netherlands).

ON THE QUANTUM STATISTICAL BASIS OF NON-EQUILIBRIUM THERMODYNAMICS. II, by J. Vlieger, P. Mazur, and S. R. de Groot. [1961] [17]p. (AFOSR-1847) [AF 61(052)16] AD 456583 Unclassified

Also published in Physica, v. 27: 957-973, Oct. 1961.

The quantum statistical theory of Wigner distribution functions, presented in the previous paper (item no. 1300, Vol. V) on the foundations of non-equilibrium thermodynamics, is used in order to develop the theory of "joint Wigner distribution functions," which may be employed for the calculation of quantum mechanical correlation functions. The joint equilibrium distribution function of a set of extensive state variables is defined. This distribution function is expressed in terms of the joint Wigner distribution function of the micro-canonical ensemble. The properties of joint equilibrium distribution functions of extensive variables, in particular the so-called property of detailed balance are studied. It is shown that joint equilibrium distribution functions, which in general do not represent a probability, are joint probabilities, if the set of quantum mechanical operators, corresponding to the extensive state variables, is of a certain class. The theory of distribution functions of extensive state variables thus obtained, which is formally the same as developed previously on the basis of classical statistical mechanics, is used for the derivation of the Onsager reciprocal relations in non-equilibrium thermodynamics. The theory is developed in the present paper for Maxwell-Boltzmann statistics. (Contractor's abstract)

1303

Leyden U. Lorentz Inst. (Netherlands).

ON THE QUANTUM STATISTICAL BASIS OF NON-EQUILIBRIUM THERMODYNAMICS. III, by J. Vlieger, P. Mazur, and S. R. de Groot. [1961] [5]p. (AFOSR-1848) [AF 61(052)16] AD 613746 Unclassified

Also published in Physica, v. 27: 974-978, Oct. 1961.

The quantum statistical theory of Wigner distribution functions, which has been developed in the two previous papers on the foundations of non-equilibrium thermodynamics for Maxwell-Boltzmann statistics (item nos. 1300, 1302, Vol. V) is extended in the present paper to the cases of Bose-Einstein and Fermi-Dirac statistics.

1304

Library of Congress. Science and Technology Div., Washington, D. C.

AIR FORCE SCIENTIFIC RESEARCH BIBLIOGRAPHY. Vol. I: 1950-1956, by G. V. Hooker, M. H. Duffner and others. 1961, 1150p. incl. refs. (AFOSR-700) (ISSA-60-4) AD 265450 Unclassified

This bibliography includes abstracts of all publications supported in whole or in part by the Air Force Office of Scientific Research during the period 1954 through 1956. It also includes all earlier reports supported by AFOSR or its anlage found during this search back through 1950. 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. References, reports, and clues to the existence of reports were found by searching the indexes and report collections of the AFOSR Technical Library, and the Armed Services Technical Information Agency. Reports are posted chronologically and/or alphabetically under contracts, these in turn under laboratories, and these under contractors. The abstracts are coded for future machine searching. A detailed subject index, arranged alphabetically, is provided. Because of the high percentage of mathematical papers included in this volume, a separate mathematical classification is included. In addition to the subject indexes, a contract index, an AFOSR control number index, and a personal author index are provided.

1305

Liège U. (Belgium).

ASYMPTOTIC BEHAVIOR OF THE SPECTRAL MATRIX OF THE OPERATOR OF ELASTICITY, by F. J. Bureau and E. J. Pellicciaro. Jan. 1961, 30p. incl. refs. (Technical scientific note no. 5) (AFOSR-296) (In cooperation with Delaware U.) (AF 61(052)-86) AD 258240 Unclassified

Presented at meeting of the Amer. Math. Soc., Washington, D. C., Jan. 23-26, 1961.

Also published in Jour. Soc. Indus. and Appl. Math., v. 10: 1-18, Mar. 1962.

Let the operator $Mu = -b^2 \text{ grad (div } v) + a^2 \text{ rot(rot } v)$ be applied to smooth vector functions $v(x) = [v_1(x), v_2(x), v_3(x)]$ which vanish on the boundary of a regular region in 3-space. Let $0 < \lambda_1 \leq \lambda_2 \leq \ldots$ be the eigenvalues, and $v(x, \lambda_k)$ the eigenvectors of the boundary-value problem $Mv = \lambda v$. The spectral function is

$\psi(x, \lambda) = \Sigma\, v(x, \lambda_k) \cdot v(x, \lambda_k)$, summed over all eigenvalues $< \lambda$, and normalized by $2\psi(x, \lambda) = \psi(x, \lambda - 0) + \psi(x, \lambda + 0)$. Bureau has obtained the asymptotic behavior of the spectral function of an elliptic vector operator M, using a knowledge of the solution of the Cauchy problem for the related hyperbolic equation $\partial^2 u/\partial t^2 = Mu$ (item no. 855, Vol. III). In the present work this method is applied to the specific operator M defined above. For this operator the Cauchy problem has an explicit solution. The main result is that

$$\psi(x, \lambda) \sim \frac{1}{6\pi^2} \left(\frac{2}{a^3} + \frac{1}{b^3}\right) \lambda^{3/2}.$$ (Math. Rev. abstract)

1306

Liège U. (Belgium).

THE CAUCHY PROBLEM FOR PARTIAL DIFFERENTIAL EQUATION OF THE SECOND ORDER AND THE METHOD OF ASCENT, by F. J. Bureau. May 1961 [56]p. (Technical scientific note no. 6) (AFOSR-756) (AF 61(052)86) AD 262025 Unclassified

Also published in Jour. Math. Anal. and Appl., v. 4: 146-179, 1962.

A method of ascent is used to solve the Cauchy problem for linear partial differential equations of the second order in p space variables with constant coefficients (i.e., the pure wave equation, the damped wave equation, and the heat equation). This method consists of inferring the solution of the problem referred to from the well known solution of the same problem for 1 space variable. The commutability of repeated pf $\int$, the solution deduced by the method of singularities for the Cauchy problem for the damped wave equation, and the solution of singular integral equations of the Volterra type are also considered. (Contractor's abstract)

1307

Liège U. (Belgium).

RESEARCH IN HYPERBOLIC DIFFERENTIAL EQUATIONS, by F. J. Bureau. Annual summary rept. no. 3, Mar. 15, 1961, 4p. (AFOSR-799) (AF 61 (052)86) AD 258235 Unclassified

The following problems are studied during the period of Mar. 15, 1960 to Mar. 14, 1961: (1) Investigate the Cauchy problem for partial differential equations of order $n > 2$ and $p > 2$ independent variables. In particular, consideration is given to linear operators connected with integrals otherwise divergent. (2) investigate boundary value problems for totally hyperbolic equations in several independent variables. (3) Investigate problems which are not specifically described in (1) and (2) above, but are suggested by and related to the research conducted under this contract. Two technical reports were issued (see item nos. 1097 and 1099, Vol. IV). A third report is also published in this period (see item no. 1305, Vol. V). The results obtained are summarized.

1308

Liège U. (Belgium).

ASYMPTOTIC REPRESENTATION OF THE SPECTRAL FUNCTION OF SELF-ADJOINT ELLIPTIC OPERATORS OF THE SECOND ORDER WITH VARIABLE COEFFICIENTS. II, by F. J. Bureau. Nov. 1961, 17p. incl. refs. (Technical scientific note no. 7) (AFOSR-1874) (AF 61(052)86) AD 272014 Unclassified

Also published in Jour. Math. Anal. and Appl., v. 4: 181-192, 1962.

The results of the previous paper (see item no. 855, Vol. III) are extended. The following expression of the asymptotic behavior of $\theta(x, x; \lambda)$ is improved:

$$\theta(x, x; \lambda) = \frac{A(x)}{\pi^{p/2} 2^p \Gamma(1/2p + 1)} \lambda^{p/2}[1 + R(\lambda)],$$ where

$R(\lambda) = 0(1/\log)$, when $L = \Delta$, $R(\lambda) = 0(\lambda^{-1/2})$.

1309

Liège U. Inst. of Astrophysics, Cointe-Sclessin, (Belgium).

EFFECT OF GAMMA AND NEUTRON RADIATION UPON MOLECULAR AND IONIC CRYSTALS BY PURE NUCLEAR QUADRUPOLE SPECTROSCOPY, by J. Duchesne. [1958] [4]p. incl. table, refs. (AFOSR-5124) (AF 61(514)1212) AD 413648 Unclassified

Also published in Proc. Second United Nations Geneva Conf., Geneva (Switzerland) (Sept. 1958), London, Pergamon Press, [1958] p. 348-351.

Nuclear quadrupole spectroscopy is used to determine the effect of gamma and neutron radiation upon p-dibromobenzene, $NaClO_3$, $CHI_3 \cdot 3S_8$, and other benzene derivatives. It is found that halogen derivatives of the same species are much more resistant to radiation damage in the case of aromatic compounds than in that of allphatic compounds upon being exposed to gamma radiation of Co^{60}. Iodoform exhibits a high resistance to damage and it is believed that the sulfur might act as a shield. The resistance of aromatic compounds is attributed to the delocalization properties of their π electrons and geometric symmetry. In comparing the quantities of energy necessary to reduce the intensity of the quadrupole line corresponding to Cl^{35} by 40% either by gamma or neutron irradiation it is found that the latter is more efficient in producing damage. Irradiation of $CHI_3 \cdot 3S_8$ by Co^{60} in the presence of oxygen produces a resonance line, the intensity of which is practically time invariant

1310

Liège U. Inst. of Astrophysics, Cointe-Sclessin (Belgium).

NUCLEAR QUADRUPOLE RESONANCE IN IRRADIATED CRYSTALS AND IN A SEMI-CONDUCTOR. ORIGIN OF FREE RADICALS IN CARBONACEOUS ROCKS, by J. Duchesne, M. Read and others. Final technical rept. Jan. 15, 1961, 49p. incl. diagrs. tables, refs. (AFOSR-416) (AF 61(052)167) AD 254956 Unclassified

Part I: The intensity decrease of quadrupole lines is used as a method for the study of the damage induced by high energy radiation in solid matter. The method is successfully applied to a semi-conductor and, by the study of $AsBr_3$, the results have been shown to be independent of the nucleus, the line of which is chosen for the measurement. Thermally treated irradiated compounds, which are thereafter re-irradiated, are especially considered; the origin of radioprotection phenomena and the behavior of the interactions between centers perturbed by irradiation are studied further. A generalization is proposed for this method by substituting the study of solid solutions for that of pure compounds, thus allowing the determination of radioresistance of any compound inclusive of the polymers. Part II: The problem of the genesis of free radicals encountered in coals, lignites, peats and petroleum is analyzed. Two hypotheses concerned with the botanical origin and the effect of natural radioactivity are put forward. (Contractor's abstract)

1311

Liège U. Inst. of Astrophysics, Cointe-Sclessin (Belgium).

[NUCLEAR QUADRUPOLE RESONANCE IN IRRADIATED CRYSTALS] Résonance nucléaire quadripolaire dans les cristaux irradiés, by J. Depireux, N. Cornet and others. [1960] [3]p. incl. diagrs. (AFOSR-J660) (AF 61(052)167) Unclassified

Presented at Ninth Ampere Colloquium, Pisa (Italy) Sept. 12-16, 1960.

Also published in Arch. Sci., v. 13, Fascicule Spécial: 661-663, 1960.

Solid solutions of anthracene, naphthalene, 1,2,4,5-tetramethylbenzene, and 1,4-dimethylnaphthalene in p-dichlorobenzene were irradiated up to 10^8 roentgens using a Co^{60} source. The sensitivities of these compounds to radiation are discussed.

1312

Liège U. Inst. of Astrophysics, Cointe-Sclessin (Belgium).

ORIGIN OF FREE RADICALS IN CARBONACEOUS ROCKS, by J. Duchesne, J. Depireux, and J. M. van der Kaa. [1960] [10]p. incl. diagrs. table, refs. (AFOSR-J669) (AF 61(052)167) AD 415402 Unclassified

Also published in Geochim. et Cosmochim. Acta, v. 23: 209-218, May 1961.

The problem of the genesis of free radicals encountered in coals, lignites, peats and petroleum is analyzed. Two hypotheses concerned with the botanical origin and the effect of natural radioactivity are put forward. Whereas the former is able to give account of the facts for peats, the latter, combined with the geothermal hypothesis, allows us to afford a general solution for this problem. (Contractor's abstract)

1313

Liège U. Inst. of Experimental Therapeutics, Brussels (Belgium).

RESEARCH ON COMPARISON OF CELL ACTIVITY IN DIFFERENT BRAIN STRUCTURES, by J. D. Schlag. Final technical rept. Nov. 20, 1961 [40]p. incl. diagrs. table, refs. (AFOSR-2013) (AF 61(052)22) AD 272372 Unclassified

Reticular neurons never display grouped discharges related to spindles, but they respond to thalamic recruiting stimuli. Thalamoreticular connections are demonstrated. EEG arousal elicited by stimulation of thalamic unspecific nuclei must be mediated by the reticular formation. The notion of a thalamic reticular system is discussed. (Contractor's abstract)

1314

Liège U. Inst. of Experimental Therapeutics, Brussels (Belgium).

THALAMIC RETICULAR SYSTEM AND CORTICAL AROUSAL, by J. D. Schlag, F. Chaillet, and J.-P. Herzet. [1961] [2]p. incl. diagr. (AFOSR-2620) [AF 61(052)22] Unclassified

Also published in Science, v. 134: 1691-1692, Nov. 17, 1961.

By electrocoagulation of the thalamic posterior commissure, the electroencephalographic arousal by high frequency stimulation of the thalamic unspecified nuclei was prevented, whereas the synchronizing influence on the cerebral cortex remained intact. On this ground, the role of the thalamic reticular system in the control of the cerebral rhythms is discussed. It is indicated that the unspecified thalamic system is mainly or solely concerned with the production of slow cortical activity. It is also suggested that the thalamocortical mechanism of synchronization is not frequency-dependent with regard to the modalities of its activation. The results also give direct evidence that the recruiting and arousing systems of the brain are separated functional units.

1315

Liège U. Inst. of Experimental Therapeutics, Brussels (Belgium).

RECRUITING RESPONSES IN THE BRAIN STEM RETICULAR FORMATION, by J. [D.] Schlag and J. Faidherbe. [1961] [28]p. incl. illus. diagrs. refs. (AF 61(052)22) Unclassified

Published in Arch. Ital. Biol., v. 99: 135-162, Apr. 1961.

Experiments were performed in order to analyze the properties of recruiting responses induced in the mesencephalic and bulbar reticular formation by a repetitive stimulation of the unspecific thalamic nuclei, in unanesthetized cats. Classical requirements (pattern organization, latency, optimum frequency of stimulation, sites of stimulation) were fulfilled to permit the identification of the reticular responses as a typical recruitment phenomenon. A clear-cut distinction was made with other repetitive responses having a different significance. Evidence was afforded that the cerebral cortex is not necessarily implicated in the transmission of the recruiting impulses from the thalamus to the brain stem. On the contrary selective coagulations inside the thalamus tended to demonstrate that the pathway of conduction is a direct one, passing at the level of the upper portion of the center median. Microelectrode recordings from mesencephalic and bulbar units showed very complex patterns of responses which were described in detail. A study of the convergence of thalamic and somesthetic impulses on reticular neurons discloses some properties of such an interaction. Lastly, the occurrence of recruiting responses in the mesencephalic reticular formation was compared with the slightness of spontaneous spindle bursts in the mesencephalon, under the conditions of these experiments. (Contractor's abstract)

1316

Little, Arthur D., Inc., Cambridge, Mass.

EXPERIMENTAL INVESTIGATION OF DETONATION IN UNCONFINED GASEOUS HYDROGEN-OXYGEN-NITROGEN MIXTURES, by L. H. Cassutt. [1960] [7]p. incl. diagrs. (AF 18(600)1687) Unclassified

Published in ARS Jour., v. 31: 1122-1128, Aug. 1961.

An experimental program has been conducted to determine the detonability of unconfined hydrogen-oxygen-nitrogen mixtures during venting of a missile employing liquid hydrogen as a fuel or during an accidental spill from a storage or missile propellant tank. The mixtures investigated ranged from those formed by hydrogen combining with air to those in which there is no nitrogen dilution. During the tests, the gaseous mixtures were contained in 100-cu ft latex balloons; and upon initiation, measurements were made of the resulting peak overpressures. Initiation was accomplished by ignitors varying in strength from electric sparks to 100-gm explosive charges. The results of the experimental program have demonstrated that any mixture capable of sustaining a stable detonation wave when confined in a tube will detonate under unconfined conditions if the initiating impulse is sufficiently intense. For many hydrogen-oxygen compositions with no nitrogen dilution, initiation by a spark or flame source can produce full deotnation. For hydrogen-air mixtures, detonation requires initiation by at least a 2-gm explosive charge.

1317

Little, Arthur D., Inc., Cambridge, Mass.

THE IGNITION OF GASES BY ELECTRICALLY HEATED WIRES, by L. E. Ashman and A. Büchler. [1960] [9]p. incl. illus. diagrs. tables, refs. (AF 18-(603)109) Unclassified

Published in Combustion and Flame, v. 5: 113-121, June 1961.

Experimental studies have been conducted on the ignition of gases with constant temperature wire ignition sources. The wire is heated to the desired temperature in a period of microseconds by means of a condenser discharge. Thereafter, its temperature is maintained constant by a unique feedback control circuit, incorporating a photomultiplier tube that monitors radiation from the center of the wire. With this apparatus experimental studies of ignition temperature and ignition delay have been made on stoichiometric methane-air and hydrogen-air mixtures. With the methane-air mixture, an exothermic reaction occurs during the pre-ignition period. This pre-ignition reaction occurs at a velocity and for a period of time that depend upon the temperature of the wire. Near the end of this pre-ignition period, the reaction accelerates to a more rapidly propagating flame front. In the hydrogen-air mixture, on the other hand, no measurable reaction occurs during the pre-ignition period. The behavior of the hydrogen-air ignition conforms to the theory of Semenov on the ignition of gases by small ignition sources. The methane-air ignition properties do not conform to the theory, possibly because the ignition temperature is sufficiently high in the presence of small sources for the corresponding high reaction rate to reduce significantly the concentration of reactants near the source. Some effects of wire size, wire composition and gas pressure on the ignition delay have been investigated for the hydrogen-air mixture. For a given wire temperature, the ignition delay increases when either the diameter of the wire or the gas pressure is reduced. The magnitude of this reduction in ignition delay agrees, at least to a first approximation, with theoretical considerations of the effect of wire size and gas pressure on ignition delay. (Contractor's abstract)

1318

Litton Systems, Inc. Space Sciences Labs., Beverly Hills, Calif.

FOURTH ANNUAL AFOSR CONTRACTORS' MEETING

ON ION AND PLASMA ACCELERATION: SUMMARY OF ABSTRACTS, Beverly Hills, Calif., Apr. 20-21, 1961. [1961] 1v. [Publication no. 1600] (AFOSR-582) (AF 49(638)759) AD 257892 Unclassified

Abstracts are presented which, taken together, briefly describe the current status of research efforts contractually supported by AFOSR and other research programs in the field of ion and plasma acceleration.

1319

Litton Systems, Inc. Space Sciences Labs., Beverly Hills, Calif.

EXPERIMENTAL RESULTS CONCERNING THE ELECTROMAGNETIC ACCELERATION OF PLASMA TOROIDS (Abstract), by A. S. Penfold. [1961] [1]p. (Bound with its AFOSR-582; AD 257892) (AF 49(638)-579) Unclassified

Presented at Fourth annual AFOSR Contractors' meeting on Ion and Plasma Acceleration, Beverly Hills, Calif., Apr. 20-21, 1961.

Plasma toroids have been formed and accelerated (perpendicular to the plane of the toroids) to velocities of about 1.2×10^7 cm/sec. The velocity measurements were made with a 22 kmc microwave doppler system. The toroids emerge from the accelerator structure into a field-free region where the diagnostic measurements are made. The undisturbed flight time through the diagnostic region was as long as 1.5 msec, and during this time the toroids did not appear to suffer instability break-up. The ambient pressure in the diagnostic region was about 3×10^{-5} mm Hg. Most of the data is for nitrogen gas, but some has also been obtained for hydrogen and argon. A one-turn magnetic pick-up coil was placed on the axis of the accelerator to detect the self magnetic field of the toroids. The strength and shape of the signals from the pickup coil determined that: (1) the toroids have strong ring currents flowing in them, (2) the ring currents are sometimes right-handed and sometimes left-handed, and (3) the ring currents are at least as large as several hundred amp. Photographic evidence indicates that the toroids are structures whose minor diameter is determined by the pinch effect. A 10-msec Kerr cell shutter was used to obtain information about the behavior of the toroids in the diagnostic region of the machine. The Kerr cell photographs show that several toroids are formed by the machine for each firing.

1320

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

ON THE ANALYSIS OF LINEAR PYROLYSIS EXPERIMENTS, by W. Nachbar and F. A. Williams. June 1961 [41]p. incl. diagrs. refs. (Rept. no. LMSD-3-64-61-1) (AFOSR-683) (AF 49(638)412) AD 260379 Unclassified

Part I 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. 345-357.

Part 1—A Modified Linear Pyrolysis Experiment: A linear pyrolysis experiment utilizing a heated porous plate is proposed and analyzed. Simple and chain-like surface gasification processes are defined and discussed. The conditions under which the surface process is a rate process or 1 of near equilibrium are determined in the general case and for chainlike processes. It is shown that pyrolysis measurements yield the forward gasification rate in the limit of a surface rate process and the equilibrium vapor pressure in the limit of surface equilibrium. The pyrolysis rate of potassium chloride is calculated. Part 2—Remarks on the Interpretation of Pyrolysis Experiments on Ammonia Salts: Previous interpretations by other investigators of linear pyrolysis rate measurements for NH_4Cl, NH_4NO_3 and NH_4ClO_4, assumed that the surface process is an unopposed rate process. An alternative interpretation of pyrolysis experiments is presented which may be valid even when the surface process is near equilibrium. Features of Part 1 are employed to demonstrate that the difference between the plate temperature and the surface temperature of the solid may be large enough to affect seriously the activation energies which were calculated from the previous linear pyroly data. (Contractor's abstract)

1321

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

PROGRESS IN THE THEORY OF COMPOSITE PROPELLANT BURNING (Abstract), by W. Nachbar. [1961] [1]p. [AF 49(638)412] Unclassified

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

The theory of steady laminar flames with normal diffusion is being applied to construct an analytical combustion model for solid propellants having essential features of the composite propellant. For purposes of a particular application to the theory of a 2-dimensional sandwich propellant having a monopropellant oxidizer, properties of solutions of the equations governing nonadiabatic, linear deflagration of solid propellant have been studied in detail. Some new results of these studies are presented which relate to predicted behavior of burning rates and pressure deflagration limits in linear monopropellant deflagration under energy addition and losses, non-equilibrium surface conditions, and incomplete combustion.

1322

London U. Coll. [Dept. of Anatomy] (Gt. Brit.).

LEARNING AND DISCRIMINATION IN THE OCTOPUS, by J. Z. Young. [1960] [65]p. incl. diagrs. tables,

refs. (AFOSR-2939) (Sponsored jointly by Air Force Office of Scientific Research under [AF 61(052)256] and Nuffield Foundation) Unclassified

Also published in Biol. Rev. Cambridge Philos. Soc., v. 36: 32-96, Feb. 1961.

Experimental techniques used to set up representations of learning processes that promote or prevent attack by octopus are described. The results are summarized in the following categories: (1) Visual responses and the mechanism of visual discrimination with respect to untrained animals; effects of feeding on tendency to attack, representations that prevent attack, visual discrimination, the dimensions used for shape discrimination, visual discrimination after statocyst removal, and anatomical signs of vertical and horizontal organization in the visual system; (2) Chemi-tactile discrimination learning with respect to the anatomy of its learning system; its tactile responses after section of optic nerves and removal of optic lobes, to accept edible and reject inedible objects, chemical and tactile discrimination, and effects of removal of the inferior frontal and subfrontal lobes. (3) Effects of removal of the vertical lobes with regard to the anatomy of the vertical lobe system; changes in behavior to visual stimuli after vertical lobe removal, learning discrimination between figures after vertical lobe removal, accuracy of performance as a function of amount of vertical lobe tissue, tactile discrimination after vertical lobe removal, and reversal of responses with and without vertical lobes.

1323

London U. Coll. Dept. of Anatomy (Gt. Brit.).

EVIDENCE FOR THE INTRAOCULAR DISCRIMINATION OF VERTICALLY AND HORIZONTALLY POLARIZED LIGHT BY OCTOPUS, by M. F. Moody. [1961] [10]p. incl. illus. diagrs. table, refs. (AFOSR-2990) (Sponsored jointly by Air Force Office of Scientific Research under [AF 61(052)256] and Nuffield Foundation) Unclassified

Also published in Jour. Exper. Biol., v. 39: 21-30, Mar. 1962.

Four octopus groups (3 each) were trained to discriminate between vertically and horizontally plane-polarized light. Two different sources of polarized light were used: a torch, and a disk of polaroid backed by white plastic. Half the octopuses were trained using the former source, and half using the latter. With each polarized light source, discrimination could be based on a reflection or scattering pattern, but the extra-ocular cues would be different for the 2 sources. After training, each octopus was shown, without reward or punishment, the polarized light source with which it was not trained. The aggregate score shows efficient transfer, and 3 of the 4 groups showed a significant preference for the new source when the plane of polarization was the same as that which they were trained to attack. It is concluded that the discrimination is not based on extra-ocular patterns, i.e., that the analysis of the polarized light occurs within the octopus's eye. (Contractor's abstract)

1324

London U. Coll. Dept. of Anatomy (Gt. Brit.).

THE DISCRIMINATION OF POLARIZED LIGHT BY OCTOPUS; A BEHAVIOURAL AND MORPHOLOGICAL STUDY, by M. F. Moody and J. R. Parriss. [1960] [24]p. incl. illus. diagrs. tables, refs. (AFOSR-2991) (Sponsored jointly by Air Force Office of Scientific Research under [AF 61(052)256] and Nuffield Foundation) Unclassified

Also published in Zeitschr. vergleichende Physiol., v. 44: 268-291, 1961.

Groups of octopuses were trained to discriminate between different directions of the electric vector of plane polarized light. Discrimination was shown between vertical and horizontal and 45° and 135° oblique directions of the electric vector. The discriminations probably involve specialized retinal photoreceptors. Theoretical reasons are given for supposing that the rhabdomere tubules show dichroism.

1325

London U. Coll. Dept. of Anatomy (Gt. Brit.).

THE RETINA OF CEPHALOPODS AND ITS DEGENERATION AFTER OPTIC NERVE SECTION, by J. Z. Young. [1961] [18]p. incl. illus. diagrs. table, refs. (AFOSR-2992a) (Sponsored jointly by Air Force Office of Scientific Research under [AF 61(052)256] and Nuffield Foundation) Unclassified

Also published in Philos. Trans. Roy. Soc. London, v. 245B: 1-18, 1962.

Each retinal cell of octopus carries a rhabdomere on 2 opposite faces. Rhabdomeres from 4 cells combine to make a square rhabdome. The cells are mainly arranged with their axes in approximately either the vertical or horizontal plane as the eye is usually held in the head. After severing the optic nerves to any region of the retina all the retinal cells undergo retrograde degeneration, leaving only the supporting cells intact. The retinal nerve plexus disappears almost completely, but a few fibers remain. At the boundary between a region with severed and intact nerves the plexus continues for some distance into the denervated region. After removal of all the optic lobe except a portion of its outermost (plexiform) zone the retinal receptors do not degenerate completely but are reduced in length. Their axons have not been interrupted by the operation and this is therefore a partial transneuronal retrograde degeneration. (Contractor's abstract in part)

1326

London U. Coll. Dept. of Anatomy (Gt. Brit.).

THE OPTIC LOBES OF OCTOPUS VULGARIS, by J. Z. Young. [1961] [48]p. incl. illus. diagrs.

tables. refs. (AFOSR-2992) (Sponsored jointly by Air Force Office of Scientific Research under [AF 61-(052)256] and Nuffield Foundation) Unclassified

Also published in Philos. Trans. Roy. Soc. London, v. 245B: 19-58, 1962.

The optic lobes provide a system for coding the visual input, for storing a record of it and for decoding to produce particular motor responses. There are at least 3 types of optic nerve fibers ending at different depths in the layered dendritic systems of the plexiform zone. The optic nerve fibers meet the branches of at least 4 types of cells. (1) Centripetal cells passing excitation inwards. (2) Numerous amacrine cells, with cone-shaped dendritic fields but no determinable axon. (3) Centrifugal cells conducting back to the retina. (4) Commissural fibers from the opposite optic lobe, and other afferents. After section of the optic nerves the plexiform layer of the corresponding part of the optic lobe becomes reduced, but the tangential layers of dendrites remain. There is a reduction in the thickness of the layers of amacrine and other cells and a shrinkage of the whole lobe. Conversely the tangential layers can be degenerated, leaving the optic nerve fibers, by serving the arteries to the optic lobe. It is suggested that the variety of shapes of the dendritic trees within the optic lobes provides the elements of the coding system by which visual input is classified. (Contractor's abstract in part)

1327

London U. Coll. [Dept. of Anatomy] (Gt. Brit.).

HOW CAN THE MEMORY OF THE NERVOUS SYSTEM BE STUDIED? by J. Z. Young. [1961] [19]p. incl. diagrs. refs. (AFOSR-J1054) (AF EOAR-61-39) Unclassified

Also published in Experimental Methods in Biology from Vallisnori to Today, Symposium on Tri-Centennial of the Birth of Antonio Vallisnori, Padova (Italy) (1961), Padova, Societa Cooperativa Topografica, 1962, p. 1-21.

Part of this paper is concerned with the location of the memory within the nervous system of octopuses. From certain experiments it was concluded that the actual representation that constitutes a record of the outcome of past visual events is stored in the optic lobes of the animal, whereas the tactile experience is stored in the inferior frontal lobe. An octopus records relevant features of the visual input by a type of coding and storage in which he makes a selection among a pre-arranged set, which may be called a code or language and which allows the octopus to respond to a particular feature of a situation. A hypothesis is suggested to correlate this assumption to the fact that the dendrites of cells at the surface of the optic lobes do not run at random in all directions; they tend to run nearly straight for long distances. The rest of the paper is devoted to a detailed study of the lobes themselves and their physiological role in the memory system.

1328

London U. Coll. [Dept. of Chemistry] (Gt. Brit.).

d-ORBITALS IN SOME CHEMICAL BONDS, by D. P. Craig and C. Zauli. Final rept. Jan. 1, 1959-Dec. 31, 1960. Jan. 31, 1961, 110p. incl. diagrs. tables. (AFOSR-653) (AF 61(052)61) AD 258970 Unclassified

It has been generally accepted that elements of the second row of the periodic table, such as S and P, expand the octet in certain of their compounds, and that 3d orbitals are used in the bonds. It has been suggested that the ligand field can produce a contraction of the 3d orbitals to a size compatible with the formation of strong spd hybrids, and the proposal was supported by calculations in which the ligands were represented by positive point charges. The problem of the perturbation of d orbitals by various ligand atoms was examined. Electrostatic potentials were calculated for H, C, F, and Cl atoms, and used in a calculation of the perturbing effect of the atoms on the 3d electrons. Optimum parameters have been found for the 3d electrons, and values found for the electrostatic terms in the total energy. The perturbing effect of C towards second row elements, as for example in $-CH_3$, is unexpectedly strong, comparable to that of Cl. On the other hand H has a quite negligible effect. (Contractor's abstract in part)

1329

London U. Coll. [Dept. of Chemistry] (Gt. Brit.).

MECHANISM OF BENZIDINE AND SEMIDINE REARRANGEMENTS. PART I. KINETIC DICHOTOMY: KINETICS, SOLVENT-ISOTOPE EFFECT, AND PRODUCTS OF ACID REARRANGEMENT OF 1,1'-HYDRAZONAPHTHALENE, by D. V. Banthorpe, E. D. Hughes, and C. Ingold. [1961] [16]p. incl. diagrs. tables, refs. (AFOSR-64-1806) [AF 61(052)-66] AD 449067 Unclassified

Also published in Jour. Chem. Soc. (London): 2386-2401, June 1962.

The established quadratic dependence on hydrogen-ion concentration of the rate of the acid-catalyzed rearrangements of hydrazobenzene, and of a number of its simpler derivatives, is conceived as characterizing 1 limiting kinetic form of a range of forms belonging to this group of rearrangements as whole. The first example of the anticipated second limit, that involving linear dependence of the rate on hydrogen ions, is established over a range of 10,000 in hydrogen-ion concentration, in the rearrangement of 1,1'-hydrazonaphthalene in 60% aqueous dioxan. The change in kinetic type from the benzene to the naphthalene derivatives is associated with a change in solvent isotopic effect. Replacement of the water in the medium by deuterium oxide accelerates the rearrangement of hydrazobenzene by 4-7 times. It accelerates that of 1,1'-hydrazonaphthalene by only 2-3 times. Both rearrangements are accelerated by salts and by extra

water. There are signs of an incipient change of kinetic form in the rearrangement of 1,1'-hydrazonaphthalene in a much more nearly anhydrous solvent. The rearrangement products are listed and discussed. (Contractor's abstract in part)

1330

London U. Coll. Dept. of Chemistry (Gt. Brit.).

MECHANISM OF BENZIDINE AND SEMIDINE REARRANGEMENTS. PART II. KINETICS AND PRODUCTS OF ACID REARRANGEMENT OF 1,2'-HYDRAZONAPHTHALENE, by D. V. Banthorpe and E. D. Hughes. [1961] [5]p. incl. diagrs. tables, refs. (AFOSR-64-1807) [AF 61(052)66] AD 449076 Unclassified

Also published in Jour. Chem. Soc. (London): 2402-2406, June 1962.

1,2'-Hydrazonaphthalene rearranges somewhat more slowly than does the 1,1'-isomer in like conditions in aqueous dioxan at low acidities. However, in "70%" aqueous dioxan in the presence of perchloric acid up to 0·15N, the 1,2'-compound rearranges according to the new rate, i.e., with linear, rather than a quadratic rate-dependence on hydrogen-ion concentration. The products are the ortho-linked primary diamine (I) and the dibenzocarbazole (II). The latter was produced by cyclization of the former, but could not be so produced under the conditions of the experiments in which the 2 compounds were formed together by rearrangement. The only other rearrangement product was about 1% of a second diamine. No concurrent disproportionation was observed. At somewhat higher acidities than those over which the kinetics were established, a shift in product composition towards diamine and away from carbazole was found. This is in contrast to the rearrangement of 1,1'-hydrazonaphthalene, which shows such a shift only in a much higher acidity range. A possible interpretation of these facts is suggested. (Contractor's abstract)

1331

London U. Coll. [Dept. of Chemistry] (Gt. Brit.).

MECHANISM OF BENZIDINE AND SEMIDINE REARRANGEMENTS. PART III. KINETICS AND PRODUCTS OF ACID REARRANGEMENT OF 2,2'-HYDRAZONAPHTHALENE, by D. V. Banthorpe. [1961] [7]p. incl. diagrs. tables, refs. (AFOSR-64-1808) [AF 61(052)66] AD 449097 Unclassified

Also published in Jour. Chem. Soc. (London): 2407-2413, June 1962.

The acid rearrangement of 2,2'-hydrazonaphthalene proceeds somewhat more slowly than those of the 1,1'- and the 1,2'-isomer. It follows approximately, but not exactly, the same kinetics. In 60-70% aqueous dioxan, with perchloric acid in the range 0.01-0.1N, the formal kinetic order in acid is 1.15. It is suggested that transitional kinetics are just beginning to emerge in this example. The solvent effect on the rate in a series of dioxan-water mixtures is qualitatively similar to that of the rearrangement of hydrazobenzene in a series of ethanol-water mixtures (Croce and Gettler), despite the difference of kinetic form, if in both cases we relate the free-energy of activation of the reaction to the dielectric constant of the medium. It is suggested that the rearrangements develop their characteristic polarity after uptake of the necessary number of protons, whether one or two. The products of the rearrangement of 2,2'-hydrazonaphthalene are the diamine (I) and the carbazole (II), along with traces of an unidentified amine, but no disproportionation products. Increasing in acidity above the kinetic range appears to shift the product proportions away from carbazole and towards diamine. At a sufficient acidity, no carbazole is formed. This finding is hypothetically linked with the suggested incursion of transitional kinetics. (Contractor's abstract)

1332

London U. Coll. [Dept. of Chemistry] (Gt. Brit.).

MECHANISM OF BENZIDINE AND SEMIDINE REARRANGEMENTS. PART IV. CROSSING TESTS ON PRODUCTS OF ACID REARRANGEMENTS OF MIXTURES OF HYDRAZONAPHTHALENES, by D. V. Banthorpe. [1961] [6]p. incl. tables, refs. [AF 61-(052)66] Unclassified

Published in Jour. Chem. Soc. (London): 2413-2418, June 1962.

The newly disclosed kinetic dichotomy of acid-catalyzed benzidine rearrangements has led to re-opening the question of their inter- or intra-molecularity by extending to the hydrazonaphthalene series of the non-crossing tests which formed the basis of an earlier conclusion favoring intra-molecularity in the hydrazobenzene series, in conditions of undetermined kinetics. The rearrangement in "60-70%" aqueous dioxan at 0°C, conditions in which the relevant kinetics are fully known, of mixtures of pairs of the 3 isometric hydrazonaphthalenes is examined. The product of each such mixed rearrangement was a mixture in the expected proportions of the products of the 2 individual rearrangements, which had thus been made to run concurrently, with none of any product of the individual rearrangement of the 3rd hydrazo-isomer, or, indeed, of any product foreign to the component rearrangements. Matters of accuracy and significance are discussed, and a conditional conclusion in favor of intramolecularity for the linear-acid-dependent rearrangements is drawn. (Contractor's abstract)

1333

London U. Coll. [Dept. of Chemistry] (Gt. Brit.).

MECHANISM OF BENZIDINE AND SEMIDINE REARRANGEMENTS. PART V. TRANSITIONAL KINETICS AND PRODUCTS OF ACID REARRANGEMENT OF

N-1-NAPHTHYL-N'-PHENYLHYDRAZINE, by D. V. Banthorpe, E. D. Hughes, and C. Ingold. [1961] [11]p. incl. diagrs. tables, refs. [AF 61(052)66] Unclassified

Published in Jour. Chem. Soc. (London): 2418-2428, June 1962.

The rearrangement of N-1-naphthyl-N'-phenylhydrazine in acidified "60%" aqueous dioxan has been followed over a 6000-fold range of hydrogen-ion concentration. In the lower part of that range, i.e., from 10^{-4} to 10^{-3} N-hydrogen-ion, a sub-range mainly covered with the aid of buffers, the kinetic order in hydrogen-ion was 1.0. In the upper part, viz., from 10^{-3}-0.4N-acid, a sub-range in which the acidity was set with perchloric acid, often with lithium perchlorate added to provide more comparable conditions of ionic strength, the kinetic order in acid rose with increasing acidity, from 1.0 at the lower end of the sub-range to near 2 at the upper end, the observed upper limits being 1.9 with acidities in concentration units, and 2.1 or 2.2 when they were reckoned on the basis of Hammett scales. The form in which the order in acid changes with acidity is in good agreement with a theoretical suggestion by Blackadder and Hinshelwood concerning non-integral orders in benzidine-type rearrangements. The main products of rearrangement are the diamine (I) involving 4,4'-biaryl coupling, and the diamine (II) involving 2,2'-coupling; and these along with a smaller amount of the carbazole (III), also 2,2'-coupled, accounted for the total material, in which no 2,4'-coupled compound was found. Thus, a single naphthalene residue in an aromatic hydrazo-compound suffices to exclude 2,4'-coupling. With increasing acidity, the proportions of products shift in favor of 4,4'-coupling, and against carbazole formation. Disproportionation to fission amines and azo-products was absent or unimportant. (Contractor's abstract)

1334

London U. Coll. [Dept. of Chemistry] (Gt. Brit.).

MECHANISM OF BENZIDINE AND SEMIDINE REARRANGEMENTS. PART VI. TRANSITIONAL KINETICS AND SOLVENT-ISOTOPE EFFECT IN ACID REARRANGEMENT OF N-2-NAPHTHYL-N'-PHENYLHYDRAZINE, by D. V. Banthorpe. [1961] [7]p. incl. diagrs. tables. [AF 61(052)66] Unclassified

Published in Jour. Chem. Soc. (London): 2429-2435, June 1962.

The rearrangement of N-2-naphthyl-N'-phenylhydrazine in the presence of acid in "60%" or "70%" aqueous dioxan has been followed over a 600-fold range of hydrogen-ion concentration. Throughout a broad central part of the range, the reaction has a non-integral kinetic order in acid which rises with increasing acidity. Thus in the "70%" solvent at constant total electrolyte concentration, and at acidities from 0·02N to 0·30N in perchloric acid, the order in acid rose from 1·15 to 1·85. At lower hydrogen-ion concentrations to 0·01N, mostly maintained by buffers, the order in hydrogen ions was close to unity. At higher acidities to 0·6N perchloric acid in the "60%" solvent, the rates were so related to Hammett's H_0 function as to show that the order in acid was substantially equal to 2. The manner in which the order in acid changes with acidity is in quantitative accord with a suggestion by Hinshelwood concerning hydrazo-rearrangements generally. When the water in the "60%" dioxan solvent was replaced by deuterium oxide, the rearrangement was accelerated, but by different factors according to the acidity, and hence according to the kinetic order in acid. In 0·02 N-acid, when, in the "60%" solvent, the order in acid was 1·15, the factor of acceleration was 2·6. In 0·30N-acid, when the order was 1·75, the factor was 3·8. On comparison with data for other hydrazo-compounds, it appears that the solvent isotope effect is nearly the same for these substrates when the kinetic order is the same, and is essentially correlated with kinetic order. It is concluded that the protons, whether 1 or 2, which catalyze hydrazo-rearrangements are in these examples transferred to their transition states to a similar extent, and are therefore probably completely so transferred. The rearrangement gives 1 main product, 1-o-aminophenyl-2-naphthyl-amine (I), which was recovered in yields up to 99%. The chief by-product was 3,4-benzocarbazole (0·5%). Disproportionation to fission amines and azo-compound was not detected in the conditions of the rearrangements.

1335

London U. Coll. [Dept. of Chemistry] (Gt. Brit.).

MECHANISM OF BENZIDINE AND SEMIDINE REARRANGEMENTS. PART VII. TRANSITIONAL KINETICS AND SOLVENT-ISOTOPE EFFECT IN ACID REARRANGEMENT OF O-HYDRAZOTOLUENE, by D. V. Banthorpe, C. Ingold and others. [1961] [9]p. incl. diagrs. tables. [AF 61(052)66] Unclassified

Published in Jour. Chem. Soc. (London): 2436-2444, June 1962.

Carlin and Odioso had shown that the rearrangement of o-hydrazotoluene with hydrogen chloride in "95%" ethanol has the kinetic order 1·6 in acid over the acid-concentration range 0·03—0·10N. Using perchloric acid in "60%" aqueous dioxan as the reaction medium, it is found that the order does average 1·6 in this range, though it is rising, from 1·4 to 1·8, and will continue rising to 2·0 as the acidity continues to rise to 0·25N. Moreover, the functional form of the change of order with acidity is in quantitative agreement with the requirements of the hypothesis, first advanced by Blackadder and Hinshelwood in explanation of Carlin and Odioso's fractional kinetic order, that 2 independent processes of rearrangement, 1 linear and the other quadratic in hydrogen-ion dependence, are here running concurrently. At acidities higher than 0·25N, Hammett's H_0 diverges markedly from the negative logarithm of the stoichiometric acidity, and only the former is now correlated simply with rate. Using H_0 values for conditions of constant total electrolyte, as adopted in kinetics in order to avoid including a

general salt effect in the sought specific effect of acid, we found the plot of the specific rate against $-H_0$ to be linear, with slope 2·2, up to 0·5N-acid, the limit of the kinetic investigation. When the water in the aqueous dioxan solvent was replaced by deuterium oxide, rearrangement was faster, but by factors which increased with the kinetic order in acid, as controlled by the acidity. Thus the factor was 2·1 when the order in acid was 1·3, but was 3·5 at a higher acidity at which the order was 1·9. These results are compared with those obtained (Parts I and VI) for hydrazobenzene, 1,1'-hydrazonaphthalene, and N-2-naphthyl-N'-phenylhydrazine. The rearrangement, over the whole range of conditions of the kinetic record, gives essentially one product, o-tolidine. At low acidities, disproportionation becomes a considerable competitor, and for that reason the kinetic study was not extended to acidities below 0·02N.

1336

London U. Coll. Dept. of Physics (Gt. Brit.).

EVIDENCE FOR PION-PION INTERACTIONS FROM S-WAVE PION-NUCLEON SCATTERING, by J. Hamilton, P. Menotti and others. Feb. 10, 1961, 17p. incl. diagrs. table, refs. (Technical scientific note no. 1) (AFOSR-641) (AF 61(052)468) AD 258417 Unclassified

Also published in Nuovo Cimento, Series X, v. 20: 519-528, May 1, 1961.

By fitting the s-wave partial amplitudes for π-N scattering, in an unphysical region, the energy range over which the contribution from the process $\pi + \pi \rightarrow N + \bar{N}$ can be examined has been greatly extended. The method shows up contributions from this process in states of isotopic spin T = 0 and T = 1. The energies $t^{\frac{1}{2}}$ for which this process is important can be estimated. The form of these contributions is just what would be expected from considerations of angular momentum. Estimates of the amplitudes for $\pi + \pi \rightarrow N + \bar{N}$ are deduced. The T = 0 amplitude is large, but in the T = 1 case the amplitude is much smaller than the values which have been predicted from the nucleon isovector form factors. (Contractor's abstract)

1337

London U. Coll. Dept. of Physics (Gt. Brit.).

S-WAVE PION-NUCLEON SCATTERING AND PION-PION INTERACTIONS, by J. Hamilton, T. D. Spearman, and W. S. Woolcock. [1961] [40]p. incl. diagrs. tables, refs. (AFOSR-2129) [AF 61(052)468] AD 611609 Unclassified

Also published in Ann. Phys., v. 17: 1-40, Jan. 1962.

Using a partial wave dispersion relation, it is shown how the low-energy s-wave π-N interactions can be separated into long range and short range parts. The phase shifts used in deriving our previously reported results are examined, and a critical survey of the errors and uncertainties in the method is given. The results show how s-wave π-N scattering can be resolved into 4 main constituents: core scattering, T = 0 and T = 1 π-π scattering, and rescattering. Our conclusions on T = 0 and T = 1 π-π scattering are compared with other experimental and theoretical data, and shown to be in reasonable agreement. (Contractor's abstract)

1338

London U. Coll. Dept. of Physics (Gt. Brit.).

FIXED ANGLE DISPERSION RELATIONS FOR NUCLEON COMPTON SCATTERING. I., by A. C. Hearn and E. Leader. Oct. 2, 1961 [49]p. incl. diagrs. refs. (Technical note no. 3) (AFOSR-2141) (AF 61(052)468) AD 279060 Unclassified

Also published in Phys. Rev., v. 126: 789-805, Apr. 15, 1962.

The Mandelstam representation is used to derive fixed-angle dispersion relations for the 12 scalar amplitudes describing the process $\gamma + N \rightarrow \gamma + N$. The electromagnetic interaction is calculated to order e^2. The strong interactions are estimated by including 1- and 2-pion exchange on the left-hand cut. These depend on the $\pi^0 \rightarrow 2\gamma$ decay lifetime and on the $T = 0_{\pi\pi}$ phase shift and the total cross section for photoproduction of pions on pions, respectively. The right-hand cut is estimated by allowing the exchange of a pion-nucleon pair, which depend on the amplitude for meson photoproduction on nucleons. The low-energy limit theorem provides an important tool for estimating the subtractions required in the dispersion relations. It is hoped that the representation will be accurate for barycentric photon energies up to approximately 300 mev. (Contractor's abstract)

1339

London U. Coll. Dept. of Physics (Gt. Brit.).

SINGULARITIES IN PARTIAL-WAVE AMPLITUDES FOR TWO-INGOING AND TWO OUTGOING PARTICLES, by J. Kennedy and T. D. Spearman. Dec. 20, 1961 [24]p. incl. diagrs. (AFOSR-2692) (AF 61(052)-468) AD 289145 Unclassified

Also published in Phys. Rev., v. 126: 1596-1602, May 15, 1962.

The singularities which appear in the energy plane of a partial-wave amplitude are investigated for the general process with 2 ingoing and 2 outgoing particles. These lie either on the real axis or on curves symmetrical about the real axis. The equations of these curves and the conditions under which they occur are obtained; also the ranges in the energy spectra of the crossed channels to which they correspond. These general results are applied to the particular cases of pion-nucleon scattering and pion photoproduction from nucleons. (Contractor's abstract)

1340

London U. [Inst. of Laryngology and Otology] (Gt. Brit.).

ECHO-LOCATION IN BATS, by F. C. Ormerod and J. D. Pye. [1960] [6]p. incl. illus. diagrs. refs. (AFOSR-1263) (AF 61(052)271) AD 611302 Unclassified

Also published in Acta Oto-laryngol., v. 53: 196-201, 1961.

The skulls, temporal bones and cochleas of some insect-eating nightfeeding bats have been examined. The minute structure of the cochlea is considered with regard to the use of ultrasonic waves and their echoes for locating obstacles and prey in complete darkness. A theory as to how these animals find their way through obstacles to their food is put forward. (Contractor's abstract)

1341

London U. Inst. of Laryngology and Otology (Gt. Brit.).

PERCEPTION OF DISTANCE IN ANIMAL ECHO-LOCATION, by J. D. Pye. [1961] [2]p. (AFOSR-2026) [AF 61(052)271] Unclassified

Also published in Nature, v. 190: 362-363, Apr. 22, 1961.

The theory of range perception in animal echo-location (such as in the bat) is further explained by a description of close range perception. The bat, feeding on flying insects which may be taking evasive action, presumably can obtain information down to the last few centimeters. This investigator suggests that at close range, when the echo overlaps with the emitted pulse, the bat can obtain information from beat-notes between the 2 signals. The refractory period is then not involved. The frequency-modulated pulses of Vespertilionids will give range and directional information, while the very constant-frequency pulses of Rhinolophids will measure the Doppler shift and so indicate the relative velocity. The Vespertilionids appear to have accuracy at over 50 cm. Possibly location is initially achieved by the time-difference apparatus, while at close range the beat-notes are used. The long, unmodulated pulses and low repetition-rates of the Rhinolophids do not appear to lend themselves to time-difference measurement. This author agrees with the opinion that they obtain information from the direction and loudness of the echoes. The beat-note mechanism makes this possible by avoiding masking. The complex pulses of other echo-locating animals will not form useful beat-notes. Direct echo-delay measurement, by a process such as that indicated by the time-difference tone, appears to be the only possible mechanism for these cases at present.

1342

London U. Inst. of Laryngology and Otology (Gt. Brit.).

TRINIDAD EXPEDITION. 1961, by J. D. Pye and A. Pye. Final rept. Nov. 1961 [8]p. incl. refs. (AFOSR-2183) (AF 61(052)271 and AF EOAR-61-40) AD 271650 Unclassified

Electrophysiological experiments on the cochlea and middle ear of bats, with reference to the mechanism of echolocation were performed. The results justify criticisms of earlier theories and support the hypothesis of peripheral information handling at close range. The ultrasonic cries of certain moths were examined briefly and the response of the bat's ear to these was recorded. Orientation cries of several bats were recorded on magnetic tape. A large collection of bats and other vertebrates was photographed and specimens were fixed by an intravital method for subsequent histological and anatomical examination. The problem of location of underwater prey by the fishing bat Noctilio was also investigated. (Contractor's abstract)

1343

London U. Queen Mary Coll. (Gt. Brit.).

EFFECT OF ISONICOTINYL HYDRAZINE ON THE PATH OF CARBON IN PHOTOSYNTHESIS, by G. G. Pritchard, C. P. Whittingham, and W. J. Griffin. [1959] [3]p. incl. diagr. table. (AFOSR-1642) (AF 61(052)245) AD 611509 Unclassified

Also published in Nature, v. 190: 553-554, May 6, 1961.

In a study of the pathways of incorporation of carbon-14 from labeled carbon dioxide into the amino-acids glycine and serine during photosynthesis, the compound isonicotinyl hydrazide (isoniazid) was used. Isoniazid had only a small effect on the total fixation of carbon-14 and on the distribution between the ethanol-soluble and ethanol-insoluble fractions. The incorporation of carbon-14 into sugar phosphates, phosphoglyceric acid, phosphoenol pyruvic acid, aspartic acid, malic acid, fumaric acid and alanine is considerably reduced by treatment with isoniazid. Incorporation into sucrose is stimulated at the lower concentration and slightly inhibited at the higher concentration. Incorporation into glycollic acid and glycine, is stimulated about 5- to 8-fold by treatment with 0.01 M isoniazid. Incorporation into serine is inhibited to the same extent as that into sugar phosphates, phosphoglyceric acid, etc. The results do not indicate specific inhibition of transaminases by isoniazid but suggest a different site of action.

1344

London U. Queen Mary Coll. (Gt. Brit.).

THE EFFECT OF CARBON DIOXIDE CONCENTRATION, LIGHT INTENSITY AND ISONICOTINYL HYDRAZIDE ON THE PHOTOSYNTHETIC PRODUCTION OF GLYCOLLIC ACID BY CHLORELLA, by G. G. Pritchard, W. J. Griffin, and C. P. Whittingham. Nov. 14, 1961 [13]p. incl. diagrs. refs. (Technical note no. 2) (AFOSR-2024) (AF 61(052)245) AD 271578 Unclassified

Also published in Jour. Exper. Botany, v. 13: 176-184, May 1962.

Glycolic acid production by Chlorella was measured by colorimetric determination of the acid excreted into the medium. Glycolic acid production was at a max at a low concentration of carbon dioxide but it tended toward zero as the rate of photosynthesis approached carbon dioxide saturation. The production of the acid became measurable at light intensities approaching that required to saturate photosynthesis and increased steadily with further increase in intensity. Treatment with isonicotinyl hydrazide resulted in an approximately 3-fold stimulation of glycolic acid concentration over the range of conditions used. It is suggested that the precursor of glycolic acid is ribulose diphosphate, and that isonicotinyl hydrazide acts by inhibiting the further metabolism of glycolic acid. (Contractor's abstract)

1345

Louvain U. Dept. of Applied Mechanics (Belgium).

THERMOELASTIC STABILITY, STRESSES AND DEFLECTIONS OF THIN PLATES, by F. Buckens. Aug. 1961 [99]p. incl. diagrs. tables, refs. (Technical note no. 1) (AFOSR-1510) (AF 61(052)499) AD 266465 Unclassified

An approximate solution of the problem of the stability of an homogeneous simply connected thin plate is given, for any thermal stress distributions assuming the edges to be unrestrained in the plane. Under special conditions this gives a lower bound for the critical level of temperature, when its increase is assumed to incur no change in its relative distribution. Comparison with exact solutions for circular plates gives excellent verifications. A reasonably simple method is also described to study post-buckling behavior when the temperature has increased beyond its critical level; it gives the changing pattern of stress distribution and, less directly, the changing shapes and amplitudes of deflection. The effect of initial deflections is studied and an approximate method developed, suggested by previously used properties of Airy functions at critical levels. Practical application is here far more cumbersome. The effect of restrictions at the edges are taken care of by applying an approximate formula which makes use of the critical levels of temperature determined without them. (Contractor's abstract)

1346

Louvain U. [Lab. of Biophysics] (Belgium).

RESEARCH ON RESPONSE TO PAIN, by A. E. McKenna and J. Colle. Final rept. Nov. 1, 1961, 1v. incl. illus. tables, refs. (AFOSR-2831) (AF 61(514)-1101) AD 276719 Unclassified

A modification on the Hardy-Wolff-Gooddell method of stimulation by thermal radiation was used. Thresholds of pain sensation were obtained in the usual manner but response was measured, not only by the judgement of subjects, but by the reactions in a group of physiological variables as well; these included EEG, EKG, PGR and change in respiration. Threshold values obtained in terms of skin temperatures at stimulus site after irradiation were higher (47.3 - 48.6°C) than those reported in most of the previous investigations. Plotting magnitude of responses against physical intensity of stimulus for pain and non-pain categories reveals that intensity and duration of reactions in pain is not mainly determined by physical intensity of stimulus but the determinant is presumably to be found in central factors within the subject himself. Implications of the findings for the pain experience in the true life situation are discussed. (Contractor's abstract)

1347

Lund U. Dept. of Pharmacology (Sweden).

EFFECTS OF MOTOR INACTIVATION ON THE CHEMICAL SENSITIVITY OF SKELETAL MUSCLE, by T. R. Johns and S. Thesleff. [1960] [6]p. incl. illus. diagr. table, refs. (AFOSR-1245) (Sponsored jointly by Air Force Office of Scientific Research under [AF 61(052)-106], Muscular Dystrophy Associations of America, Inc., and National Institute of Neurological Diseases and Blindness) AD 262290 Unclassified

Also published in Acta Physiol. Scand., v. 51: 136-141, 1961.

In order to determine whether the lack of motor nerve impulses, without denervation per se, alters the chemically sensitive area in skeletal muscle, the size of the ACh-sensitive areas in muscle fibers of cat tenuissimus were measured after isolation of the motor neurones by severance of the dorsal roots below a lumbar cord transection. The sensitivity of the individual muscle fiber to ACh was determined by iontophoretic micro-application of the drug, and by intracellular recording of the potential change. The frequency of miniature end-plate potentials, their amplitude, and their time course, were relatively unaffected by the isolation procedure. The procedure also caused little increase in the size of the ACh-sensitive surface. Therefore, inactivation per se did not alter the chemically sensitive area. (Contractor's abstract)

1348

Lund U. Dept. of Pharmacology (Sweden).

AN ELECTROPHYSIOLOGIC STUDY OF THE NEUROMUSCULAR JUNCTION IN MYASTHENIA GRAVIS, by O. Dahlbäck, D. Elmqvist and others. [1960] [8]p. incl. illus. (AFOSR-1246) (Sponsored jointly by Air Force Office of Scientific Research under [AF 61(052)106], Muscular Dystrophy Associations of America, Inc., and National Institute of Neurological Diseases and Blindness) AD 262291 Unclassified

Also published in Jour. Physiol. (London), v. 156: 336-343, Apr. 1961.

Some of the electrophysiological properties of the neuromuscular junction have been studied by the use of intracellular electrodes in isolated intercostal muscles obtained from patients with myasthenia gravis and from those with no known neuromuscular disorder. Spontaneous pre-junctional activity, recorded as miniature end-plate potentials (m. e. p. p. s) was decreased in frequency in muscles from myasthenic patients. The application of a solution containing 10-40 mm potassium produced no increase in the frequency of m. e. p. p. s in myasthenic muscles, whereas in normal muscle it caused a hundred-to thousandfold increase in the discharge frequency of m. e. p. p. s. In normal muscle a short period of high-frequency nerve stimulation produced a marked post-tetanic facilitation of the amplitude of the end-plate potential (e. p. p.). In myasthenic muscle no post-tetanic facilitation, or only slight and short-lasting facilitation, was observed. During tetanic nerve stimulation the amplitude of successive subthreshold e. p. p. s in myasthenic muscles fluctuated at random without a progressive decline. (Contractor's abstract)

1349

Lund U. Dept. of Pharmacology (Sweden).

ELECTROMYOGRAPHIC FINDINGS IN EXPERIMENTAL BOTULINUM INTOXICATION, by J. -O. Josefsson and S. Thesleff. [1960] [6]p. incl. illus. refs. (AFOSR-1284) (AF 61(052)106) AD 262293 Unclassified

Also published in Acta Physiol. Scand., v. 51: 163-168, 1961.

The electrical activity of botulinum intoxicated skeletal muscle was examined in the rabbit by the use of electromyography. Five to 6 days after an intramuscular injection of the toxin, fibrillation potentials appeared and persisted for a period of at least 60 days. The potentials were similar in amplitude and time course to those recorded following motor nerve degeneration. Botulinum toxin, however, is known not to affect the morphological structure of the motor nerve and its terminals. Its sole action is to block transmitter release selectively from cholinergic nerve endings. Results therefore suggest that in nerve degeneration lack of transmitter release is primarily responsible for initiating the process which produces the electromyographic pattern typical of denervation. (Contractor's abstract)

1350

Lund U. Dept. of Pharmacology (Sweden).

THE NATURE OF THE NEUROMUSCULAR BLOCK PRODUCED BY NEOMYCINE, by D. Elmqvist and J. -O. Josefsson. [1961] [6]p. incl. illus. diagrs. refs. (AFOSR-3459) (Sponsored jointly by Air Force Office of Scientific Research under [AF 61(052)106], Muscular Dystrophy Association of America, Inc., and Public Health Service) Unclassified

Also published in Acta Physiol. Scand., v. 54: 105-110, 1962.

The neuromuscular block produced by neomycine has been studied in the rat diaphragm and the frog sartorius by means of intra- and extracellular recording techniques. The block is due to a reduction in the amplitude of the end-plate potential. This reduction is partly caused by a neomycine induced decrease in the sensitivity of the post-junctional end-plate membrane to the depolarizing action of acetylcholine. Neomycine reduces the amount of transmitter released from the motor nerve in response to a nerve volley or to a high external potassium concentration. This prejunctional effect of neomycine is antagonized by an excess of Ca ions. (Contractor's abstract)

1351

Lund U. [Dept. of Pharmacology] (Sweden).

A NEW HISTOCHEMICAL METHOD FOR VISUALIZATION OF TISSUE CATECHOL AMINES, by A. Carlsson, B. Falck and others. [1961] [3]p. (AFOSR-1253) (Sponsored jointly by Air Force Office of Scientific Research under [AF 61(052)247] and Public Health Service) AD 262292 Unclassified

Also published in Med. Exper., v. 4: 123-125, 1961.

A 2-step conversion of adrenalin and noradrenalin into strongly fluorescent "lutines" has been performed in histological sections of adrenal medulla. The method permits detection of even small amounts of catechol amines by means of the fluorescence microscope.

1352

Lund U. Dept. of Pharmacology (Sweden).

PHENYLALANINE AND TYROSINE IN THE ADRENAL MEDULLA, by G. Hall, N. -A. Hillarp, and G. Thieme. [1961] [4]p. incl. illus. (AFOSR-1254) (AF 61(052)247) AD 262281 Unclassified

Also published in Acta Physiol. Scand., v. 52: 49-52, 1961.

The claim (Fellman 1958, Fellman and Devlin 1958) that large amounts of free phenylalanine are present in the adrenal medulla has been tested using cation exchange and paper chromatographic methods. The concentration of this amino acid was found to be very low (less than 20 - 40 microgram wet wt). Tyrosine—but no m-tyrosine, phenylserine or 3,4-dihydroxyphenylalanine (less than 20 microgram)—was detected in small amounts (10 - 20 microgram). Thus the catecholamine producing cells in the gland do not accumulate free phenylalanine or tyrosine to a level appreciably higher than that in the blood plasma. (Contractor's abstract)

1353

Lund U. Dept. of Pharmacology (Sweden).

EFFECT OF RESERPINE ON THE STORAGE OF NEW-FORMED CATECHOLAMINES IN THE ADRENAL MEDULLA, by A. Bertler, N.-A. Hillarp, and E. Rosengren. [1961] [5]p. incl. tables, refs. (AFOSR-1255) (AF 61(052)247) AD 262475 Unclassified

Also published in Acta Physiol. Scand., v. 52: 44-48, 1961.

When L-dopa (100 mg/kg body wt) was given i v to reserpinized (5 mg/kg) rabbits, appreciable amounts of dopamine and noradrenaline rapidly formed in the adrenal medulla. The results support the view that reserpine does not – at least not to a great extent – interfere directly with the decarboxylating and beta-hydroxylating steps in the amine synthesis. To a great extent, however, the drug prevented the new-formed amines from being incorporated in the storage granules, an incorporation which in normal animals is a very rapid and efficient process. It seems reasonable to assume that reserpine in some way blocks the process of monoamine storage. This may well be the main site of action of the drug. (Contractor's abstract)

1354

Lund U. Dept. of Pharmacology (Sweden).

UPTAKE OF DOPAMINE BY THE STORAGE GRANULES OF THE ADRENAL MEDULLA IN VITRO, by A. Bertler, G. Hall and others. [1961] [4]p. incl. table, refs. (AFOSR-2025) (Sponsored jointly by Air Force Office of Scientific Research under [AF 61-(052)247] and Public Health Service) AD 611480 Unclassified

Also published in Acta Physiol. Scand., v. 52: 167-170, 1961.

Large amounts of dopamine are taken up by the amine storage granules of the cow adrenal medulla when the granules are incubated at +31° in a solution containing dopamine. At this temperature the amine accumulates even against an apparent concentration gradient but at 0° only small amounts—if any at all—are incorporated. The amine seems to be bound in the granules but is released on osmotic lysis of the granules. (Contractor's abstract)

1355

Lund U. [Dept. of Physics] (Sweden).

FRAGMENTATION STUDY OF VERY HIGH ENERGY NUCLEAR INTERACTIONS DUE TO PRIMARY COSMIC RAYS, by S. von Friesen. Final rept. Jan. 1-Apr. 1, 1961. May 25, 1961, 3p. (AFOSR-922) (AF 61(052)116) Unclassified

The scanning of the 3rd Texas stack, composed of 12 plates (10 x 10 in.), has been exposed since Oct. 1959. The possibility of using an electronic computer for deciding whether the tracks recorded in different pellicles are caused by the same particles or not is discussed. If it is successful, work involving tracing will be greatly diminished. Photometric measurement of the tracks found in the 2nd Texas stack (exposed in 1955) is completed. A total of 384 tracks were measured and the results obtained are summarized. Measurements for the determination of the dip correction factors have recently been started. The results will be published under the continuation of this contract.

1356

Lund U. Thermochemistry Lab. (Sweden).

CELL COMPARTMENT FOR USE AT LIQUID NITROGEN TEMPERATURE IN A DOUBLE BEAM SPECTROPHOTOMETER, by Kj. Rosengren, S. Sunner, and D. Timm. Sept. 15, 1961 [7]p. incl. diagrs. refs. (Technical note no. 5) (AFOSR-1831) (AF 61(052)46) AD 271562 Unclassified

Also published in Acta Chem. Scand., v. 16: 467-470, 1962.

A thermally insulated cell compartment accommodating 2 identical quartz cells, path length less than or equal to 20 mm, was constructed with which it was possible to work uninterruptedly (without refilling) at liquid N temperature for at least 3 hr. The compartment was used together with a Unicam model SP 700 UV to near IR spectrophotometer. (Contractor's abstract)

1357

Lund U. Thermochemistry Lab. (Sweden).

AN EXPERIMENTAL APPROACH TO THE STUDY OF RADICAL FORMATION AND RECOMBINATION PROCESSES, by Kj. Rosengren, S. Sunner, and D. Timm. Sept. 15, 1961 [10]p. incl. diagrs. refs. (Technical note no. 6) (AFOSR-1832) (AF 61(052)46) AD 271563 Unclassified

Also published in Acta Chem. Scand., v. 16: 495-500, 1962.

An instrumental design was described for the irradiation of light absorbing substances and for the recording of spectra of their decomposition products in a rigid matrix at 77°K, using high pressure Hg lamps and a double-beam recording spectrophotometer. The performance of the assembly was tested by photolyzing carbon disulfide and ethyl iodide. (Contractor's abstract)

1358

Lund U. [Thermochemistry Lab.] (Sweden).

THERMOCHEMISTRY OF FREE RADICALS (Abstract), by S. Sunner. [1961] [2]p. [AF 61(052)46] Unclassified

Presented at Second AFOSR Contractors' meeting on Chemical Kinetics of Propulsion, Illinois Inst. of Tech. Armour Research Foundation, Chicago, Sept. 11-12, 1961. (AFOSR-1417; AD 265513

An experimental study of the possibilities of determining bond formation energies by direct measurement of the enthalpy change accompanying the radical recombination process 2 RX → R_2 must start with the elucidation of the conditions under which one specified, known radical can be produced, quantitatively determined and stored for a sufficiently long period of time. Thus, it is obvious that the homolytic splitting of symmetrical compounds, R - R, should be studied in the first place. It has been stated in the literature that disulfides upon irradiation or pyrolysis can be split to form intermediate thiyl radicals: R_2S_2 → 2 RSX. Therefore, it seemed reasonable to assume that the photolysis of simple disulfides under conditions favorable for the stabilization of intermediate products formed, might lead to the isolation and characterization of thiyl radicals. The technique chosen was to photolyze the disulfide in a rigid organic matrix at 77°K and to study, primarily, the changes of the ultraviolet and visible spectra. The present study is mainly concerned with investigations of aliphatic disulfides, for obvious reasons — the spectra being much less complicated, the bond energy situation being cleaner, and the analysis of possible primary and secondary reaction products being easier to perform.

Lyman Lab. of Physics, Cambridge, Mass.
see Harvard U. Lyman Lab. of Physics, Cambridge, Mass.

1359

Lyons U. Dept. of Physiology (France).

[ON THE ACTION MECHANISM OF CYCLOSERINE ON MYCOBACTERIUM TUBERCULOSIS] Sur le mécanisme d'action de la cyclosérine sur Mycobacterium tuberculosis, by H. Viallier and R. M. Cayré. [1957] [4]p. [AF 61(514)1206] Unclassified

Published in Compt. Rend. Séances Soc. Biol., v. 151: 1545-1548, July 1957.

It has been determined experimentally whether the treatment by cycloserine exerts an action on the production of typhic and paratyphic agglutinins. The disintegrating action of cycloserine is also studied.

1360

Lyons U. [Dept. of Physiology] (France).

[VARIATIONS IN ELECTRICAL RESPONSES OF THE THALAMUS OF MAN DURING A PERIOD OF CONCENTRATION] Variations des réponses électriques somesthésique au niveau du thalamus chez l'Homme, au cours de l'attention, by M. Jouvet and C. Lapras. [1959] [4]p. incl. diagrs. [AF 61(514)1206] Unclassified

Some somesthetic responses have been collected at the level of the ventro-posterior-lateral nerve of the thalamus, during stereotaxic intervention in the conscious subject. These responses increase in amplitude when the subject turns his attention towards somesthetic stimulation. They decrease and can disappear when the subject's attention is attracted towards another sensory modality.

1361

Lyons U. [Dept. of Physiology] (France).

[ELECTRICAL ACTIVITY OF RHINENCEPHALON DURING SLEEP IN THE CAT] L'activité électrique du rhinencéphale au cours du sommeil chez le Chat, by M. Jouvet, F. Michel and J. Courjon. [1959] [5]p. incl. diagrs. refs. [AF 61(514)1206] Unclassified

Published in Compt. Rend. Séances Soc. Biol., v. 153: 101-105, Apr. 1959.

Recordings have been made from the sensory motor cortex, mesencephalic reticulum and hippocampus of the cat during sleep, barbitone and nembutal anesthesia and after decortication. Under such conditions the potentials of the rhinencephalon are rapid and of high voltage.

1362

Lyons U. [Dept. of Physiology] (France).

[ELECTROMYOGRAPHIC CORRELATIONS IN SLEEP OF THE DECORTICATE AND CHRONIC MESENCEPHALIC CAT] Corrélations électromyographique du sommeil chez le Chat décortiqué et mésencéphalique chronique, by M. Jouvet and F. Michel. [1959] [4]p. incl. illus. (AF 61(514)1206) Unclassified

Published in Compt. Rend. Séances Soc. Biol., v. 153: 422-425, June 1959.

From observations on the rhythms of activity of the cat brain after removal of cortex and mesencephalic regions, it is believed that the phenomenon of sleep is of telencephalic origin which is responsible for the inhibition of normal activity. A 2nd phase has a rhombencephalic origin.

1363

Lyons U. Dept. of Physiology (France).

RESEARCH ON THE NEUROPHYSIOLOGICAL MECHANISMS OF SLEEP AND ATTENTION, by M. Jouvet. Final technical rept. Jan. 1959-Dec. 1960. May 1961, 48p. incl. illus. diagrs. refs. (AFOSR-1103) (AF 61-(052)109) AD 262071 Unclassified

Neurophysiological mechanisms of sleep: Investigations on cats and man have led to the discovery of a Ponto limbic system which is responsible for the fast cortical activity during sleep in cat, and for the

oneiric activity in man. Neurophysiological mechanisms of attention: Depth recordings in the human brain have shown the existence of a central control of corticipetal afferent during attention. (Contractor's abstract)

1364

Lyons U. Dept. of Physiology (France).

[RESEARCH ON THE NEUROPHYSIOLOGICAL MECHANISMS OF SLEEP AND NEGATIVE EXPERIENCE] Recherches sur les mécanismes neurophysiologiques du sommeil et de l'apprentissage négatif, by M. Jouvet. [1959] [35]p. incl. illus. diagrs. (AFOSR-1193) (AF 61(052)109) Unclassified

Also published in Brain Mechanisms and Learning; A Symposium, Montevideo (Uruguay) (Aug. 2-8, 1959), Oxford, Blackwell Scientific Publications, 1961, p. 445-479. (AFOSR-1191)

Since the problem of falling asleep is intimately related with negative learning, some experimental facts which suggest that 2 different mechanisms at least act during sleep are considered. Then some evidence is described which concerns the intervention of 1 of these mechanisms during 2 types of negative learning: the habituation of the arousal reaction and the habituation of the orientation reaction.

1365

Lyons U. [Dept. of Physiology] (France).

[ON THE EXISTENCE OF A HYPNIC PONTO-LIMBIC SYSTEM: ITS CONNECTION WITH DREAM ACTIVITY] Sur l'existence d'un système hypnique ponto-limbique: ses rapports avec l'activité onirique, by M. Jouvet. [1961] [37]p. incl. illus. diagr. table, refs. (AFOSR-J345) (AF 61(052)109 and AF 61(052)472) Unclassified

Also published in Physiologie de L'Hippocampe: Colloques Internationaux du Centre National de la Recherche Scientifique, Montpellier (France) (Aug. 24-26, 1961), Paris, Centre National de la Recherche Scientifique, No. 107: 297-330, 1962.

Investigations on normal human subjects confirm that dreaming is associated with the stage of sleep with rapid eye movements. A specific EEG rhythm is described during this stage. Results obtained on chronic decorticate and decerebrate human subjects have confirmed the main results obtained in the cat, and lead to the conclusion that the stage of sleep with rapid eye movements in humans is similar to the Rhombencephalic phase of sleep. Results suggest that dreaming occurs periodically during sleep when a ponto-limbic system is brought into play probably by a neuro humoral mechanism.

1366

Lyons U. Dept. of Physiology (France).

[ON THE INITIATION OF TWO MECHANISMS FOR DIFFERENT ELECTROENCEPHALOGRAPHIC EXPRESSION AT THE LEVEL OF PHYSIOLOGICAL SLEEP IN THE CAT] Sur la mise en jeu de deux mécanismes à expression électro-encéphalographique différente au cours du sommeil physiologique chez le Chat, by M. Jouvet, F. Michel and J. Coujon. [1959] [3]p. incl. illus. (AF 61(052)109) Unclassified

Published in Compt. Rend. Séances Acad. Sci., v. 248: 3043-3045, May 25, 1959.

Results show 2 different mechanisms responsible for physiological sleep. One, of telencephalic origin acts upon the activating ascending system. The other, of rhombencephalic origin acts upon the γ system. (Contractor's abstract)

1367

Lyons U. Dept. of Physiology (France).

[ON A PERIOD OF RAPID CEREBRAL ELECTRICAL ACTIVITY DURING PHYSIOLOGICAL SLEEP] Sur un stade d'activité électrique cérébrale rapide au cours du sommeil physiologique, by M. Jouvet, F. Michel, and J. Courjon. [1959] [5]p. incl. illus. (AF 61(052)-109) Unclassified

Published in Compt. Rend. Séances Soc. Biol., v. 153: 1024-1028, 1959.

Results seem to indicate that there are 2 mechanisms invoived with physiological sleep. The first mechanism represents the initiation of a rostral inhibiting system, acting upon the ascending activating reticular system. The second mechanism represents the initiation of an inhibiting caudate system acting upon the gamma system.

1368

Lyons U. Dept. of Physiology (France).

TELENCEPHALIC AND RHOMBENCEPHALIC SLEEP IN THE CAT, by M. Jouvet. [1960] [19]p. incl. illus. diagrs. refs. (AF 61(052)109) Unclassified

Published in Ciba Foundation Symposium on the Nature of Sleep, London (Gt. Brit.) (June 27-29, 1960), Boston, Little, Brown and Company [1961], p. 188-206.

The EEG tracing of decorticate or mesencephalic cats shows no slow phase whereas periods of "rhombencephalic sleep" persist. In the cats with a pontile reticular formation (R. F.) lesion, on the other hand, only the phase of "slow sleep" appears, without any paradoxical phase (p. p.). These facts lead to the acceptance of the intervention of 2 different systems during physiological sleep in the cat. (1) The first system appears to intervene during "spindles and

slow waves" sleep in the intact animal. It requires the presence of the neocortex which is responsible for the slow activity. This corticifugal slow activity expresses an inhibition phenomenon since the arousal threshold produced by direct stimulation of the R. F. rises during this stage which may therefore be described as telencephalic sleep. This telencephalic stage may represent a stage which is acquired during telencephalization and which could be described as "neosleep". (2) The phase of "rapid" sleep (p. p.) which is proposed to call the "rhombencephalic phase" is dependent upon a totally different system, situated at the level of the pontile reticular formation. It controls, through the inhibitory R. F., the somato-vegetative phenomena (disappearance of all muscular tonic activity even in the cases of decerebration or decerebellation hypertony, variation in respiratory and cardiac rhythms). The rapid cortical activity which accompanies this phase is not suppressed by the interruption of the activating reticular system. This phase of sleep which only exists in mesencephalic or pontile cats could be likened to an "archisleep". It is more profound than the first one as the threshold of awakening is increased in comparison with that of the slow wave phase of sleep. Finally, it can be triggered off in animals by stimulating the lower part of the brain stem, and it is suggested that this phase depends upon a neurohumoral mechanism. (Contractor's abstract)

1369

Lyons U. Dept. of Physiology (France).

[EVIDENCE OF A HYPNIC CENTER AT THE RHOMBENCEPHALOGRAPHIC LEVEL IN THE CAT] Mise en évidence d'un centre hypnique au niveau du rhombencéphale chez le Chat, by M. Jouvet and F. Michel. [1960] [3]p. incl. diagrs. [AF 61(052)109] Unclassified

Published in Compt. Rend. Séances Acad. Sci., v. 251: 1188-1190, Sept. 12, 1960.

The work of several authors concerning the hypnic center at the rhombencephalic level of the cat's brain is presented. Results are given in graphic form.

1370

Lyons U. [Dept. of Physiology] (France).

[BEGINNING OF THE PARADOXAL PHASE OF SLEEP BY STIMULATION OF THE CEREBRAL STEM IN THE INTACT AND CHRONICALLY MESENCEPHALIC CAT] Déclenchement de la phase paradoxale du sommeil par stimulation du tronc cérébral chez le Chat intact et mésencéphalique chronique, by M. Jouvet and F. Michel. [1960] [8]p. incl. illus. (AF 61(052)109) Unclassified

Published in Compt. Rend. Soc. Séances Biol., v. 154: 636-641, 1960.

By stimulation of the reticular formation, one notices the extinction of EMG activity of the muscles at the nape of the neck and at the forehead. A slow rhythmic activity appears at the level of the differential reticular formation. Prolonged stimulation of the differential reticular formation during a period of deep sleep, brings about the appearance of a typical paradoxal phase with rapid cortical activity, respiratory acceleration, and eye movement.

1371

Lyons U. Dept. of Physiology (France).

ON THE NERVE PATHWAYS RESPONSIBLE FOR THE RAPID CORTICAL ACTIVITY DURING PHYSIOLOGICAL SLEEP IN THE CAT (PARADOXAL PHASE) Sur les voies responsables de l'activité rapide corticale au cours du sommeil physiologique chez le Chat, by M. Jouvet and F. Michel. [1960] [4]p. (AF 61-(052)109) Unclassified

Published in Compt. Rend. Séances Soc. Biol., v. 154: 995-998, 1960.

It is shown that rapid cortical activity during physiological sleep does not depend on the putting into action of the ascending activating reticular system. Experimental results suggest, on the contrary, the setting into action of a system recently described as the Midbrain Lombic circuit.

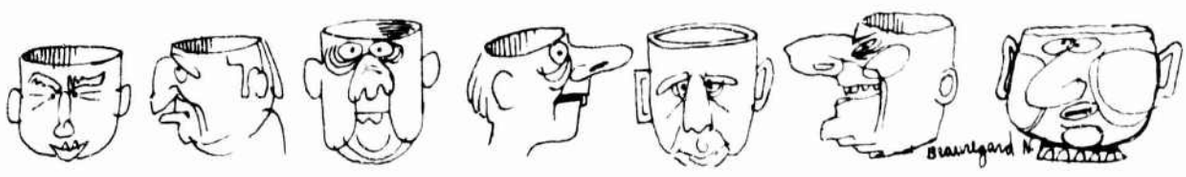
1372

Lyons U. Dept. of Physiology (France).

[EFFECTS OF LESIONS OF THE PONTINE RETICULAR FORMATION ON SLEEP IN THE CAT] Effets des lésions de la formation reticulée pontique sur le sommeil du Chat, by M. Jouvet and D. Mounier. [1960] [5]p. (AF 61(052)109) Unclassified

Published in Compt. Rend. Séances Soc. Biol., v. 154: 2301-2305, 1960.

Results show that the lesions suppress the appearance of the paradoxical sleep.



1373

McMaster U. Hamilton Coll., Ont. (Canada).

THE NEW UNIT OF ATOMIC MASS, by H. E. Duckworth. [1961] [1]p. (AFOSR-777) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)-247] and National Research Council of Canada) AD 259322 Unclassified

Also published in Canad. Jour. Phys., v. 39: 639, Apr. 1961.

The tenth General Assembly of the International Union of Pure and Applied Physics recommended the adoption of the exact number 12 as the relative nuclidic mass of the carbon isotope of mass number 12. This action will effect a unification of the physical scale of relative nuclidic masses and the chemical scale of atomic weight.

1374

McMaster U. [Hamilton Coll.] Ont. (Canada).

OXIDATION OF METALS, by W. W. Smeltzer and J. M. Perrow. [1961] 6p. incl. tables, refs. (AFOSR-598) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)734 and Defence Research Board) AD 258151) Unclassified

Also published in Indus. and Eng. Chem., v. 53: 319-324, Apr. 1961.

This report consists of a review of research concerning the field of oxidation theory. Topics covered are: metal oxides, metal oxidation and alloy oxidation.

1375

McMaster U. [Hamilton Coll.] Ont. (Canada).

THE OXIDATION OF AN IRON-5 PER CENT CHROMIUM ALLOY IN THE TEMPERATURE RANGE 600°-850°C, by J. M. Perrow and W. W. Smeltzer. [1961] 4p. incl. illus. diagrs. (AFOSR-1708) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)734 and Defence Research Board) AD 259893 Unclassified

Also published in Jour. Electrochem. Soc., v. 109: 1023-1026, Nov. 1962.

An investigation is reported on the oxidation of an iron-5% chromium alloy over the temperature range 600-850°C. The film on abraded specimens underwent transformation by nodular-type growths to produce a scale containing iron chromite and ferric-chromic oxide. The alloy underlying iron chromite was susceptible to internal oxidation. These phenomena combined with mechanical breakdown of oxides gave rise to nonreproducible oxidation rate curves.

1376

McMaster U. [Hamilton Coll.] Ont. (Canada).

THE OXIDATION AND REDUCTION KINETICS OF IRON AND IRON OXIDES, by W. W. Smeltzer. [1960] [6]p. incl. diagrs. tables, refs. [AF 49(638)734] Unclassified

Presented at Hamilton Branch meeting of the Canadian Inst. of Mining and Metallurgy, Sept. 1960.

Published in Trans. Canad. Inst. Mining and Metall., v. 54: 445-450, 1961.

The scientific basis for the reaction mechanisms of iron and oxides with oxidizing and reducing atmospheres has been emphasized. It has been shown that the magnitudes of the parabolic oxidation rates at high temperatures may be predicted from values for the diffusivity of lattice defects, and oxide compositions from the iron-oxygen phase diagram. It is known that the rates are controlled to constant values by a chemisorption reaction. The rate controlling steps are the dissociation of the gaseous reactant and movement of lattice defects at the oxide surface. Moreover, the reduction of oxides may be explained by a surface controlled reaction when the iron product is porous.

1377

Madrid U. Dept. of Crystallography (Spain).

THERMAL MOTION IN MOLECULAR CRYSTALS (Abstract), by M. L. Canut and J. L. Amorós. [1960] [1]p. (AF 49(638)193) Unclassified

Presented at Fifth Internat'l. Cong. of Crystallography, Cambridge (Gt. Brit.), Aug. 15-24, 1960.

Published in Acta Cryst., v. 13: 1106, Dec. 10, 1960.

Results indicate that the shape and location of the extended diffuse domains are correlated with the shape and orientation of the individual molecules. The agreement obtained when theoretical isodiffusion contours are compared with the observed values shows that these diffuse regions arise from independent (out of phase) molecular motion with vibrational frequencies of the optical type, being the kind of diffuse scattering, a function of $(1-\exp/-2B \sin^2\theta/\lambda^2/)$ that was first predicted by Debye, and it has the same nature as the electron diffuse scattering bands found in anthracene by Charlesby, Finch and Wilman.

1378

Madrid U. Dept. of Crystallography (Spain).

RESEARCH IN THE AREA OF CRYSTALLOGRAPHY, by J. L. Amorós and M. L. Canut. Final technical rept. Dec. 15, 1961 [79]p. incl. diagrs. refs. (AFOSR-2239) (AF 61(052)193) AD 289103 Unclassified

Thermal dependence and the inversion phenomenon of the one phonon scattering have been studied. A new method for the determination of Debye characteristic temperatures of solids has been developed. The dependence of the continuous diffuse scattering on T^2 instead of the F^2 has been experimentally and theoretically demonstrated. A new iterative zone refining apparatus has been developed. The formation of whiskers of KH_2PO_4 has been studied and interpreted. (Contractor's abstract)

1379

Madrid U. Dept. of Crystallography (Spain).

[TECHNIQUES FOR THE GROWTH OF LARGE SINGLE CRYSTALS OF ORGANIC SUBSTANCES] Técnicas para obtención de monocristales grandes de sustancias orgáncias, by E. Riaño and J. L. Amorós. [1961] [6]p. incl. illus. diagrs. refs. (AFOSR-4258) (AF 61(052)193) Unclassified

Also published in Rev. Cien. Apl., No. 83: 489-494, Nov.-Dec. 1961.

A new iterative zone refinement apparatus has been developed. The iterative process permits the selection of a predetermined impurity level in the substance to be refined. The single and multiple passes effect on the distribution of impurities in the refined ingot is also examined, and the specifications of the apparatus are set forth. In addition a multiple furnace of Pepinsky's type has been developed to grow single crystals of low (up to 300°C) melting point substances. (Contractor's abstract)

1380

Madrid U. Dept. of Crystallography (Spain).

[THERMAL AGITATION IN MOLECULAR CRYSTALS: DIFFUSE X-RAY SCATTERING BY ACRIDINE (III)] L'agitation thermique dans les cristaux moléculaires: la diffusion des rayons X par l'acridine III, by J. L. Amorós, A. De Acha, and M. L. Canut. [1961] [10]p. incl. illus. diagrs. refs. (AFOSR-4263) (AF 61(052)-193) Unclassified

Also published in Bull. Soc. Franc. Mineral. et Crist., v. 84: 40-50, 1961.

The thermal diffusion of x-rays by acridine (III) at ordinary temperature is studied from Laue's diagrams. The regions of continuous diffusions are interpreted with Fourier difference transforms (FDT). After calculating a value near the characteristic Debye temperature ($\theta = 41°K$), a theoretical comparison is made of the first, second, and third order Laval functions, the FDT, and $|\overline{X}|$. (Contractor's abstract, modified)

1381

Madrid U. Dept. of Crystallography (Spain).

[LOW TEMPERATURE INVERSION PHENOMENON IN DIFFUSE DIFFRACTION] El fenómeno de inversión en la difracción difusa del bencilo a baja temperatura, by L. M. Valdés and M. [L.] Canut. [1961] [8]p. incl. illus. diagrs. table. (AFOSR-4269) (AF 61(052)193) Unclassified

Also published in Bol. R. Soc. Esp. Hist. Nat., v. 59: 41-48, 1961.

The inversion phenomenon of the 1 phonon scattering has been observed in benzil. On the other hand, the continuous diffuse regions appearing at room temperature do not show the inversion phenomenon. The streaks at the lowest temperature become much thinner and weak diffuse maxima midway between the reciprocal lattice points do appear at 100°K. Weak diffuse maxima appearing in the streaks connecting different reciprocal lattice points are predicted in Born's theory as in these directions the optical branches of the vibrational spectrum have minima of frequency. (Contractor's abstract)

1382

Madrid U. Dept. of Crystallography (Spain).

[THE FORMATION OF WHISKERS AND OTHER PARTICULARS IN THE GROWTH OF MONOPOTASSIUM PHOSPHATE] La formación de triquitos y otras particularidades del crecimiento en el fosfato monopotasio, by J. L. Amorós, E. Riaño, and J. J. Alonso. [1961] [10]p. incl. illus. diagrs. table. (AFOSR-4270) (AF 61-(052)193) AD 408213 Unclassified

Also published in Bol. R. Soc. Esp. Hist. Nat., v. 59: 157-166, 1961.

Several peculiarities of the growth of dihydrogen potassium phosphate are shown. The technique of constant cooling is described as applied to the growth of DPP crystals. Rapidly grown crystals show many imperfections (zones of good crystal bounded by zones of bad crystal), that have been studied by electron microscopy. The formation of whiskers is studied and analyzed in terms of the periodic bond theory. The appearance of starvation surfaces and -lines is also studied. (Contractor's abstract)

1383

Madrid U. Dept. of Crystallography (Spain).

X-RAY THERMAL DIFFUSE SCATTERING IN AZELAIC AND PIMELIC ACIDS, by R. L. Banerjee, M. L. Canut, and J. L. Amorós. [1960] [16]p. incl. illus. diagrs. refs. (AFOSR-4271) (AF 61(052)193) AD 455781 Unclassified

Also published in Indian Jour. Phys., v. 35: 62-76, Feb. 1961.

Thermal diffuse scattering of azelaic and pimelic acids is studied by x-ray diffraction methods and compared with the observed diffuse scattering in other dycarboxylic acids. The interpretation of such diffuse scattering is done both by considering the propagation of thermal elastic waves accordingly with the crystal structure and by using the difference Fourier transform approach which gives account of the extended continuous regions of diffuse scattering. Also, the dynamic symmetry of the crystals is studied as deduced from the consideration of the observed diffuse scattering. (Contractor's abstract)

1384

Madrid U. Dept. of Crystallography (Spain).

TEMPERATURE DEPENDENCE OF THE X-RAY DIFFUSE SCATTERING OF MOLECULAR CRYSTALS: NAPHTHALENE, by M. L. Canut and J. L. Amorós. [Mar. 15, 1961] [11]p. incl. illus. diagrs. refs. (AFOSR-4272) (AF 61(052)193) AD 408212 Unclassified

Also published in Jour. Phys. and Chem. Solids, v. 21: 146-155, 1961.

For molecular crystals a theoretical analysis has been made on the thermal dependence of the Laval functions TDS_1, TDS_2, TDS_3 and our difference Fourier transform function DFT. The temperature factor of TDS_1 has been computed for naphthalene at several temperatures by assuming constancy of Θ-D and also with the assumption that the frequencies increase 7.6% in 100°K by lowering the temperature. In both cases the inversion phenomenon appears, being observable at low temperatures. The DFT form function of naphthalene has also been computed at several temperatures, in terms of Θ-E and the isodiffusion lines corresponding to the extended regions G and C are shown at 300° and 130°K. The reciprocal space regions more temperature-sensitive according to the different diffuse scattering functions are also shown. It is emphasized that experimental work on the thermal behavior of the diffuse scattering at low temperatures and high values of the reciprocal vector is of the most interest. Experimental tests in naphthalene have shown the inversion of TDS_1 and that the continuous diffuse regions do not correspond to a one-photon scattering. (Contractor's abstract)

Mallinckrodt Chemical Lab., Cambridge, Mass.
see Harvard U. Mallinckrodt Chemical Lab., Cambridge, Mass.

1385

Manitoba U. [Dept. of Mathematics] Winnipeg (Canada).

PERMUTATIONS WITH CONFINED DISPLACEMENTS, by N. S. Mendelsohn. [1960] [12]p. incl. table, refs. (AF 49(638)860) Unclassified

Published in Canad. Math. Bull., v. 4: 29-38, 1961.

This report is concerned with the enumeration of permutations by displacements; if $(p_1, p_2, \ldots, p_n)$ is a permutation of elements 1 to n, then the displacement associated with p_i is $p_i - i \pmod n$. More exactly, the enumeration is of permutations with s displacements equal to or greater than r, a number demoted by φ (n, r, s), for the first few values of r. The complementary character of the chessboards expressing forbidden positions for r and n - r shows that φ (n, r, s) = φ (n, n - r, n - s). Hence, if $\varphi(t; r) = \varphi(n, r, o) + \varphi(n, r, 1)t + \ldots$, then $\varphi(t; n - r) = t^n \varphi(t^{-1}; r)$. The main results are: $\varphi(t; n - 1) = D_n(t)$, the recontre hit polynomial, and $\varphi(t; n - 2) = U_n(t)$, the ménage hit polynomial. (Math. Rev. abstract)

1386

Manitoba U. Dept. of Mathematics, Winnipeg (Canada).

THE THEORY OF ORTHOMORPHISMS OF ABELIAN GROUPS AND ORTHOGONAL LATIN SQUARES, by D. M. Johnson, A. L. Dulmage, and N. S. Mendelsohn. [1961] [35]p. incl. tables, refs. (Rept. no. 1960/1) (AFOSR-230) (AF 49(638)860) AD 252056 Unclassified

Methods of construction of orthomorphisms, their relation to finite plane geometries, and their transformation properties are given. Orthomorphisms are mappings of a finite group onto itself which produce latin squares orthogonal to the square which is the addition table of the group. The theory is applied to all groups of order up to and including 12 and to the Veblen Wedderburn projective plane of order 9.

1387

Manitoba U. Dept. of Mathematics, Winnipeg (Canada).

STUDIES IN GRAPH THEORY, by A. L. Dulmage, D. M. Johnson, and N. S. Mendelsohn. [1961] [23]p. (AFOSR-601) (AF 49(638)860) AD 256227 Unclassified

Also published in Canad. Jour. Math., v. 14: 529-539, 1962.

Corresponding to every graph, bipartite graph or directed bipartite graph there exists a directed graph which is connected if and only if the original graph is connected. It is shown that for every directed graph

there exists a certain bipartite graph such that the directed graph is connected if and only if the bipartite graph is irreducible. Other connections between reducibility and connectivity are established. (Contractor's abstract)

1388

Manitoba U. [Dept. of Mathematics] Winnipeg (Canada).

ORTHOMORPHISMS OF GROUPS AND ORTHOGNAL LATIN SQUARES, I, by D. M. Johnson, A. L. Dulmage, and N. S. Mendelsohn. May 1, 1960, 17p. incl. tables, refs. (AFOSR-2796) (AF 49(638)860) AD 428411 Unclassified

Also published in Canad. Jour. Math., v. 13: 365-372, 1961.

For abstract see item no. 1386, Vol V.

1389

Manitoba U. [Dept. of Mathematics] Winnipeg (Canada).

THOSE STIRLING NUMBERS AGAIN, by N. S. Mendelsohn. [1961] [3]p. [AF 49(638)860] Unclassified

Published in Canad. Math. Bull., v. 4: 149-151, 1961.

A formula for the number of distinct equivalence relations among a set of n elements is derived: $f(n) = e^{-1} \sum_{r=0}^{\infty} \frac{(r-1)^{n-1}}{r!}$. Another explicit formula for Stirling numbers of the second kind S (n, r) is introduced: $S(n, r) = \frac{1}{(r, 2)!} \sum_{j=0}^{r-2} (-1)^j \binom{r-2}{j} T_{n-1, r-j}$, where $T_{n,r}$ is the sum of the geometric progression $\sum_{i=0}^{n-1} r^i$. (Math. Rev. abstract)

1390

Manitoba U. [Dept. of Mathematics] Winnipeg (Canada).

ON THE INVERSION OF SPARSE MATRICES, by A. L. Dulmage and N. S. Mendelsohn. [1961] [3]p. (AFOSR-4399) (AF AFOSR-62-235) AD 413841 Unclassified

Also published in Math. Comput., v. 16: 494-496, Oct. 1962.

Given a nonsingular square matrix A, it is desired to find permutation matrices P, Q so that PAQ is reduced to a triangular matrix. For this the authors suggest using their own algorithm (see no. 1392, Vol. V) to find the irreducible components of a bipartite graph associated with A. As an alternative, they suggest adaptation of a related algorithm by F. Harary which was limited to the case $Q = P^{-1}$. (Math. Rev. abstract)

1391

Manitoba U. [Dept. of Mathematics] Winnipeg (Canada).

MATRICES ASSOCIATED WITH THE HITCHCOCK PROBLEM, by A. L. Dulmage and N. S. Mendelsohn. [1961] [10]p. incl. refs. (AFOSR-J49) [AF AFOSR-62-235] Unclassified

Also published in Jour. Assoc. Comput. Mach., v. 9: 409-418, Oct. 1962.

This paper is concerned with convexity properties of m x n matrices whose entries are non-negative real numbers and whose row and column sums are specified positive numbers. Such matrices make their appearance in an important linear programming problem known as the Hitchcock or transportation problem. The determination of the vertices of such sets of matrices enables 1 to obtain all solutions of the transportation problem when the solution is not uniquely determined. (Contractor's abstract)

1392

Manitoba U. [Dept. of Mathematics] Winnipeg (Canada).

TWO ALGORITHMS FOR BIPARTITE GRAPHS, by A. L. Dulmage and N. S. Mendelsohn. [1961] [12]p. incl. diagrs. (AFOSR-J748) (AF AFOSR-62-235) AD 413645 Unclassified

Also published in Jour. Soc. Indus. and Appl. Math., v. 11: 183-194, Mar. 1963.

A bipartite graph K has 2 finite sets of vertices S and T and a set of edges. Each edge is a pair (s_i, t_j), $s_i \in S$, $t_j \in T$. The adjacency matrix A of K has $a_{ij} = 1$ if (s_i, t_j) is an edge in K, and $a_{ij} = 0$ otherwise. Two algorithms are given: the transversal algorithm and the decomposition algorithm. A transversal (or set of independent edges) of K is a collection of edges which are pairwise vertex-disjoint. A maximum transversal has the greatest possible number of independent edges. The transversal algorithm provides a method for finding a maximum transversal. This gives a way of calculating the term rank of a matrix, introduced by Ryser and also affords a constructive proof of König's theorem that the order of a maximum transversal of K is equal to its "coverance". The decomposition algorithm shows how to decompose the matrix A of K into minimal block submatrices. (Math. Rev. abstract)

1393

[Maremont Corp.] Rocket Power [Div.] Pasadena, Calif.

CHEMICAL SYNTHESIS WITH MONOENERGETIC IONS (Abstract), by S. Singer, C. Bodai, and L. K. Branson. [1961] [2]p. [AF 49(638)913] Unclassified

Presented at Second AFOSR Contractors' meeting on Chemical Kinetics of Propulsion, Illinois Inst. of Tech., Armour Research Foundation, Chicago, Sept. 11-12, 1961. (AFOSR-1417; AD 265513)

This study is concerned with the reaction of low-energy polyatomic ions in the gas phase with free-radical or stable target molecules. Several unusual and possibly sensitive compounds are accessible by the reaction of such fragments, and the reaction conditions appear to favor preparation of substances which would be difficult to obtain by ordinary chemical methods. In addition, the monoenergetic ion beam can ultimately give reaction rate parameters similar to those determined in ordinary gas- or liquid-phase kinetics. To obtain the quantities sufficient for characterization of new compounds, ion currents of approximately 0.5 milliampere are required. At such currents the product yield from a reaction of high cross-section is of the order of 5 ml of gas in 24 hr. The products are removed continuously from the reaction zone into a collection and analysis system which provides for gas-liquid chromatography, molecular weight determination, etc.

1394

[Marey Inst., Paris (France)]

[THE POSSIBILITY OF POST-ACTIVATION AS A TRANSPORTER OF PLASTICITY IN THE ESTABLISHMENT OF TEMPORARY LIAISONS] La facilitation de post-activation comme facteur de plasticité dans l'établissement des liaisons temporaires, by A. [E.] Fessard and T. Szabo. [1959] [21]p. incl. illus. diagrs. [AF 61(052)103] Unclassified

Published in Brain Mechanisms and Learning; A Symposium, Montevideo (Uruguay) (Aug. 2-8, 1959), Oxford, Blackwell Scientific Publications, 1961, p. 353-373. (AFOSR-1191)

Auto-rhythmic ganglion cells of Aplysia have been used to show the long-lasting frequency changes of the pacemaker that survive the immediate effects of a brief tetanus applied to an afferent tract. A satisfactory test of the facilitation transfer mechanism has been applied to the disynaptic system of neurones that control the discharges of electric organs in Torpedo. Pyramidal cells in Hippocampus have also been proved to be able to reveal potentiation transfers when activated through different pathways that converge on to the intermediate polysynaptic structures leading to them.

1395

[Marey Inst., Paris (France)]

[OBSERVATIONS OF THE PROJECTIONS OF THE CORTEX IN THE RETICULAR MESOENCEPHALOGRAPHIC FORMATION IN THE CAT] Observations sur les projections du cortex dans la formation réticulée mésencéphalique chez le Chat, by P. Borenstein and P. Buser. [1960] [5]p. incl. illus. diagr. refs. (AF 61(052)-103) Unclassified

Published in Compt. Rend. Séances Soc. Biol., v. 154: 38-42, May 31, 1960.

In this work, the distribution of cortico-reticular mesoencephalographic projections are defined. Certain functional aspects which follow directly from topographical data are noted.

1396

[Marey Inst., Paris (France)]

[EVIDENCE, IN THE FREELY AWAKENED CAT, OF THE ASSOCIATIVE CORTICAL ACTIVITIES APPEARING IN THE INATTENTIVE ANIMAL] Mise en évidence, chez le Chat éveillé libre, d'activités corticales associatives n'apparaissant que chez l'animal inattentif, by D. Albe-Fessard, A. Mallart, and P. Aléonard. [1961] [4]p. incl. illus. (AFOSR-743) (AF 61(052)103) Unclassified

Also published in Compt. Rend. Séances Acad. Sci., v. 252: 1060-1062, Feb. 13, 1961.

The results of a study on the origin of impulses which provoke 2 types of evoked cortical potentials are presented. Observations of the inattentive animal show responses whose amplitude is of the order of magnitude of amplitudes observed under chloralose (0.5-1 mv). These responses totally disappear in the attentive animal. The evoked potential observed in the primary somatic area consists of 2 phases. During attentive behavior the second phase is practically eliminated whereas the first is not seriously diminished further.

1397

[Marey Inst., Paris (France)]

[REDUCTION DURING ATTENTIVE BEHAVIOR OF THE AMPLITUDE OF EVOKED RESPONSES IN THE CENTRAL MEDIAN OF THE THALAMUS OF THE FREELY AWAKENED CAT, CARRIER OF FIXED ELECTRODES] Réduction au cours du comportement attentif de l'amplitude des réponses évoquées dans le centre médian du thalamus chez le Chat éveillé libre, porteur d'électrodes à demeure, by D. Albe-Fessard, A. Mallart, and P. Aléonard. [1961] [3]p. incl. illus. (AFOSR-744) (AF 61(052)103) Unclassified

Also published in Compt. Rend. Séances Acad. Sci., v. 252: 187-189, Jan. 4, 1961.

A visible correlation exists between the fluctuations of the average frequency of the waves which constitute the corticogram and the fluctuations of the amplitude of the response derived in the central median. One can see that these responses are not ample when the principal waves of the cortical activity have a frequency equal or lower than 10-12 s. It has been verified that the variations of amplitude observed in the CM is not due to an external cause bringing about a modification of the stimulation in the cat. The specific response provoked by the same stimulation is not exhibited with an appreciable variation in amplitude during an attentive reaction bringing about a reduction of the response from the CM.

1398

[Marey Inst., Paris (France)]

[OBSERVATIONS ON INSTRUMENTAL ALIMENTARY CONDITIONING IN THE CAT] Observations sur le conditionnement instrumental alimentaire chez le Chat, by P. Buser and A. Rougeul. [1959] [28]p. incl. illus. diagrs. (AFOSR-1194) (AF 61(052)103) Unclassified

Also published in Brain Mechanisms and Learning; A Symposium, Montevideo (Uruguay) (Aug. 2-8, 1959), Oxford, Blackwell Scientific Publications, 1961, p. 527-554. (AFOSR-1191)

A study was performed concerning the effects of the removal of the sensorimotor cortex on learning and executing the lever -pressing movement to a signal stimulus, in an instrumental conditioning situation. After total bilateral removal of sensorimotor cortex normal scores may still be obtained, but most of the observed movements are disturbed in several ways which have been analyzed. In sensorimotor deprived animals statistical dispersion of latency values is much larger than in normal animals. In time also, individual delays for deprived animals appear mostly variable in the course of one session. Spontaneous conditioned movement appears less frequent in ablated than in normal animals. Two types of qualitative disturbances of movements, automatic hyperactivity and disorientation phases, are described. None of the previously described disturbances are definitely observed following other cortical removals. These results are discussed in relation to neurophysiological data on afferent projections to and integrative properties of the motor cortex in the cat.

1399

[Marey Inst., Paris (France)]

RESEARCH ON NERVOUS PROCESSES UNDERLYING LEARNING BEHAVIOR, by A. E. Fessard. Final rept. May 1, 1958-Apr. 30, 1961, 15p. incl. refs. (AFOSR-1195) (AF 61(052)103) AD 262908 Unclassified

These investigations deal with some important points related to nervous processes underlying learning behavior. They have contributed to a better knowledge of the anatomical-functional organizations which, in mammalian brains, are responsible for associative operations, on the one hand, and for integrative motor activites on the other. In addition, a new line of theoretical considerations associated with some experimental approach has been initiated in order to obtain a better understanding of how activity traces occur and persist within the central nervous system.

1400

[Marey Inst., Paris (France)]

[AFFERENT CONVERGENCES OF CORTICAL AND PERIPHERAL ORIGIN AT THE CENTRUM MEDIANUM OF THE ANESTHETIZED AND AWAKENED CAT] Convergences d'afferences d'origines corticale et peripherique vers le Centre Médian du Chat anesthesie ou éveillé, by D. Albe-Fessard and E. Gillett. [1960] [13]p. incl. illus. refs. (AFOSR-2178) (AF 61(052)103) Unclassified

Also published in Electroencephalog. and Clin. Neurophysiol. Jour., v. 13: 257-269, 1961.

Activities evoked in the Centrum Medianum (CM) by applying isolated electric shocks to homo- and contralateral cortices were picked up with macroelectrodes. The lowest threshold response is elicited by stimulating the motor, S II and inferior temporal areas (4 V vs 7V for for the suprasylvian region). Zona incerta and the suprasylvian cortical sites into which the CM-relayed ascending impulses project are also activated. Impulses generated by peripheral and cortical stimulations mutually occlude within CM and suprasylvian cortex. Convergences of impulses from various peripheral and cortical origins could be observed on single units in the 2 kinds of preparations. The different kinds of interactions between these converging impulses suggest that the long-lasting depressions are not due to true refractory periods but to a phase of inhibition. (Contractor's abstract)

1401

[Marey Inst., Paris (France)]

[INFLUENCES OF THE CEREBRAL CORTEX ON THE MOTOR DISCHARGES EVOKED BY LUMINOUS STIMULATION IN THE CAT UNDER CHLORALOSE] Influences de l'écorce cérébrale sur les décharges motrices évoquées par la stimulation lumineuse chez le Chat sous chloralose, by P. Ascher, D. Jassik-Gerschenfeld, and P. Buser. [1961] [3]p. incl. illus. (AFOSR-2179) AF 61(052)103] Unclassified

Also published in Compt. Rend. Séances Acad. Sci., v. 252: 1383-1385, Feb. 27, 1961.

This report summarizes observations concerning the influence of the cerebral cortex on motor discharges evoked by illumination. Responses to auditory or visual stimulations are recorded on the two ventrical lumbar roots. Results seem to deny the existence of control superimposed on sub-cortical circuits responsible for the reflex discharge to luminous stimulation.

1402

[Marey Inst., Paris (France)]

SOMATIC FUNCTIONS OF THE NERVOUS SYSTEM, by P. Buser and A. Rougeul. [1961] [32]p. incl. refs. (AFOSR-2180) (AF 61(052)103) Unclassified

Also published in Ann. Rev. Physiol., v. 23: 387-416, 1961.

This review represents an attempt to bring together recent data from the field of somatic functions in the nervous system. Presented material has been grouped into sections developed to the usual anatomofunctional entities. (Contractor's abstract, modified)

1403

[Marey Inst., Paris (France)]

[SUPPRESSIVE ACTION OF THE CAUDATE NUCLEUS ON THE REFLEX REACTIVITY OF THE PYRAMIDAL SYSTEM IN THE CAT] Action suppressive du noyau caudé sur la reactivité réflexe du systeme pyramidal chez le Chat, by P. Buser, H. Encabo, and P. Borenstein. [1961] [3]p. incl. illus. refs. (AFOSR-2684) (AF 61-(052)103) Unclassified

Also published in Compt. Rend. Séances Acad. Sci. v. 253: 538-540, July 17, 1961.

The suppressive action of the caudate nucleus on the reflex reactivity of the pyramidal system is studied in the anesthetized and unanesthetized cat. The oscillographic analysis is carried on simultaneously on the motor cortex and on the corresponding pyramidal tractus. The peripheral stimulations are of the current type and the electrical central stimulations (thalamic and caudate) are applied by bipolar stereotaxic electrodes. Four sets of results are presented: Set 1 shows the existence of a cortical response to the isolated sensory stimulation; Set 2 shows the existence of a cortical response to electrical stimulation, but an absence of the characteristic pyramidal discharge; Set 3 indicates more suppression (or less complete suppression) of the pyramidal discharge when the sensory stimulus is preceded by a caudate stimulation; Set 4 shows consecutive controls as a result of sensory stimulation.

1404

[Marey Inst., Paris (France)]

[CORTICAL CONTROL OF THE VISUAL PROJECTIONS NEAR THE ASSOCIATIVE AND MOTOR CORTEX] Controle corticifuge des projections visuelles vers le cortex associatif et moteur, by J. Bruner, P. Buser, and R. Sindberg. [1961] [2]p. (AFOSR-2685) (AF 61-(052)103) Unclassified

Also published in Jour. Physiol. (Paris), v. 53: 284-285, 1961.

The experiences described in this report are devoted to forming a bond between a certain number of anterior data concerning the visual sensory projections in the associative and motor cortex or the influence that can be exerted on the area. The results obtained are based on electrical and natural stimulation of the cortex.

1405

[Marey Inst., Paris (France)]

[OBSERVATIONS RELATIVE TO THE PROJECTIONS OF THE NEOCORTEX NEAR THE CAUDATE NUCLEUS] Observations relatives aux projections du néocortex vers le noyau caudé, by H. Encabo, P. Borenstein, and P. Buser. [1961] [2]p. (AFOSR-2686) (AF 61(052)103) Unclassified

Also published in Jour. Physiol. (Paris), v. 53: 434-435, 1961.

This report concerns the activities of neo-cortico origin which may be registered at the caudate nucleus level of the brain. The responses of the caudate nucleus are collected by standard bipolar electrodes at the time of electric stimulations and at the time of natural stimulations, combined with the modification of the reactivity of one or the other cortical area, by local application of strychnine (2 parts per 1000), or the inverse, by the result of a depressive pharmacological action or local chilling. (Contractor's abstract)

1406

[Marey Inst., Paris (France)]

[ROLE OF CORTICAL SOMATIC AREAS IN THE CONTROL OF CERTAIN SOMESTHETIC MOTOR DISCHARGES] Rôle des aires corticales somatiques dans le contrôle de certaines décharges motrices somesthésiques, by P. Ascher, D. Jassik-Gerschenfeld, and M.-L. Fanjul-Moles. [1961] [2]p. (AFOSR-2687) (AF 61(052)103) Unclassified

Also published in Jour. Physiol. (Paris), v. 53: 254-255, 1961.

Results show an increase in responses collected in L7 at the time of stimulation of the anterior left foot of the cat. Application of 3M KCl produces the inverse result. Generally speaking, all action on the primary somesthetic area appears to modify the effect of stimulations of the corporal regions projecting upon that area. These results extend to the somesthetic domain the idea of a facultative influence of primary cortical areas on the sub-cortical motor reflexes.

1407

[Marey Inst., Paris (France)]

SENSORY RESPONSES OF THE AMYGDALA WITH SPECIAL REFERENCE TO SOMATIC AFFERENT PATHWAYS, by R. Wendt and D. Albe-Fessard. [1961] [37]p. incl. illus. diagrs. refs. (AFOSR-J636) (AF 61-(052)103) AD 414069 Unclassified

Also published in Physiologie de L'Hippocampe; Colloques Internationaux du Centre National de la Recherche Scientifique, Montpellier (France) (Aug. 24-26, 1961), Paris, Centre National de la Recherche Scientifique, No. 107: 171-200, 1962.

The presence of evoked responses to somatic, visual, and auditory stimuli, previously reported by others under different conditions, has been confirmed. Responses to these 3 modalities have a similar waveform and occur in the same area of the amygdala and prepiriform cortex, but with different spatial extent. The lateral and basal nuclei of the amygdala and the prepiriform cortex showed responses to the most extensive regions of the body surface as well as to visual and auditory stimulation. Evoked responses are bilateral, do not show somatotopic organization and occur at a relatively brief latency. Barbiturate anesthesia greatly reduced responses to somatic stimulation. Evidence is presented that (1) the pathway which mediates the amygdaloid response to contralateral anterior limb stimulation relays in the ipsilateral thalamus at the level of the VPL and then in the ipsilateral somatic area II of the cortex; (2) the pathway for the response to the ipsilateral anterior limb stimulation relays in the contralateral thalamus at the level of the VPL, in the contralateral area SII and in the ipsilateral area SII, in that order. Responses in the amygdala to light flash directed in the eye were bilateral and were independent of the pathways which mediate the somatic responses. (Contractor's abstract)

1408

Marquette U., Milwaukee, Wis.

ON PRODUCTS OF STARLIKE FUNCTIONS, by E. P. Merkes, M. S. Robertson, and W. T. Scott. [1961] [5]p. (AFOSR-2814) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-34 and National Science Foundation) Unclassified

Also published in Proc. Amer. Math. Soc., v. 13: 960-964, Dec. 1962.

A function f(z) regular in $|z| < 1$ is starlike of order α if $\mathrm{Re}\{zf'(z)/f(z)\} \geq \alpha$ for $|z| < 1$. It is shown that if $f_n(z)$ is starlike of order $1-d_n \geq 0$ for $n = 1,2, \ldots$, then $F(z) = z\Pi_{n=1}^{\infty} z^{-1} f_n(z)$ is starlike of order $1 - \Sigma_1^{\infty} d_n$ if the product converges uniformly in every subdisk. Application is made to the radius of univalence of a class of entire functions, giving a generalization of a theorem of H. S. Wilf (Ill. Jour. Math., v. 6: 242-244, June 1962).

1409

Marseille U. (France).

[SEARCH FOR A METHOD OF STUDYING THE NEUROPHYSIOLOGICAL ACTION OF PSYCHOTROPIC DRUGS IN MAN] Recherche d'une methode d'approche de l'action neurophysiologique de diverses drogues psychotropes chez l'Homme, by J. Paillard, J. Bert and others. [1961] [2]p. (AFOSR-1723) (AF 61(052)95) Unclassified

Also published in Rev. Neurol., v. 104: 227-228, 1961.

A study of the action of various psychotropic drugs (Largactil, 20-28 MD Delelande, and Meprobromate) have been undertaken by simultaneous recording of the EEG and reflex responses of the triceps surae muscles set up by mechanical percussion of the tendon and electrical stimulation of the posterior tibial nerve. The EEG have been subjected to frequences analysis and the use of two test reflexes allowed a differentiation to be made between agents effecting the motoneurons innervating the muscle spindles. The most striking results were seen with 20-28 where in 13 out of 14 subjects the tendon reflexes were rapidly depressed. In 7 cases the Hoffmann reflexes were also depressed although later. The effects are less marked and less constant with Largactil. A slowing of the frequency of the EEG is seen first followed by a depression of the tendon reflexes and afterwards by depression of the Hoffmann reflex. The Meprobromate tends to increase the reactivity of

the monosynaptic reflex and also to increase the variability. Changes in the EEG are constant but occur later. (Contractor's abstract)

1410

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. Final rept. Oct. 1961, 46p. incl. illus. diagrs. refs. (AFOSR-2139) (AF 49-(638)946) AD 273250 Unclassified

Apparatus for conducting fatigue, tensile and creep studies in the pressure range of 760 mm Hg to 10^{-8} mm Hg is described. Experimental data are presented for aluminum single crystals showing, with decreasing pressure, an improvement in fatigue life and a decrease of strength in tension and creep. (Contractor's abstract)

1411

Maryland U. [Dept. of Mathematics] College Park.

CONTINUOUS DEPENDENCE AND UNIQUENESS IN CAUCHY'S PROBLEM FOR FIRST ORDER, NON-LINEAR, PARTIAL DIFFERENTIAL EQUATIONS, PART II, by A. Douglis. Apr. 13, 1961 [11]p. incl. refs. (AFOSR-443) (Also bound with its AFOSR-3299) (AF 49(638)590) AD 255701 Unclassified

For abstract see item no. 1412, Vol. V.

1412

Maryland U. [Dept. of Mathematics] College Park.

THE CONTINUOUS DEPENDENCE OF GENERALIZED SOLUTIONS OF NON-LINEAR PARTIAL DIFFERENTIAL EQUATIONS UPON INITIAL DATA, by A. Douglis. [1961] [18]p. incl. refs. (AFOSR-3299) (AF 49(638)590) Unclassified

Also published in Commun. on Pure and Appl. Math., v. 14: 267-284, Aug. 1961.

In this paper the author considers the Cauchy problem with an initial condition at $t = 0$ for an equation of the form $u_t + F(x, t, u, u_x) = 0$ under the hypothesis that the smooth function $F(x,t,u,p)$ satisfies the condition $F_{pp} \geq 0$. The author defines a generalized solution of the Cauchy problem for this equation in the class of continuous functions, allowing a discontinuity of the first derivative, and for two generalized solutions $u_1(x,t)$, $u_2(x,t)$ of the Cauchy problem he obtains the bound $|u_1(x,t)-u_2(x,t)| \leq e^{ct} \sup |u_1(x,0)-u_2(x,0)|$. From this bound he obtains a uniqueness theorem for the Cauchy problem in the class of discontinuous functions for a quasi-linear equation of the form $u_t + (F(x, t, u))_x = 0$. Consideration is also given to the Cauchy problem for a hyperbolic system of the form $u_t + F(x, t, v_x) = G_1(u, v)$, $v_t - u_x = G_2(u, v)$, where the smooth function F satisfies the conditions $F_p \leq a_0 < 0$, $F_{pp} > 0$, and $G_i(u,v) = A_i(x, t, u, v) + \int_\xi^x K_i(x,t,\xi, x', u(x',t), v(x',t))dx$, $i = 1, 2$. For two generalized solutions u_1, v_1 and u_2, v_2 of the Cauchy problem for this system in the region D, it is established that $I(t) \leq CI(0)$, where $D = \{\alpha + At \leq x \leq \beta - At, 0 \leq t \leq \tau\}$, $A = \max |F_v|$, the constant C depends only on the maximum modulus of u_1, v_1 and u_2, v_2.

$$I(t_1) = \int \left[\left(\frac{u_1(x,t_1)-u_2(x,t_1)}{f(x,t_1)} \right)^2 + (v_1(x, t_1)-v_2)x,t_1))^2 \right] dx,$$

where the integral is taken along the intersection of D with the line $t = t_1$, and $f(x,t) \geq \sqrt{(-a_0)}$. From this theorem a proof is obtained of the uniqueness of a generalized solution of the Cauchy problem in a certain class of discontinuous functions for a quasi-linear system of the form

$$u_t + (F(x,t,v))_x = A(x,t)u + B(x,t)v + E_1(x,t),$$

$$v_t - u_x = C(x,t)u + D(x,t)v + E_2(x,t)$$

under the condition that $F_v < 0$, $F_{vv} > 0$. The author considers generalized solutions having at most discontinuities of shock-wave type. (Math. Rev. abstract)

1413

Maryland U. Dept. of Physics, College Park.

A NOTE ON REARRANGEMENT COLLISIONS, by T. B. Day, L. S. Rodberg and others. Mar. 22, 1961, 9p. (Technical rept. no. 208) (AFOSR-771) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)24, Atomic Energy Commission, and National Science Foundation) AD 259315 Unclassified

Also published in Phys. Rev., v. 123: 1051-1053, Aug. 1, 1961.

The conventional Born approximation formula for rearrangement collisions is used extensively in both atomic and nuclear physics. This formula contains a direct contribution from the heavy particle or core interaction. A straight forward demonstration shows that for the usual case of a massive core this contribution does not appear, so that the only effect of this interaction is to distort the incident and outgoing waves. Such problems as the post-prior discrepancy are clarified. (Contractor's abstract)

1414

Maryland U. Dept. of Physics, College Park.

TWO-POINT FUNCTION AND GENERALIZED FREE FIELDS, by A. L. Licht and J. S. Toll. Apr. 8, 1961 [16]p. (Technical rept. no. 210) (AFOSR-772) (AF 49-(638)24) AD 259316 Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 59, Feb. 1, 1961.

Also published in Nuovo Cimento, Series X, v. 21: 346-351, July 16, 1961.

Several theorems are proven which relate to the possibility of constructing a noninteracting field with an arbitrary 2-point Wightman function. They are: (a) if $\varphi(x)$ is a complete local field, and $[\varphi(x), \varphi(y)] = D(x - y)$, where D is an arbitrary operator depending on x and y only through their difference, then D is a c-number function; (b) such fields are generalized free fields, as defined by Greenberg; (c) any generalized free field is unitarily equivalent to a superposition of Klein Gordon fields, and moreover the asymptotic condition and unitarity restrict this to a superposition of ordinary free fields with different discrete masses. (Contractor's abstract)

1415

Maryland U. Dept. of Physics, College Park.

LECTURES ON THE USE OF PERTURBATION METHODS IN DISPERSION THEORY, by R. J. Eden. 1961, 1v. incl. diagrs. refs. (Technical rept. no. 211) (AFOSR-773) (AF 49(638)24) AD 259317 Unclassified

The following chapters are given: (1) Analytic structure in elementary particle physics; (2) Mathematical methods for the study of singularities of amplitudes in perturbation theory; (3) Functions of two complex variables; (4) Singularities of the general fourth order amplitude; (5) and (6) The Mandelstam representation for a general term in perturbation theory; (7) Acnodes and cusps on Landau curves; and (8) Production amplitudes and unitarity.

1416

[Maryland U. Dept. of Physics, College Park]

ASYMMETRY PARAMETER OF Λ DECAY AND THE INTERMEDIATE BOSON OF WEAK INTERACTIONS, by S. Oneda, J. C. Pati, and B. Sakita. [1960] [3]p. incl. table, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)24], Atomic Energy Commission, and Wisconsin U. Research Committee) Unclassified

Published in Phys. Rev. Ltrs., v. 6: 24-26, Jan. 1, 1961.

It is pointed out that the negative sign of the asymmetry parameter α^- of the $\Lambda \rightarrow p + \pi^-$ decay provides a favorable argument for the conjecture that the V-A four-fermion interaction may be mediated by a vector boson. A related problem has already been discussed in previous work (see item no. 1189, Vol. IV). There, however the arguments were developed under the assumption that the sign of α^- is positive, which was believed to be true at that time. The purpose of the present note is to stress the implications of the negative sign.

1417

Maryland U. Dept. of Physics, College Park.

ON THE COMMUTATOR OF A FREE KLEIN-GORDON FIELD OPERATOR WITH AN "ARBITRARY" HEISENBERG FIELD OPERATOR (Abstract), by Z. Fried, A. L. Licht, and J. S. Toll. [1961] [2]p. (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)24 and National Science Foundation) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 59-60, Feb. 1, 1961.

The following theorem will be proved: Let $\varphi(x)$ be a free field operator satisfying the Klein Gordon equation with some arbitrary mass m. Then $[\varphi(x), B(y)] = \langle 0|[\varphi(x),B(y)]|0\rangle$, provided that (a) $[B(y),B(z)]_{y_0=z_0} = 0$; (b) $[\varphi(y),B(z)]_{y_0=z_0} = 0$; (c) $[\varphi(x), \Box_y B(y)]_{x_0=y_0} = 0$; and (d) that $\varphi(x),B(y)$ together are complete, i.e., that any operator which commutes with φ and B is a c function.

1418

Maryland U. Dept. of Physics, College Park.

TEST OF GLOBAL SYMMETRY IN PION-BARYON INTERACTIONS BY K^- + p REACTIONS, by J. C. Pati. [1961] [6]p. incl. refs. [AF 49(638)24] Unclassified

Published in Phys. Rev., v. 123: 705-710, July 15, 1961.

Under the hypothesis that the K-meson interactions do not mask the symmetries of the pion-baryon interactions appreciably, the branching ratios of the K^- + p reactions are studied to test the validity of global symmetry. The T^{-1}-matrix formalism of Matthews and Salam is adopted to calculate the branching ratios. The new Dalitz-Tuan solutions for $\bar{K}N$ scattering lengths, which incorporate the (K^+,

K^0) mass difference and the new branching ratios of the various K^- + p reactions, presented at Kiev, are adopted in the analysis. The errors in the experimental branching ratios are so chosen as to satisfy the Amati-Vitale inequality. It is found that the a^- and b^+ (also a^+, though poorly) Dalitz-Tuan solutions can explain the branching ratios for K^- captured at rest. The extension of the analysis to 30-mev incident K^- mesons under the zero-range approximation leads to very poor agreement with experiments. (Contractor's abstract)

1419

Maryland U. Dept. of Physics, College Park.

POSSIBILITY OF A SPIN WAVE MAGNETIC MOMENT DETECTOR, by T. B. Day and J. Sucher. [1961] [2]p. (Technical rept. no. 201) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)24 and National Science Foundation) Unclassified

Published in Jour. Appl. Phys., v. 32: 1788-1789, Sept. 1961.

The possibility of a device which would electromagnetically signal the presence of a neutral particle is considered by using the solutions of the combined Maxwell and spin-wave equations. Results indicate that the usual "radiative pole" $k^2 = n^2\omega^2$, is found to be a pole in the integrand of the Green's function only at a direction of observation perpendicular to the applied field H_0. Moreover, at that angle of observation (90°) and in that mode ($k^2 = n^2\omega^2$), it is found that for point charges or magnetic moments, the radiation field vanishes due to the vanishing numerator of the integrand of the Green's function. At another angle of interest, viz. 0° (along H_0), there exist modes which are almost "radiative" and for which the Green's function resonates at a particular frequency. The characteristic modes, and hence the frequencies at which the system "rings" depend on the polar angle of the direction of observation as measured from the direction of H_0. Thus, unless the point charge or point dipole moment is moving in the x direction, so that the Čerenkov cone coincides with a cone of constant polar angle of observation, the "ringing" frequency is expected to be different at different azimuthal angles about the direction of motion of the particle. Finally, while the dependence of the opening angle of the Čerenkov cone on the particle velocity is the same as usual, it is also expected that the resonant radiation will be polarized, that is that the resonant radiation will be met in one of circular polarization H_+ of H_-, but not in both.

1420

Maryland U. Dept. of Physics, College Park.

THE CONFIGURATION AVERAGE OF THE GROUND STATE ENERGY OF AN ISOTOPICALLY DISORDERED LATTICE, INCLUDING THE CONTRIBUTION FROM CUBIC AND ANHARMONIC TERMS IN THE POTENTIAL ENERGY OF THE LATTICE. APPLICATION TO A LINEAR CHAIN AND THE PARTICULAR CASE OF A HYDROGEN-DEUTERIUM MIXTURE, by R. A. Coldwell-Horsfall and A. A. Maradudin. July 1961 [51]p. (Technical rept. no. 219) (AFOSR-1165) (AF 49(638)399) AD 261438 Unclassified

Deviations from the laws of perfect solutions have been observed in mixtures of light isotopes such as H_2 - D_2 and He^3 - He^4 mixtures. The free energy of the disordered state appears to be always greater than that of the pure isotopes so that phase separation occurs below a certain critical temperature. An expression is obtained for the configuration average of the ground state energy of an isotopically disordered lattice, taking into account the cubic and quartic anharmonic terms in the expansion of the potential energy of the lattice in powers of the nuclear displacements. The obtained result is applied to the case of a linear chain and have calculated the difference between the ground state energy of a disordered linear chain and that of the separated components, for the particular case of an equimolecular mixture of hydrogen and deuterium. The calculation has been carried out to second order in the parameter μ which represents the deviation of the isotopic masses from the mean mass of the lattice. This enables us to compare our result with that of Prigogine et al. It is found that the difference between the ground state energy of the disordered state and that of the separated phases has the value 10.38 cal/mol. The anharmonic contribution to the ground state energy causes this difference to be less than in the harmonic approximation. (Contractor's abstract)

1421

Maryland U. Dept. of Physics, College Park.

ANOMALOUS LATTICE SPECIFIC HEAT OF SUPERCONDUCTORS, by R. A. Ferrell. [1961] [4]p. incl. diagrs. refs. (Technical rept. no. 209) (AFOSR-1293) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)399 and Office of Naval Research) AD 256651 Unclassified

Also published in Phys. Rev. Ltrs., v. 6: 541-544, May 15, 1961.

The explanation of the anomaly suggested by Daunt and Olsen (Phys. Rev. Ltrs., v. 6: 267, 1961) is critized, and an explanation is presented which is based on a shift in the lattice frequency spectrum due to the changed phonon self-energy.

1422

Maryland U. Dept. of Physics, College Park.

THEORY OF SPIN WAVE INTERACTIONS IN FERROMAGNETISM, by N. I. Greenberg. July 1961 [148]p. incl. refs. (Technical rept. no. 222) (AFOSR-1331) (AF 49(638)399) AD 263805 Unclassified

The interactions of spin waves in an ideal Heisenberg model of a ferromagnet are studied. In particular, the effect of spin wave interactions on the free energy and spontaneous magnetization are examined. Treating a spin wave as a local phenomena, only binary collisions between spin waves need be considered at low temperature. The free energy of the system is developed as an expansion in terms of a binary kernal function; this binary kernal function is determined from the 2 particle propagator, which can formally be evaluated. When the free energy expansion is evaluated, the results of Dyson are obtained. That is, the lowest order correction term introduced in the spontaneous magnetization by spin wave interactions is of order T^4. (Contractor's abstract)

1423

Maryland U. Dept. of Physics, College Park.

THE FERMI SURFACE FOR AN INTERACTING ELECTRON GAS, by P. Fulde. July 1961 [6]p. incl. diagr. (Technical rept. no. 218) (AFOSR-1908) (AF 49(638)-399) AD 269076 Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 35, Feb. 1, 1961.

According to Migdal's theorem the magnitude of the discontinuity in the momentum distribution of an interacting degenerate electron gas is equal to the single-particle renormalization constant. The latter has been calculated from the study of the self-energy of a single-electron excitation. In a similar fashion, the Green's function method also can be applied to the calculation of the entire momentum distribution. The results for the momentum distribution can be compared with those of Daniel and Vosko and of Goldstone obtained by a different method. As a check on the results for the momentum distribution, the total kinetic energy can be calculated. From this, by means of the Virial theorem, the actual ground-state energy can be obtained and compared with the direct calculation by Gell-Mann and Brueckner. (Contractor's abstract)

1424

Maryland U. Dept. of Physics, College Park.

SOLID STATE THEORY. Final rept. Nov. 1961, 1v. incl. refs. (AFOSR-1856) (AF 49(638)399) Unclassified

The proposed program as of Sept. 29, 1958 is as follows: (a) electron-electron and electron-lattice interactions; (b) effect of local variations in periodic lattices; (c) vibrational frequency spectra of NaCl type lattices; (d) low temperature thermodynamic properties of crystal; (e) interatomic force constant; and (f) low temperature magnetism in alloys. Specific emphasis was given on superconductivity under program (a). Thirty-four abstracts and papers published under each program are given. A list of personnel and approximate periods of employment is also given.

1425

Maryland U. Dept. of Physics, College Park.

TRANSVERSE COLLECTIVE OSCILLATIONS IN SUPERCONDUCTORS (Abstract), by R. A. Ferrell. [1961] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)399 and Office of Naval Research) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 65, Feb. 1, 1961.

Transverse collective waves in superconductors can be treated similarly to plasmons in a degenerate electron gas. A discrete exciton can separate from the continuum and be pulled down into the energy gap without phonon exchange or Coulomb interaction but as a result of only the magnetic interaction of the quasi-particle and hole. This type of exciton is not an eigenstate of the BCS Hamiltonian and occurs only when the magnetic interaction terms are added to the Hamiltonian. The criterion for the exciton to separate from the continuum is identical to that for free propagation of light at a frequency below the gap frequency. It requires that the positive polarizability due to absorptions above the gap be strong enough to cancel the negative London polarizability. Although more complicated, such an electromagnetic window in the gap is analogous to the well-known optical window of silver films in the near ultraviolet. A further nonnegligible electromagnetic collective effect in superconductors is the excitation of ordinary transverse phonons.

1426

Maryland U. Dept. of Physics, College Park.

ANHARMONIC CONTRIBUTIONS TO VIBRATIONAL THERMODYNAMIC PROPERTIES OF SOLIDS. I. GENERAL FORMULATION AND APPLICATION TO THE

LINEAR CHAIN, by A. A. Maradudin, P. A. Flinn, and R. A. Coldwell-Horsfall. [1961] [23]p. incl. refs. (AF 49(638)399) Unclassified

Presented at meeting of the Amer. Phys. Soc., Monterey, Calif., Mar. 20-23, 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 119, Mar. 1961. (Title varies)

Published in Ann. Phys., v. 15: 337-359, Sept. 1961.

Cubic and quartic anharmonic corrections to the Helmholtz free energy of a crystal have been derived as functions of temperature for a general force constant model of the crystal. The resulting expressions are evaluated in the high temperature limit for the case of a fcc lattice with nearest-neighbor central force interactions between atoms. These results are then applied to the calculation of the high-temperature anharmonic corrections to the specific heat at constant volume and to the thermal expansion. (Contractor's abstract)

1427

Maryland U. Dept. of Physics, College Park.

ANHARMONIC CONTRIBUTION TO THE ENERGY OF A DILUTE ELECTRON GAS INTERPOLATION FOR THE CORRELATION ENERGY (Abstract), by W. J. Carr, Jr., R. A. Coldwell-Horsfall, and A. E. Fein. [1961] [1]p. (AF 49(638)399) Unclassified

Presented at meeting of the Amer. Phys. Soc., Monterey, Calif., Mar. 20-23, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 119, Mar. 20, 1961.

The first anharmonic contribution to the ground state energy of a bcc lattice of electrons, oscillating in a uniform background positive charge, has been calculated. The result is $-0.73r_s^{-2}$ ry, with r_s the radius, in Bohr units, of the sphere equivalent in volume to that occupied per electron. Combining this term with previous results gives for the ground state energy of a dilute electron gas the expression

$$E = E_{exp} - 1.792r_s^{-1} + 2.65r_s - \frac{3}{2} - 0.73r_s^{-2} + 0)r_s - \frac{5}{2}), \text{ where}$$

E_{exp} comes from the overlapping of electronic wave functions and falls off exponentially with $r_s^{\frac{1}{2}}$; while the $r_s^{-\frac{3}{2}}$ terms are, respectively, the Coulomb energy of a bcc lattice and the zero point energy of the electrons. The "correlation" energy corresponding to the above expression as well as the kinetic and potential parts, has been plotted and an interpolation has been made between the low-density curve and the high-density expression of Gell-Mann and Brueckner. The magnitude of the correlation energy so obtained for the intermediate region $2 < r_s < 6$ is approximately 15 to 30% smaller than previous estimates. The interpolated curves give strong evidence that the next term in the above low-density expansion for E is approximately $-0.81r_s^{-\frac{5}{2}}$. On the assumption that the high-density expression is rapidly converging near $r_s = 1$, it also is predicted that the r_s term in the high-density expansion will be approximately $-0.02r_s$.

1428

Maryland U. Dept. of Physics, College Park.

EFFECTIVE CHARGE OF QUASI-PARTICLES IN A METAL (Abstract), by E. R. Burke and R. A. Ferrell. [1961] [2]p. (AF 49(638)399) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 242-243, Apr. 24, 1961.

According to Stern the charge of a quasi-particle in a metal e* is related to the effective mass m* by the equation $e^*/m^* = e/m$, when only electron-electron interactions play a role and lattice effects can be ignored. The unstarred quantities are the free charge and mass of an electron. Stern has further pointed out that this simple relationship no longer holds when electron-phonon interactions are taking place. An explicit calculation in lowest order perturbation theory of the deviation from Stern's formula has been performed and numerical results will be presented, in which the percentage deviation is expressed in terms of the percentage contribution to the effective mass due to electron-phonon emission and absorption. Since the e/m ratio is modified by the electron-phonon interactions, it is clear that the latter can significantly influence the cyclotron resonance frequency in a metal.

1429

Maryland U. Dept. of Physics, College Park.

TIME-DEPENDENT PAIR CORRELATION FUNCTION FOR A DEGENERATE FERMION GAS (Abstract), by J. R. Cullen and R. A. Ferrell. [1961] [1]p. (AF 49(638)-399) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 245, Apr. 24, 1961.

Let P^1 be a single-particle projection operator in a

small region of configuration space centered about point 1 and $P_2(t)$ be a corresponding operator at point 2 and at the later time t in the Heisenberg picture. Then van Hove's time-dependent pair correlation function, defined in connection with the scattering properties of the fermion gas, is given essentially by the vacuum expectation value $\langle P_2(t)P_1 \rangle$. On the other hand, the true joint probability of finding a particle at point 1 and, in addition, another particle at point 2 time t later is given by $\langle P_1P_2(t)P_1 \rangle$. These 2 functions can be expected to be identical only for the case t = O, for which the projection operators commute (and $P_1^2 = P_1$). Explicit expressions can be exhibited for the one-dimensional free-fermion gas.

1430

Maryland U. Dept. of Physics, College Park.

NEUTRON SCATTERING BY CONDUCTION ELECTRONS AS A PROBE OF THE SUPERCONDUCTIVITY ENERGY GAP (Abstract), by W. H. Lupton and R. A. Ferrell. [1961] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)399 and Office of Naval Research) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 262, Apr. 24, 1961.

A consideration of the inelastic scattering of neutrons by the conduction electrons in a metal reveals a cross section that is peaked in the forward direction due to the interaction of the neutron magnetic moment with the electronic currents. A phenomenological treatment shows that the cross section is related to the frequency and wave number-dependent conductivity. A degenerate electron gas is used as a model for the normal state of a metal. In a superconductor an electron must receive enough energy to surmount the energy gap, hence the small angle cross section is reduced. The ratio of the cross sections in the superconducting and normal states has been estimated from the conductivity reported by Glover and Tinkham. The scattering by the nuclei of the crystal lattice is also analyzed since it would be an important competing process in a proposed experiment.

1431

Maryland U. [Dept. of Physics] College Park.

ANHARMONIC CONTRIBUTIONS TO VIBRATIONAL THERMODYNAMIC PROPERTIES OF SOLIDS. II. THE HIGH TEMPERATURE LIMIT, by A. A. Maradudin, P. A. Flinn, and R. A. Coldwell-Horsfall. [1961] [27]p. incl. diagrs. table, refs. [AF 49(638)399] Unclassified

Published in Ann. Phys., v. 15: 360-386, Sept. 1961.

The cubic and quartic anharmonic contributions to the Helmholtz free energy of a crystal are evaluated in the high temperature limit for the particular case of a face-centered cubic lattice with nearest neighbor central force interactions between atoms. The results are compared with those of earlier calculations, and are applied to a model of lead. (Contractor's abstract)

1432

Maryland U. Dept. of Physics, College Park.

GEOMAGNETICALLY TRAPPED ELECTRONS FROM COSMIC RAY ALBEDO NEUTRONS, by A. M. Lenchek, S. F. Singer, and R. C. Wentworth. May 1961 [58]p. incl. diagrs. tables, refs. (AFOSR-677) (AF 49(638)530) AD 258732 Unclassified

Also published in Jour. Geophys. Research, v. 66: 4027-4046, Dec. 1961.

The ability of the cosmic ray neutron albedo mechanism to account for geomagnetically trapped electrons is investigated quantitatively. Injection as a function of energy, pitch angle and altitude is computed from a reasonable neutron albedo model. Loss mechanisms based on Coulomb interactions with the residual atmosphere are considered to act both independently and simultaneously. Slowing down is generally dominant. The electron belt which results has (a) an intensity whose energy spectrum shows a sharp peak at approximately 200 kev, (b) an angular distribution which is approximately isotropic up to the loss cone and (c) an omni-directional, integral intensity in the geomagnetic equatorial plane which is approximately constant vs altitude. The effect of the Capetown magnetic anomaly is shown to produce a slot of only 2% in the equatorial plane. Only a small fraction of the trapped electrons can be accounted for in terms of neutron albedo, essentially all trapped electrons exceeding 400 kev. An auroral component of low energy electrons is also present.

1433

Maryland U. Dept. of Physics, College Park.

GEOMAGNETICALLY TRAPPED PROTONS FROM COSMIC-RAY ALBEDO NEUTRONS, by A. M. Lenchek and S. F. Singer. July 1961 [93]p. incl. diagrs. tables, refs. (AFOSR-1179) (AF 49(638)530) AD 262797 Unclassified

Also published in Jour. Geophys. Research, v. 67: 1263-1287, Apr. 1962.

Albedo neutrons from galactic cosmic rays are shown to account for the gross features of the observed geomagnetically trapped protons. This source leads to an equilibrium intensity (at altitudes up to several thousand km and at low latitudes) that compares quite favorably with observations, in the shape of the energy spectrum in the spatial distribution, and in the absolute intensity. In

this analysis we take account of the anisotropic emergence of neutrons (above 50 mev) and of nuclear interactions in the oxygen exosphere (above 300 mev). The anisotropy of the albedo in effect steepens the neutron energy spectrum significantly. More detailed features, such as the angular distribution, may also be computed from the neutron albedo theory, but no observations are available for comparison at present. The phenomenon responsible for the absence of trapped protons beyond about 2 earth radii is not yet understood. A number of nonadiabatic mechanisms are compared. Injection resulting from the neutron albedo from solar high-energy particles and the consequent transfer of charged albedo particles from polar latitudes to middle latitudes is examined. (Contractor's abstract)

1434

Maryland U. [Dept. of Physics] College Park.

PITCH ANGLE DIFFUSION IN A MAGNETIC MIRROR GEOMETRY, by R. C. Wentworth and W. M. MacDonald. [1961] [12]p. (Technical rept. no. 220) (AFOSR-1345) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)530 and Office of Naval Research) AD 263807 Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 53, Feb. 1, 1961.

The diffusion in pitch angle produced by Coulomb collisions of charged particles in a magnetic mirror was discussed using a variety of distribution functions and corresponding diffusion equations. A new derivation of an appropriate diffusion equation is presented by considering the random motion of particles on a sphere in momentum space. The effect of scattering at different points of the periodic particle orbit must be considered and leads to corrections on this problem. One result is that with a reflecting barrier instead of a loss-cone, the equilibrium flux tends toward an isotropic pitch angle distribution. (Contractor's abstract)

1435

Maryland U. Dept. of Physics, College Park.

GEOMAGNETICALLY TRAPPED RADIATION, by S. F. Singer and A. M. Lenchek. Aug. 1961, 137p. incl. diagrs. tables, refs. (Technical rept. no. 224) (AFOSR-1518) (AF 49(638)530) AD 265769 Unclassified

Also published in Prog. in Cosmic Ray Phys., v. 6: 245-335, 1962.

The neutron albedo theory is reviewed in detail with respect to protons and electrons to show to what extent it can account for the photographic emulsion and electron spectrometer experiments in rockets. The general principles of charged particle motion in the geomagnetic field are discussed by employing the adiabatic invariants. The general relations between unidirectional intensity, angular distributions and omnidirectional intensity are summarized. The properties of the upper atmosphere and exosphere are summarized since they are of prime importance in determining the distribution of trapped radiation. Cosmic ray neutron albedo theory, a specific mode of origin for electrons, is investigated quantitatively. It is concluded that only trapped electrons >400 kev (a very small fraction of the trapped electrons) can be accounted for by this theory. The factors determining the lifetimes of trapped protons are discussed and the contribution to the trapped protons by albedo from solar flare cosmic rays has been estimated.

1436

Maryland U. [Dept. of Physics] College Park.

ON THE SHORT-TIME FLUCTUATIONS OF COSMIC-RAY INTENSITY (Abstract), by F. L. Patel and K. Maeda. [1961] [1]p. [AF 49(638)530] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 52, Feb. 1, 1961.

In order to resolve possible short-period variations of cosmic-ray intensity (time scale of a few min) high counting (approximately 40,000 per min) cosmic-ray telescopes have operated at Climax and at Banff. Fluctuations have been observed in the rate-meter records which show a strong local time dependence with a max near 1400 hr. This is consistent with preliminary results of K. Tozuka and M. Wada although their method of analysis is somewhat different. Possible interpretation of this diurnal effect as well as other nonperiodic short-time variations are discussed. It is shown that a meteorological cause is improbable.

1437

Maryland U. Dept. of Physics, College Park.

THEORY OF MAGNETIC STORMS, by S. F. Singer. [1961] [9]p. incl. diagrs. refs. [Technical rept. no. 233] (AF 49(638)530) Unclassified

Presented at Internat'l. Conf. on Cosmic Rays and the Earth Storm, Kyoto (Japan), Sept. 4-15, 1961.

Published in Jour. Phys. Soc. Japan, v. 17, Suppl. A-I: 329-337, Jan. 1962.

This present paper stems from an earlier one, which put forward a new model of the magnetic storm—certain hypotheses of the earlier paper were the subject of controversy and others were proved incorrect. These are pointed out in the present work. The suggestion that

charged particles may become permanently trapped in the geomagnetic field has, however, been widely accepted. Objections to the ring current theory are considered, as is the shock wave mechanism of generation of the sudden commencement (SC). The effects of the distorted non-dipole field of the earth are also approached. It is suggested that satellite observations may fix the position of the SC current system.

1438

Maryland U. Dept. of Physics, College Park.

INJECTION OF TRAPPED PROTONS FROM SOLAR FLARE PARTICLES, by A. M. Lenchek and S. F. Singer. [1961] [5]p. incl. diagrs. (AF 49(638)530) Unclassified

Presented at Internat'l. Conf. on Cosmic Rays and the Earth Storm, Kyoto (Japan), Sept. 4-15, 1961.

Published in Jour. Phys. Soc. Japan, v. 17, Suppl. A-II: 123-127, Jan. 1962.

Protons coming from the sun cannot be trapped directly. An injection mechanism is calculated as follows: Solar protons arriving at the polar cap produce albedo neutrons, some of which decay within the geomagnetic field at lower latitudes. In the decay, protons are released, most of which are dumped into the atmosphere at lower latitudes but some of which are trapped. The injection coefficients of these two cases are calculated as well as absolute intensities for typical solar events. The newly trapped protons show some peculiar properties when compared to the protons injected by the galactic cosmic rays. They exhibit a peculiar angle distribution and therefore spatial distribution with a depression of omnidirectional intensity in the equatorial plane. Their decay proceeds with the development of a peak in the energy spectrum which moves upward as time progresses. (Contractor's abstract)

1439

Maryland U. Dept. of Physics, College Park.

NATURE AND ORIGIN OF RADIATION BELTS, by S. F. Singer. [1961] [7]p. incl. diagrs. refs. (AF 49(638)-530) Unclassified

Presented at Internat'l. Conf. on Cosmic Rays and the Earth Storm, Kyoto (Japan), Sept. 4-15, 1961.

Published in Jour. Phys. Soc. Japan, v. 17, Suppl. A-II: 187-193, Jan. 1962.

Recent developments in the neutron albedo theory are reported and the results are compared with observational data. For protons the calculated energy spectrum agrees extremely well with the observed spectra, provided nuclear interactions and an anisotropic emission of albedo neutrons are taken into account. The spatial distribution is calculated on the basis of the determination of geometric injection coefficients. The lifetime is assumed to be controlled by exospheric densities close to the earth and determined by the breakdown of the adiabatic invariance of magnetic moment at larger distances. This leads to a maximum intensity at about 1½ earth radii and a virtual disappearance of protons at about 2 earth radii. The absolute intensities of trapped protons calculated from neutron albedo theory and the most reasonable exospheric models are in very good agreement with observations in nuclear emulsions. From neutron albedo calculations are made of the properties of the resulting trapped electrons. The lifetime is a particularly challenging problem. It is concluded that only a fraction of the observed trapped electrons can be of neutron albedo origin. The remainder, and particularly the large bulk of low energy electrons are locally accelerated, with the energy ultimately derived from the sun. (Contractor's abstract)

1440

Maryland U. Dept. of Physics, College Park.

FORBUSH DECREASES PRODUCED BY DIFFUSIVE DECELERATION MECHANISM IN INTERPLANETARY SPACE, by S. F. Singer, H. Laster, and A. M. Lenchek. [1961] [6]p. incl. diagrs. (AF 49(638)530) Unclassified

Presented at Internat'l. Conf. on Cosmic Rays and the Earth Storm, Kyoto (Japan), Sept. 4-15, 1961.

Published in Jour. Phys. Soc. Japan, v. 17, Suppl. A-II: 583-586, Jan. 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 which enter the coud 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. (Contractor's abstract)

1441

Maryland U. Dept. of Physics, College Park.

PARTICLES IN THE MAGNETOSPHERE, by S. F. Singer. [1961] [3]p. incl. table, refs. (AF 49(638)530) Unclassified

Presented at Internat'l. Conf. on Cosmic Rays and the Earth Storm, Kyoto (Japan), Sept. 4-15, 1961.

Published in Jour. Phys. Soc. Japan, v. 17, Suppl. A-II: 609-611, Jan. 1962.

This is a summary of the known behavior of thermal particles (cosmic rays), high energy protons, high energy electrons, low energy electrons and magnetic storm belt particles in the magnetosphere and their accordance (or lack of) with neutron albedo theory.

1442

Maryland U. Dept. of Physics, College Park.

PLASMA SHEATH AND SCREENING AROUND A RAPIDLY MOVING BODY, by E. H. Walker. Mar. 1961 [27]p. incl. diagrs. (AFOSR-460) (AF 49(638)899) AD 253850 Unclassified

Presented at meeting of the Amer. Astronaut. Soc., Washington, D. C., Mar. 17, 1961.

The distribution of the potential and the charge density is derived quite generally for a stationary charged sphere and for a charged body moving rapidly through a plasma. Previous treatments were restricted to the cases where either the body's potential was small, being limited to less than 5 times the plasma temperature, or the body was small compared to the Debye length, or the body was moving slowly compared to the ion velocity. (Contractor's abstract)

1443

Maryland U. Dept. of Physics, College Park.

STUDY OF DRAG OF CHARGED BODIES IN A PLASMA, by E. H. Walker. Final rept. Apr. 1, 1960-May 31, 1961, 3p. (AFOSR-1159) (AF 49(638)899) AD 261570 Unclassified

This final report summarizes the work done on the problems of the production of a satellite wake. Special consideration is given to the problem of calculating the screening of a body moving rapidly through a plasma. A brief resume of various ways of calculating this screening is given and E. H. Walker's own theories are included in summary form.

1444

Maryland U. Dept. of Physics, College Park.

IONOSPHERE OF THE MOON (Abstract), by S. F. Singer and E. H. Walker. [1961] [2]p. (AF 49(638)899) Unclassified

Published in Program Joint Meeting of the Internat'l. Scientific Radio Union, U.S.A. Nat'l. Committee, and Inst. of Radio Engineers, Georgetown U., Washington, D. C., May 1-4, 1961.

A peculiar kind of "ionosphere" is shown to exist near the lunar surface. Unlike the usual ionosphere, the lunar electron layer is not caused by photoionization of an existing neutral atmospheric gas. Instead bombardment by solar UV photons leads to photo emission from the lunar surface and to the formation of a space charge limited "electronosphere" having a density of $\sim 10^4$ cm^3 at the surface. The electric field produced can exert considerable forces on positively charged dust particles which may exist near the lunar surface and be liberated by meteor impact. With an appreciable density of dust particles, the space charge is reduced and the ionosphere can expand to altitudes of several meters with enhanced electron densities. Therefore, on the moon there exists a dust ionosphere made up of positively charged dust particles and negative electrons. (Contractor's abstract)

1445

Maryland U. Dept. of Physics, College Park.

ELECTROSTATIC SCREENING OF BODIES IN SPACE, by S. F. Singer and E. H. Walker. Sept. 1961 [16]p. incl. diagrs. (Technical rept. no. 226) (AFOSR-1399) (AF AFOSR-61-57) AD 263806 Unclassified

Also published in Icarus, v. 1: 7-12, May 1962. (Title varies)

Bodies in space subject to the solar ultraviolet flux will emit photoelectrons. A certain number of these escape and are balanced by the accretion of thermal electrons from the surrounding plasma. For a positively charged body, a much larger number of photoelectrons is released from the surface but do not escape because their energy is insufficient to do so. Their effect is to produce an inner screening of the body's electric charge. This screening is calculated for spherical bodies as a function of size. For large bodies the space charge density of photoelectrons becomes quite large; in the case of the Moon it reaches a value of the order of 10^3 to 10^4 electrons/cm^3 just above the lunar surface. For small dust particles, however, the photoelectric cloud becomes negligible. (Contractor's abstract)

1446

Maryland U. Dept. of Physics, College Park.

INTERACTION OF WEST FORD NEEDLES WITH EARTH'S MAGNETOSPHERE AND THEIR LIFETIME, by S. F. Singer. 1961, 10p. incl. tables, refs. (Technical rept. no. 227) (AFOSR-1400) (AF AFOSR-61-57) AD 263649 Unclassified

Also published in Nature, v. 192: 303-306, Oct. 28, 1961.

Certain aspects of the interaction of the West Ford medium with the exosphere, in particular the interaction of the electric charge, which the needles are certain to carry with the ionized portion of the exosphere are examined. The possibility of making unique observations which can help establish the important parameters of this interaction is pointed out. Numerical predictions of orbit changes and a useful modification of the experiment are suggested.

1447

Maryland U. Dept. of Physics, College Park.

INTERACTION OF WEST FORD NEEDLES WITH EARTH'S MAGNETOSPHERE AND THEIR LIFETIME, by S. F. Singer. [1961] [2]p. (AFOSR-1400A) (Bound with its AFOSR-1400; AD 263649) (AF AFOSR-61-57) Unclassified

Also published in Nature, v. 192: 1061, Dec. 1961.

It is generally believed that the pressure of solar radiation will bring down the copper needles which were to be placed in orbit for the West Ford experiment in about 7 yr provided they are launched into a resonant orbit. Shapiro and Jones (Science, v. 134: 973, 1961) show that if the semi-major axis of the orbit is changed by more than 150 km, the resonance would be destroyed and the lifetime greatly increased. The author corrects a previous publication value on the problem of the drag of a charged body moving through a plasma (item no. 1446, Vol. V) and arrives at the conclusion that not only will the drag spoil the resonance but also it will, in all likelihood, provide an upper limit for the lifetime which amounts to a few months, possibly as much as 3 years.

1448

Maryland U. [Inst. for Fluid Dynamics and Applied Mathematics] College Park.

ON CALCULATING WEAK SOLUTIONS OF QUASI-LINEAR, FIRST-ORDER PARTIAL DIFFERENTIAL EQUATIONS, by A. Douglis. [1961] [36]p. incl. refs. (AF 18(600)573) Unclassified

Published in Contrib. Differential Equations, v. 1: 59-94, 1963.

To establish convergence, some results of independent interest in the theory of semi-monotonic functions are developed which satisfy a one-sided Lipschitz condition of the form $(f(x'') - f(x'))/f(x'' - x') \leq A$, or else a similar inequality with the direction reversed. It is shown that for $f(x,t)$ defined on the square $0 \leq x \leq 1$, $0 \leq t \leq 1$ and satisfying $f(x,t) \leq A/2$, and for $f(x,t)$ semi-monotonic in t for fixed x, and semi-monotonic in x for fixed t, the Riemann integral of $f(x,t)$ exists on S. (Math. Rev. abstract, modified)

1449

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

RADIO EMISSION BY PLASMA OSCILLATIONS IN NONUNIFORM PLASMAS, by D. A. Tidman and G. H. Weiss. Feb. 1961, 30p. incl. diagr. (Technical note no. BN-230) (AFOSR-306) (AF 18(600)1315) AD 251573 Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 299, Apr. 24, 1961.

Also published in Phys. Fluids, v. 4: 703-710, June 1961.

Calculations were conducted on the electromagnetic radiation emitted when a field of longitudinal plasma oscillations is incident on a localized fluctuation in density in a plasma. Use was made of the collisionless Boltzmann equation to describe the electron component of the plasma and compare the results with those previously obtained using the moment equations for this problem. (Contractor's abstract)

1450

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

A PROBLEM OF EQUIPMENT MAINTENANCE, by G. H. Weiss. Feb. 1961 [26]p. incl. diagrs. table. (Technical note no. BN-233) (AFOSR-362) (AF 18(600)1315) AD 252680 Unclassified

Also published in Management Sci., v. 8: 266-277 Apr. 1962.

Availability of a group of mechanisms described by a lifetime distribution $R(t) = \exp(-t/T)$. Various inspection schemes are assumed, and each inspection is assumed to be imperfect as regards to discovering mechanism failures. It is also postulated that inspection and repair require random amounts of time. The asymptotic availability of such mechanisms is calculated by means of the theory of semi-Markov processes. (Contractor's abstract)

1451

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

THE EFFECT OF COLLISIONS ON TWO-STREAM INSTABILITIES IN A PLASMA, by D. A. Tidman and G. H. Weiss. Mar. 1961, 28p. incl. diagrs. refs. (Technical note no. BN-234) (AFOSR-423) (AF 18(600)1315) AD 254030 Unclassified

Also published in Proc. Symposium on Electromagnetics and Fluid Dynamics of Gaseous Plasma, New York (Apr. 4-6, 1961), Brooklyn, Polytechnic Press, v. 11: 111-119, 1962. (Title varies) (AFOSR-3388)

An investigation is made of the effect of a small amount of 2-body scattering on the 2-stream instability that occurs in a plasma of contrastreaming electrons and ions. This is done by assuming the electron-ion collision frequency is small and making a perturbation expansion in this quantity. Contrary to what might be expected, it is found that the first correction in this small collision frequency increases the growth rate of unstable perturbations in the streams. (Contractor's abstract)

1452

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

RADIATION BY A LARGE-AMPLITUDE PLASMA OSCILLATION, by D. A. Tidman and G. H. Weiss. Mar. 1961, 10p. (Technical note no. BN-236) (AFOSR-479) (AF 18(600)1315) AD 254031 Unclassified

Also published in Phys. Fluids, v. 4: 866-868, July 1961.

The amount of energy radiated away by a longitudinal wave localized in a zero-temperature plasma and oscillating with the plasma frequency $\omega_e = [4\pi N_0 e^2/m]^{\frac{1}{2}}$ is calculated. This radiation process is treated by carrying the perturbation theory for small-amplitude waves to second order. In second order the coupling of the longitudinal oscillating electric field E_L and the transverse field E_T enter into the linear theory in such a way that the radiation emitted comes off at the second harmonic, $2\omega_e$, of the plasma frequency.

1453

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

ON MAGNETOHYDRODYNAMIC STABILITY OF A SELF-GRAVITATING PLASMA, by R. K. Jaggi. Feb. 1961, 25p. incl. tables. (Technical note no. BN-231) (AFOSR-747) (AF 18(600)1315) AD 257449 Unclassified

Also published in Zeitschr. Astrophys., v. 54: 190-199, 1962.

Boundary conditions are deduced which apply on the free surface of a self-gravitating plasma. These equations are applied to study the stability problems of a self-gravitating plasma. It is proved that the stable length of the compression waves in an infinite homogeneous plasma is increased by the presence of a uniform magnetic field. The stability of a self-gravitating plasma cylinder of infinite length is worked out and it is seen that a magnetic field of the order of 5.10^{-6} gauss increases the stable length of the plasma cylinder by more than 10 times. (Contractor's abstract)

1454

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

STATISTICAL PROPERTIES OF LOW-DENSITY TRAFFIC, by G. [H.] Weiss and R. Herman. July 1961 [18]p. incl. diagrs. refs. (Technical note no. BN-254) (AFOSR-1080) (AF 18(600)1315) AD 262260 Unclassified

Also published in Quart. Appl. Math., v. 20: 121-130, July 1962.

An infinitely long line of traffic moving on a highway without traffic lights or other inhomogeneities is studied. It is assumed that each car travels at a constant speed which is a random variable. A further assumption is that when one car overtakes another, passing is always possible and occurs without change of speed. It is shown that any initial headway distribution must relax to a negative exponential distribution in the limit of t becoming infinite. The statistics of passing events are examined, and it is shown that the probability of passing or being passed by n cars in time t is described by a Poisson distribution. (Contractor's abstract)

1455

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

ON THE CALCULATION OF ANALYTIC FUNCTIONS OF CYCLIC MATRICES, by P. B. Abraham and G. [H.] Weiss. July 1961 [18]p. (Technical note no. BN-253) (AFOSR-1265) (AF 18(600)1315) AD 262708 Unclassified

Also published in Jour. Math. Phys., v. 3: 340-345, Mar.-Apr. 1962.

Recently Löwdin, Paunez, and de Heer, have discussed the calculation of functions of cyclic matrices and presented 3 exact methods for doing this. It is shown that the last of their methods can be generalized to a method which is convenient for approximate calculations and which in addition can be extended to the calculation of functions of higher order cyclic matrices. It is also shown that by the same techniques it is possible to evaluate functions of a skew circulant matrix. (Contractor's abstract)

1456

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

RADIATION BY PLASMA OSCILLATIONS INCIDENT ON A DENSITY DISCONTINUITY, by D. A. Tidman and J. M. Boyd. July 1961 [24]p. incl. diagrs. (Technical note no. BN-252) (AFOSR-1272) (AF 18(600)1315) AD 262274 Unclassified

Also published in Phys. Fluids, v. 5: 213-218, Feb. 1962.

The electromagnetic radiation produced by plasma oscillations propagating across a density discontinuity is calculated. The boundary conditions to be applied in this process are also discussed in some detail. (Contractor's abstract)

1457

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

WAVE MOTION IN A TWO-COMPONENT PLASMA WITH ANISOTROPIC PRESSURE, by R. K. Jaggi. Sept. 1961 [14]p. incl. diagrs. (Technical note no. BN-259) (AFOSR-1529) (AF 18(600)1315) AD 264891 Unclassified

Also published in Phys. Fluids, v. 5: 497-498, Apr. 1962.

Results for the propagation of small amplitude waves in a plasma with anisotropic pressure tensor are summarized. It is shown that the anisotropy of the pressure tensor has an appreciable effect on the propagation and decay of waves in a plasma. It is also shown that an anisotropy in the electron pressure can lead to an instability of hydromagnetic waves. (Contractor's abstract)

1458

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

THE RELAXATION OF MOMENTS DERIVED FROM A MASTER EQUATION, by K. E. Shuler, K. Andersen, and G. H. Weiss. Nov. 1961, 22p. (Technical note no. BN-264) (AFOSR-1688) (In cooperation with National Bureau of Standards) (AF 18(600)1315) AD 266574 Unclassified

Also published in Jour. Math. Phys., v. 3: 550-556, May-June 1962.

A study has been made of the relaxation of the moments of probability distributions whose time evolutions are governed by a master equation. The necessary and sufficient condition for the first moment, $M_1(t)$, to undergo a simple exponential relaxation is found to be $\sum_{n=0}^{\infty} nA_{nm} = \beta m + \gamma$, where A_{nm} is the transition probability per unit time for transitions from state m to n, and where β and γ are constants. The necessary and sufficient condition under which the first k moments, $M_1(t)$, $M_2(t)$ ... $M_k(t)$, satisfy a closed system of linear equations is found to be $\sum_{n=0}^{\infty} n^r A_{nm} = \sum_{i=0}^{k} \beta_{ri} m^i$. Near equilibrium all the moments $M_r(t)$ obey, to a good approximation, a simple exponential relaxation law irrespective of the form of the A_{nm}. For systems described by the Fokker-Planck equation

$$\frac{\partial P(x,t)}{\partial t} = -\frac{\partial}{\partial x}\left[b_1(x)\,P(x,t)\right] + \tfrac{1}{2}\frac{\partial^2}{\partial x^2}\left[b_2(x)P(x,t)\right],$$

the necessary and sufficient condition that the first moment $M_1(t)$ undergo a simple exponential relaxation is found to be $b_1(x) = \beta X + \gamma$ and the necessary and sufficient condition for the second moment, $M_2(t)$ to have a simple exponential relaxation is $2 \times b_1(x) + b_2 = \beta_{22}x^2 + \gamma_2$. It is shown that these conditions are equivalent to the conditions on the A_{nm} stated above.

1459

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

COMMENTS ON RADIATION BY PLASMA OSCILLATIONS, by D. A. Tidman. [1961] [1]p. (AFOSR-1806) (AF 18(600)1315) Unclassified

Also published in Phys. Fluids, v. 4: 1186, Sept. 1961.

In a recent paper (item no. 1449, Vol. V), it is found that the amount of electromagnetic radiation produced by plasma oscillations colliding with a small inhomogeneity in a plasma became exponentially small for wavelengths of the plasma oscillations less than the density gradient scale L. An appreciable amount of radiation from this gradient-coupling would presumably only be produced by plasma oscillations incident on steep gradients, for example, at the boundaries of a plasma or at shock surfaces in the plasma. The purpose of this report is to correct an algebraic error, which in no way alters the above conclusion, and to make some additional comments on this problem.

1460

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

THE STABILITY OF THE PINCH WITH ANISOTROPIC

PRESSURE, by R. K. Jaggi. Dec. 1961 [27]p. incl. diagr. refs. (Technical note no. BN-269) (AFOSR-1896) (AF 18(600)1315) AD 269252 Unclassified

Also published in Nuclear Fusion, v. 2: 78-83, Sept. 1962.

A dispersion equation is obtained for the stability of the pinch from the hydromagnetic equations supplemented by an equation for the pressure tensor of the ions. The dispersion equation is obtained for the marginal instability case only. It is observed that this dispersion equation coincides with the dispersion equation obtained from the Chew, Goldberger and Low equations for the marginal instability case. It is concluded that the region of stability predicted from the equations which were used is slightly more than that given by the kinetic equation used by Chandrasekhar, Kaufmann and Watson.

1461

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

TWO-STREAM INSTABILITIES WITH COLLISIONS, by D. A. Tidman and G. [H.] Weiss. [1961] [9]p. (AFOSR-3390) (Bound with AFOSR-3388) (AF 18(600)1315) Unclassified

Also published in Electromagnetics and Fluid Dynamics of Gaseous Plasma, Proc. of Symposium, New York (Apr. 4-6, 1961), Brooklyn, Polytechnic Press, v. 11: 111-119, 1962. (AFOSR-3388)

For abstract see item no. 1451, Vol. V.

1462

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

LOSS OF PARTICLES IN A PINCHED DISCHARGE IN AN AXIAL MAGNETIC FIELD, by R. K. Jaggi. [1961] [3]p. (AFOSR-3509) (AF 18(600)1315) Unclassified

Also published in Nuclear Fusion, v. 1: 198-200, 1961.

A calculation of the loss of deuterons from a pinched current to the wall of the container has been given by G. P. Thomson. This calculation is extended so that account is taken of an axial magnetic field. It is found that such a field can materially reduce the particle loss. (Contractor's abstract)

1463

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

LIMITING OPTICAL FREQUENCIES IN ALKALI HALIDE CRYSTALS, by A. A. Maradudin and G. H. Weiss. [1961] [9]p. incl. refs. [AF 18(600)1315] Unclassified

Published in Phys. Rev., v. 123: 1968-1976, Sept. 15, 1961.

Rosenstock has pointed out that on the basis of symmetry arguments that the frequencies of the 3 optical branches of an ionic crystal in the limit of infinite wavelengths are all equal. This result is in contrast with the relation $(\omega_l/\omega_t) = (\epsilon_0/\epsilon_\infty)^{\frac{1}{2}}$ due to Lyddane, Sachs, and Teller, where ω_l and ω_t are the limiting longitudinal and transverse frequencies and ϵ_0 and ϵ_∞ are the static and high-frequency dielectric constants, respectively. By use of Kellermann's model for NaCl, the small-k expansions of the elements of the dynamical matrix for a finite spherical crystal of radius R are obtained. It is found that, if the limit $k \to 0$ is taken before the limit $R \to \infty$, the 3 optical frequencies are all equal, while if the order of taking limits is reversed the result of Lyddane, Sachs, and Teller is obtained. These conclusions are in agreement with Rosenstock's result, and with remarks of Fröhlich, and provide an explicit expression for the infrared frequency in the finite-crystal case. A similar calculation for Wigner's low density electron crystal yields the result that in a finite spherical crystal the limiting frequencies of the 2 transverse branches and the 1 "longitudinal" branch are all equal. The possibility of the experimental observation of these effects is discussed. (Contractor's abstract)

1464

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

EXTENSION OF THE RANGE OF VALIDITY OF THIRRING'S EXPANSION FOR THE SPECIFIC HEAT OF CRYSTALS, by R. A. Sack, A. A. Maradudin, and G. H. Weiss. [1961] [5]p. incl. tables, refs. (Sponsored jointly by [Air Force Office of Scientific Research under AF 18(600)1315] and National Science Foundation) Unclassified

Published in Phys. Rev., v. 124: 717-722, Nov. 1, 1961.

In 1913, Thirring obtained an expansion for the vibrational contribution to the specific heat of a crystalline solid in powers of $1/T^2$. The coefficients of this series are proportional to successive moments of the frequency spectrum. In its original form, Thirring's expansion converges only for $T > T_a$, where $T_a = \hbar\omega_L/2\pi k$ and ω_L is the max normal mode frequency, and because of slow convergence, it is useless from a numerical point of view for $T < 4T_a/3$. The range of convergence of the expansion can be extended to absolute zero and its computational usefulness down to $T \approx 2T_a/3$ by means of a Euler transformation, which effectively converts it into

an expansion in $1/(T^2 + T_b^2)$ with $T_b \approx T_a$. The improvement in convergence is so efficient that, usually, only the first 6 or 7 even moments are required to obtain 4-figure accuracy at $T = T_a$. Alternatively, nonlinear transformations can be applied if the specific heat is to be calculated for a few values of temperature only. Some examples of the use of these methods are presented. Conversely, Euler's transformation provides a means for a more detailed description of the frequency distribution from specific heat measurements. (Contractor's abstract)

1465

Maryland U. [Inst. for Fluid Dynamics and Applied Mathematics] College Park.

EFFECT OF COULOMB SCATTERING ON TWO-STREAM INSTABILITIES IN A PLASMA (Abstract), by D. A. Tidman. [1961] [1]p. [AF 18(600)1315] Unclassified

Presented at meeting of the Amer. Phys. Soc., Colorado Springs, Colo., Nov. 15-18, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 140, Feb. 23, 1962.

A theoretical study has been made of the effect that a small amount of 2-body scattering has on the 2-stream instability that occurs in a plasma of contrastreaming electrons and ions. This was done by making a perturbation expansion in the electron-ion collision frequency and then calculating the correction to the perturbation electric field of an unstable wave to first order in the collision frequency. It is found that as the streaming kinetic energy is thermalized, enhanced Landau damping competes with the growth of an unstable perturbation. This takes the form of a loss of energy of a perturbation through an interaction between the electric field of a wave and scattered electrons in the stream. The Fokker-Planck scattering formulae were used to account for the gradual thermalization of the electron stream through a large number of distant Coulomb encounters. Simple relaxation scattering formulae which do not contain this diffusion nature in velocity space of the thermalization of the streams may give misleading results.

1466

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

INSTABILITY OF CONTRASTREAMING PLASMAS WITH RESONANCE DISTRIBUTION FUNCTIONS, by F. Ek, S. L. Kahalas, and D. A. Tidman. [1961] [6]p. incl. diagrs. table, refs. [AF 18(600)1315] Unclassified

Published in Phys. Fluids, v. 5: 328-323, Mar. 1962.

An analysis is made of the instability of waves in contrastreaming plasmas. The unperturbed distribution function, which occurs in the dispersion relation, is taken to be a resonance function of the form $f_0(v) = (v^2 + V^2)^{-3}$, where V is related to the thermal velocity. The case of identical contrastreaming plasmas is analyzed in 2 phases: an electron instability which may arrest the streaming motion and an electron-ion instability involving the static, heated electrons and the ion streams. Critical temperatures for these instabilities are determined and compared with results obtained from Maxwellian distribution functions. Stability criteria for arbitrary temperatures are obtained with the resonance function. Growth rates over the band of allowed wave numbers are given for both phases of instability. (Contractor's abstract)

1467

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

THE CAUCHY PROBLEM AND THE MIXED BOUNDARY VALUE PROBLEM FOR A NON-LINEAR HYPERBOLIC PARTIAL DIFFERENTIAL EQUATION IN TWO INDEPENDENT VARIABLES, by J. Conlan. [1959] [26]p. [AF 49(638)228] Unclassified

Published in Arch. Rational Mech. Anal., v. 3: 355-380, Aug. 4, 1959.

This report deals with the Cauchy problem and the mixed value problem for a canonical form of a second order partial differential equation of hyperbolic type in 2 independent variables. The exact statements of the Cauchy problem and of the mixed value problem dealt with are given in Theorems 1 and 8 respectively. These 2 theorems are proved here by a variation of a method employed by J. B. Diaz in the treatment of the characteristic boundary value problem. The main interest of the present approach is that the existence theorems are proved in a way which leads directly to a method for the actual numerical construction of solutions. (Contractor's abstract)

1468

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

ON KORN'S INEQUALITY, by L. E. Payne and H. F. Weinberger. Jan. 1961, 19p. (Technical note no. BN-229) (AFOSR-275) (In cooperation with Minnesota U.) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)228 and Office of Naval Research) AD 252340 Unclassified

Also published in Arch. Rational Mech. Anal., v. 8: 89-98, 1961.

Of fundamental importance in the study of boundary value and eigenvalue problems in classical elasticity is

Korn's inequality (Ann. Math., v. 48: 441-471, 1947). In this analysis the best possible Korn constants for the sphere and for the circle are given. (Contractor's abstract)

1469

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

SOME INTEGRAL INEQUALITIES FOR UNIFORMLY ELLIPTIC OPERATORS, by J. H. Bramble and L. E. Payne. Apr. 1961, 11p. (Technical note no. BN-239) (AFOSR-556) (AF 49(638)228) AD 255477 Unclassified

Also published in Contrib. Differential Equations, v. 1: 129-135, 1963.

Certain inequalities are derived which lead to bounds for solutions of mixed boundary value problems for second order elliptic partial differential equations. (Contractor's abstract)

1470

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-590) (AF 49(638)228) AD 256019 Unclassified

Also published in Contrib. Differential Equations, v. 1: 95-127, 1963.

Pointwise a priori bounds are obtained for the solution of the Dirichlet problem associated with a rather general second order elliptic differential operator. These bounds involve only integrals of the data itself and not of its derivatives. Furthermore, the bounds obtained are applicable at any point in the domain of definition (i.e., up to the boundary of the region). (Contractor's abstract)

1471

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

SOME HIGHER ORDER INTEGRAL IDENTITIES WITH APPLICATION TO BOUNDING TECHNIQUES, by J. H. Bramble and B. E. Hubbard. Apr. 1961, 32p. (Technical note no. BN-241) (AFOSR-759) (In cooperation with Naval Ordnance Lab., Silver Spring, Md.) (AF 49(638)228) AD 256902 Unclassified

Also published in Jour. Research Nat'l. Bur. Stand., v. 65B: 261-268, 1961.

A certain class of integral identities is derived. These identities relate integrals of derivatives of a function u over the boundary C of a region R to integrals of derivatives of $\frac{u}{R}$. The highest order derivatives appear in the form of derivatives of a certain differential operator. An application of the identities to the problem of obtaining bounds for the derivatives of the solution of a certain boundary value problem is given. (Contractor's abstract)

1472

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

POINTWISE BOUNDS IN PARABOLIC AND ELLIPTIC PARTIAL DIFFERENTIAL EQUATIONS, by F. J. Bellar, Jr. May 1961, 148p. incl. refs. (Technical note no. BN-246) (AFOSR-760) (AF 49(638)228) AD 256984 Unclassified

A method is presented for obtaining explicit upper and lower pointwise bounds for the solution of rather general interior boundary value problems. The differential equations associated with these problems are of the elliptic type in certain sections while both linear and non-linear parabolic equations are the subject of investigation in other sections. The bounds which are obtained are in terms of the integrals of the squares of known functions and hence, in the linear case, improvement is possible using the Rayleigh-Ritz technique. (Contractor's abstract)

1473

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

ON A CLASS OF SINGULAR SOLUTIONS OF THE EULER-POISSON-DARBOUX EQUATION, by D. K. Suschowk. Apr. 1961, 30p. incl. refs. (Technical note no. BN-238) (AFOSR-634) (AF 49(638)228) AD 258929 Unclassified

Also published in Arch. Rational Mech. Anal., v. 11: 50-61, 1962.

The relations between a class of singular solutions of the Euler-Poisson-Darboux equation and the (regular) solutions of Weinstein-Lions are investigated. A modified radiation problem is formulated and reduced to Weinstein's generalized radiation problem. Finally, another problem is exhibited, which admits a uniquely determined solution in the case where neither the generalized nor the classical radiation problem has a non-trivial solution. This problem, moreover, is always possible, as long as the real part of the parameter occurring in the Euler-Poisson-Darboux equation is positive.

1474

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

BOUNDS FOR DERIVATIVES IN THE DIRICHLET PROBLEM FOR POISSON'S EQUATION, by J. H. Bramble and L. E. Payne. May 1961, 30p. (Technical note no. BN-248) (AFOSR-940) (AF 49(638)228) AD 258908 Unclassified

Also published in Jour. Soc. Indus. Appl. Math., v. 10: 370-380, June 1962.

Inequalities are derived which lead to pointwise bounds for derivatives of the solution of the Dirichlet problem for the Poisson equation. We obtain at interior points bounds for first and second derivatives which involve the undifferentiated data providing the boundary data are square integrable and the Laplacian of the function is Holder continuous in D. (Contractor's abstract)

1475

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

BOUNDS ON APSIDAL ANGLES, by F. T. Metcalf. July 1961, 58p. incl. refs. (Technical note no. BN-250) (AFOSR-967) (AF 49(638)228) AD 259978 Unclassified

A new technique is developed for obtaining upper and lower bounds on the apsidal angle which occurs in certain problems of mechanics. The motion of a particle on a surface of revolution may be shown to take place between 2 horizontal planes cutting the surface. The particle moves periodically from 1 level to the other and then back again. As the particle moves from the lowest level of motion to the highest, the corresponding increase in the azimuth is called the apsidal angle. For the spherical pendulum the bounds which are derived constitute the well-known inequalities of Puiseux and Halphen. In the case of the heavy symmetrical top the bounds obtained by W. Kohn are derived. In both instances the advantage of this method is a simplification due to the elimination of the need for contour integration. This technique also permits new cases to be considered; namely, the motion of a particle on a paraboloid of revolution and on a spheroid. A result concerning motion on an arbitrary surface of revolution is also obtained. (Contractor's abstract)

1476

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

A RECIPROCAL THEOREM FOR A FIRST ORDER THEORY OF ELECTROSTRICTION WITH SOME APPLICATIONS, by R. J. Knops. June 1961, 17p. (Technical note no. BN-249) (AFOSR-1007) (In cooperation with Brown U., Providence, R. I.) (AF 49(638)228) AD 260336 Unclassified

Also published in Zeitschr. Angew. Math. und Phys., v. 14: 148-155, Mar. 25, 1963.

A reciprocal theorem is presented for linear electrostriction. It is used to derive an integral representation for the displacement and expressions for the mean-value of the stresses and strains. (Contractor's abstract)

1477

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

ON POMPEIU'S PROOF OF THE MEAN VALUE THEOREM OF THE DIFFERENTIAL CALCULUS OF REAL VALUED FUNCTIONS, by A. K. Aziz and J. B. Diaz. June 1961, 27p. (Technical note no. BN-251) (AFOSR-1081) (In cooperation with Georgetown U., Washington, D. C.) (AF 49(638)228) AD 260451) Unclassified

Also published in Contrib. Differential Equations, v. 1: 467-481, 1963.

In a recent paper (item no. 980, Vol. III) the writers obtained a mean value theorem for vector valued functions of a real variable which plays a role analogous to that of Lagrange's mean value theorem in the differential calculus of real valued functions. This report contains an analysis of various methods for proving these theorems. (Contractor's abstract)

1478

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

ON THE FORMULATION OF FINITE DIFFERENCE ANALOGUES OF THE DIRICHLET PROBLEM FOR POISSON'S EQUATION, by J. H. Bramble and B. E. Hubbard. Sept. 1961, 35p. incl. diagrs. refs. (Technical note no. BN-257) (AFOSR-1404) (AF 49(638)228) AD 263808 Unclassified

Also published in Numer. Math., v. 4: 313-327, 1962.

Obtained in this analysis are some estimates of the type given by Gerschgorin. A general theorem is stated which can be used as a guide in the formulation of finite difference analogues of the Dirichlet problem for Poisson's equation. Various examples are given and analyzed. (Contractor's abstract)

1479

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

ON THE GEOMETRIC CHARACTER OF SINGULARITY

MANIFOLDS FOR HARMONIC FUNCTIONS IN THREE VARIABLES. I, by R. P. Gilbert. Sept. 1961, 18p. (Technical note no. BN-256) (AFOSR-1405) (AF 49-(638)228) AD 263809 Unclassified

Also published in Arch. Rational Mech. Anal., v. 9: 352-360, 1962.

The singularities of harmonic functions in three variables is investigated. This is done by considering harmonic functions generated by the Whittaker-Bergman operator, and the connections between the singularities of these functions and those of the associated functions of two complex variables. Several theorems are obtained concerning the nature of these singularities by using the methods of projective differential geometry. (Contractor's abstract)

1480

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-1497) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)228 and Naval Ordnance Lab.) AD 264737 Unclassified

Also published in Arch. Rational Mech. Anal., v. 10: 171-179, 1962.

Certain finite difference analogues are proposed for a class of Sturm-Liouville eigenvalue problems. It is shown that the eigenvalues of the related matrix problems differ from their counterparts in the Sturm-Liouville problem by $0(h^2)$ where h is the mesh size. The expressions in this bound are obtained explicitly in terms of the coefficients of the differential equation and their first derivatives. (Contractor's abstract)

1481

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

SOME UNIQUENESS THEOREMS IN THE THEORY OF ELASTICITY, by J. H. Bramble and L. E. Payne. Oct. 1961, 21p. incl. refs. (Technical note no. BN-261) (AFOSR-1530) (AF 49(638)228) AD 264661 Unclassified

Also published in Arch. Rational Mech. Anal., v. 9: 319-328, 1962.

It is known that in the first boundary value problem of classical elasticity the range of values of Poisson's ratio for which the solution is unique may be extended to include values outside the range of physical interest. It is shown that certain other interesting boundary value problems in classical elasticity have unique solutions for an extended range of values of Poisson's ratio. Such results may prove useful in non-linear elasticity. (Contractor's abstract)

1482

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

ON GENERALIZED AXIALLY SYMMETRIC POTENTIALS, by R. P. Gilbert. Oct. 1961, 22p. incl. diagrs. refs. (Technical note no. BN-262) (AFOSR-1613) (AF 49(638)-228) AD 267287 Unclassified

Also published in Jour. Reine und Angew. Math., v. 212: 158-168, 1963.

Certain properties of generalized axially symmetric potentials (GASP) are investigated by means of integral operator methods. A modified form of the residue theorem is obtained. In addition, the Hadamard criteria concerning the expansion coefficients of a meromorphic function and its singularities seem to hold also for GASP.

1483

Maryland U. [Inst. for Fluid Dynamics and Applied Mathematics, College Park.]

SOME ISOPERIMETRIC INEQUALITIES IN THE TORSION PROBLEM FOR MULTIPLY CONNECTED REGIONS, by L. E. Payne. [1961] [11]p. incl. refs. (Technical note no. BN-263) (AFOSR-1668) [AF 49(638)228] AD 266570 Unclassified

Also published in Studies in Mathematical Analysis and Related Topics: Essays in Honor of George Pólya, ed. by H. Chernoff, M. M. Shiffer and others. Stanford U. Press, 1962, p. 270-280.

A number of isoperimetric inequalities involving the solution of the torsion problem for multiply-connected cross sections are derived. It is indicated how these inequalities may be used to give maximum principles in certain types of boundary value problems. (Contractor's abstract)

1484

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

BOUNDS IN THE NEUMANN PROBLEM FOR SECOND ORDER UNIFORMLY ELLIPTIC OPERATORS, by J. H. Bramble and L. E. Payne. Nov. 1961, 17p. (Technical note no. BN-266) (AFOSR-1759) (AF 49(638)228) AD 267959 Unclassified

Also published in Pacific Jour. Math., v. 12: 823-833, Fall 1962.

In this analysis, lower bounds are established for certain eigenvalues. These inequalities lead to explicit a priori bounds in the Neumann problem for second order elliptic operators. (Contractor's abstract)

1485

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

SOME PROPERTIES OF GENERALIZED AXIALLY SYMMETRIC POTENTIALS, by R. P. Gilbert. Nov. 1961, 19p. incl. refs. (Technical note no. BN-265) (AFOSR-1854) (AF 49(638)228) AD 269071 Unclassified

Also published in Amer. Jour. Math., v. 84: 475-484, July 1962.

Some properties of the functions of generalized axially symmetric potential theory (GASPT) are investigated by the Sonine-Bergman operator. GASPT function elements are considered in the case of entire and meromorphic associates. Theorems concerning inequalities and location of singularities are obtained. (Contractor's abstract)

1486

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

A SCHWARZ LEMMA FOR AXIALLY SYMMETRIC POTENTIALS, by R. P. Gilbert. Dec. 1961, 13p. incl. refs. (Technical note no. BN-268) (AFOSR-1947) (AF 49(638)228) AD 270070 Unclassified

By using a special form of the Whittaker-Bergman operator, it is shown that the Schwarz-lemma is true in the case of axially symmetric potentials. (Contractor's abstract)

1487

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

ON THE UNIQUENESS PROBLEM IN THE SECOND BOUNDARY VALUE PROBLEM IN ELASTICITY, by J. H. Bramble and L. E. Payne. Dec. 1961, 16p. incl. refs. (Technical note no. BN-270) (AFOSR-1972) (AF 49-(638)228) AD 270211 Unclassified

Also published in Proc. Fourth U.S. Nat'l. Cong. of Appl. Mech., New York, Amer. Soc. Mech. Engineers, California U., Berkeley (June 18-21, 1962), v. 1: 469-474, 1962.

Kirchhoff's uniqueness proof shows that, if the shear modulus is different from zero and Poisson's ratio T lies in the interval (-1, 1/2), the second boundary value problem in elasticity (surface tractions prescribed) has a unique solution (up to a rigid body motion). A demonstration is given that for general domains uniqueness holds provided T lies in the interval (-1, 1-K/2(1 + K)), where K is a constant depending on the geometry of the region. If the bounding surface is star shaped, K is equal to zero. (Contractor's abstract)

1488

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

ON A MIXED BOUNDARY-VALUE PROBLEM FOR LINEAR HYPERBOLIC PARTIAL DIFFERENTIAL EQUATIONS IN TWO INDEPENDENT VARIABLES, by A. K. Aziz and J. B. Diaz. [1961] [28]p. incl. table, refs. (AFOSR-3156) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(6' ?)228, National Science Foundation, and Naval Ordnance Lab.) Unclassified

Also published in Arch. Rational Mech. Anal., v. 10: 1-28, 1962.

The hyperbolic equation $u_{xy} + au_x + bu_y + cu = d$, where a, b, c, d are continuous functions of (x,y) is considered. The following boundary-value problem is considered: Let R be a closed rectangle in the (x,y)-plane with sides parallel to the axes and opposite vertices at (0,0) and (x, y) in the first quadrant. Let Γ_1, Γ_2 be continuous curves issuing from the origin, with equations $y = f_1(x)$, $0 \le x \le x_0$, $x = f_2(y)$, $0 \le y \le y_0$, and lying entirely in R. It is required to find a solution in R of the differential equation, which is of class C′ with continuous mixed derivative u_{xy}, and which is subject to the boundary conditions $\alpha_0 u + \alpha_1 u_x + \alpha_2 u_y = \sigma$ on Γ_1; $\beta_1 u + \beta_1 u_x + \beta_2 u_y = t$ on Γ_2, $u(0,0) = \gamma$. The coefficients α_k, σ; β_k, t vary continuously on Γ_1, Γ_2 respectively. Existence and uniqueness theorems in each of three classes are obtained. In class I, α_1 and β_2 are non-vanishing; α_2 and β_1 vanish identically. In class II, α_1 and β_2 are non-vanishing; the coefficients satisfy compatability conditions at the origin. In class III, α_1, α_2, β_1, β_2 all vanish identically. In addition, a critique of previous solutions and purported solutions of a number of special cases of the boundary-value problems is presented. (Math. Rev. abstract)

1489

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

PROCEEDINGS OF THE SYMPOSIUM ON FLUID DYNAMICS AND APPLIED MATHEMATICS, Maryland U., College Park, Apr. 28-29, 1961, ed. by J. B. Diaz

and S. I. Pai. New York, Gordon and Breach Science Publishers, 1962, 207p. incl. illus. diagrs. refs. (AFOSR-5043) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)228] and National Science Foundation) Unclassified

Various aspects of fluid dynamics and applied mathematics are discussed. The topics covered are: nonlinear buckling of thin shells, turbulence, singular partial differential equations, differential equations of symmetric type, Landau damping, statistical properties of the product of a turbulent first order reaction, shock tubes and chemical kinetics, existence and uniqueness theorems for partial differential equations, and kinetic theory.

1490

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

SINGULAR PARTIAL DIFFERENTIAL EQUATIONS AND THEIR APPLICATIONS, by A. Weinstein. [1961] [21]p. incl. refs. (AFOSR-J383) (AF 49(638)228) AD 406449 Unclassified

Also published in Proc. Symposium on Fluid Dynamics and Applied Mathematics, College Park, Md. (Apr. 28-29, 1961), New York, Gordon and Breach Science Publishers, 1962, p. 29-49.

The equations discussed are mainly of the form $u_{tt} + (k/t)u_t + A(u) = 0$, where $u = u(x, t)$, $x = (x_1, \ldots, x_m)$, and A is a sufficiently regular differential operator in x vanishing for $u = 0$. Results include: singular equations of higher order, isoperimetric inequalities for the vibrating membrane, the generally axially symmetric Helmholtz equation and its fundamental solution, mean values and the Euler-Poisson-Darboux equation, subharmonic functions of higher order, the minimum principle for the wave equation, and convexity. (Math. Rev. abstract)

1491

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.

Let x be a mapping of a compact interval $\bar{I} = [a, b]$ into a (real or complex) normed space X which is differentiable in I and such that $\lim_{t \to a} x(t) = x(a)$, $\lim_{t \to b} x(t) = x(b)$. It is shown that under these assumptions there exists a $\xi \in I$ for which $\|[x(b) - x(a)]/(b-a)\| \leq \|x'(\xi)\|$. This result is used to prove the following uniqueness theorems for differential equations $x' = f(t,x)$ in which f is a mapping of $J \times X$ into X, where $J = (t_0, t_0 + a)$. Let $x_0 \in X$ be arbitrary. Suppose either there is a constant $L \geq 0$ such that $\|f(t,x) - f(t,x_1)\| \leq L\|x-x_1\|$ for every $t \in J$ and every x, x_1 in X, or $\|f(t,x)-f(t,x_1)\| \leq (t-t_0)^{-1}\|x-x_1\|$ for every $t \in J$ and every x, x_1 in X and f has a limit at (t_0, x_0). Then there is at most one continuous mapping x of $(t_0, t_0 + a)$ into X which is differentiable in J such that $x'(t) = f(t, x(t))$ for every $t \in J$ and $x(t_0) = x_0$. An analogous result is also proved when, in addition, the value of the derivative of x at t_0 is prescribed. (Math. Rev. abstract)

1492

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

EXISTENCE OF SOLUTIONS OF AN n^{-th} ORDER HYPERBOLIC PARTIAL DIFFERENTIAL EQUATION, by J. Conlan and J. B. Diaz. [1960] [13]p. (AFOSR-64-0359) (AF 49(638)228) AD 434506 Unclassified

Presented at meeting of the Amer. Math. Soc., Pasadena, Calif., Nov. 1960.

Also published in Contrib. Differential Equations, v. 2: 277-289, 1963.

The existence of a solution of the classical initial value problem for an ordinary differential equation can be proved by, among other methods, Picard's method of successive approximations, by the Euler-Cauchy polygon method, and by what may be called the method of Weierstrass approximating polynomials. In Picard's method, the function f(x,y) is assumed to be continuous in (x,y) and to satisfy a Lipshitz condition in the variable y; and it is proved that a solution of the given equation exists and is unique. In the Euler-Cauchy polygon method, the function f(x,y) is only assumed to be continuous, and the existence of at least one solution is proved (uniqueness need not hold in this case). In the third method the function f(x,y), as in the Euler-Cauchy polygon method, is only supposed to be continuous in (x,y). Hence, from Weierstrass' theorem concerning the approximation of continuous functions by polynomials, there is a sequence of polynomials which converges uniformly to f(x,y). By the Picard method of proof (or by any other method of proving existence of a solution of the given equation which employs the Lipshitz condition) it follows that there exists a sequence of solutions. The sequence on functions is equibounded and equicontinuous. (Contractor's abstract)

1493

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

A SPHERE THEOREM FOR THE EQUATIONS OF ELASTICITY, by J. H. Bramble. [1961] [6]p. [AF 49-(638)228] Unclassified

Published in Zeitschr. Angew. Math. und Phys., v. 12: 1-6, Jan. 25, 1961.

The problem of the sphere with an elastically supported boundary is treated. The solutions for the interior problem, rather than the exterior problem are given, although the two are not essentially different. The free and mixed boundary cases, given by Collins, are limiting cases of the elastically supported boundary. These are included also since the forms of the solutions are quite different from those given by Collins. The components of the displacement and stress are dealt with in rectangular coordinates and because of the symmetry of the sphere the 3 components of the displacement vector are given as a single indexed quantity. (Contractor's abstract)

1494

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

LOWER BOUNDS FOR EIGENVALUES, by N. W. Bazley. [1961] [19]p. incl. diagrs. tables, refs. (AF 49(638)228) Unclassified

Published in Jour. Math. and Mech., v. 10: 289-307, Mar. 1961.

A method is developed for finding lower bounds to the eigenvalues of semi-bounded self-adjoint operators. Following a modification of Aronszajn's procedure, it is shown that for a large class of operators the solution of the intermediate problems can be reduced to the determination of the roots of a secular equation. The actual computations consist of quadratures, inversion of a matrix, and computation of the eigenvalues of a matrix.

1495

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

ON THE CAPACITY OF THE ICOSAHEDRON, by J. Conlan, J. B. Diaz, and W. E. Parr. [1961] [3]p. (In cooperation with Naval Ordnance Lab., Silver Spring, Md.) [AF 49(638)228] Unclassified

Published in Jour. Math. Phys., v. 2: 259-261, Mar.-Apr. 1961.

An application of Dirichlet's principle, using a simple trial function suggested by the symmetries of the problem, is shown to furnish fairly close, readily computable, upper bounds for the capacity of any regular solid. (Contractor's abstract)

1496

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

CONTINUATION OF SOLUTIONS OF THE EQUATIONS OF ELASTICITY ACROSS A SPHERICAL BOUNDARY, by J. H. Bramble. [1961] [14]p. (In cooperation with Naval Ordnance Lab., Silver Spring, Md.) [AF 49(638)-228] Unclassified

Published in Jour. Math. Anal. and Appl., v. 2: 72-85, 1961.

The present paper deals with solutions, τ_{ij} (stresses), and u_i (displacements), of the equations of elasticity in 3 dimensions. Explicit formulas for continuation are given when Q (the boundary) is fixed, free, and elastically supported. Each case is treated by reducing it to a solution of Navier's equation which vanishes on Q. This in turn may be treated by means of a classical reflection principle for solutions of Laplace's equation. (Contractor's abstract)

1497

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

A NOTE ON HARMONIC FUNCTIONS IN (p + 2) VARIABLES, by R. P. Gilbert. [1961] [5]p. [AF 49(638)228] Unclassified

Published in Arch. Rational Mech. and Anal., v. 8: 223-227, 1961.

Let H be represented by the Whittaker-Bergman operator $(1/2\pi i)\int_L f(t, \zeta)d\zeta/\zeta$ in a sufficiently small neighborhood of a point X^0, where L is a regular contour in the ζ-plane, $t = \frac{1}{2}(-x_1 - ix_2)\zeta + x_3 + \frac{1}{2}(x_1 + ix_2)\zeta^{-1}$ and f is an analytic function of the complex variables t and ζ except on $t = \psi(\zeta)$ (ψ an analytic function of ζ). Then H is singular at X, X not on the x_3-axis, if and only if X satisfies, the equations $t - \psi(\zeta) = 0$ and $(\partial/\partial\zeta)(t - \psi(\zeta)) = 0$. (Math. Rev. abstract)

1498

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

INVESTIGATION OF THE FLOW THROUGH AXIAL FLOW COMPRESSOR ROTOR BLADES BY MEANS OF THE

ELECTRIC SPARK TECHNIQUE, by J. R. Weske and Y. Kageyama. Jan. 1961 [21]p. incl. illus. diagrs. (Technical note no. BN-228) (AFOSR-212) (AF 49-(638)385) AD 252038 Unclassified

Instantaneous flow patterns of subsonic flow past the blades of single stage axial flow compressor rotor were derived from multiple periodic spark traces. Processes of evaluation and of analysis were developed by which the characteristics of performance may be related to the particulars of interaction between the flow and the rotating blading system. Possibilities of extension of the technique of investigation to transonic and supersonic flow and to highly three-dimensional patterns are indicated. (Contractor's abstract)

1499

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

SHOCK WAVES IN RADIATION-MAGNETO-GAS DYNAMICS, by S. I. Pai and A. I. Speth. [1961] [17]p. incl. diagrs. (Technical note no. BN-223) (AFOSR-38) [AF 49(638)401] AD 249846 Unclassified

Also published in Phys. Fluids, v. 4: 1232-1237, Oct. 1961.

The general Rankine-Hugoniot relations for a normal shock wave in radiation-magnetogasdynamics are investigated. These relations differ considerably from those without radiation effects, particularly for the case that the gas is initially so hot that the radiation pressure is not negligible. For a given strength of the shock wave, the temperature jump across the shock with radiation effect is much smaller than that without radiation effect. Various limiting cases are discussed. In certain cases, the results may be expressed in terms of an effective ratio of specific heats and an effective gas pressure. A general method of solution by successive approximations is given and some numerical results are obtained. (Contractor's abstract)

1500

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

THE WAVE MOTIONS OF SMALL AMPLITUDE IN A FULLY IONIZED PLASMA. III. WITH A TRANSVERSE APPLIED MAGNETIC FIELD, by S. I. Pai. [1961]1v. incl. illus. (Technical note no. BN-235) (AFOSR-542) (AF 49(638)401) AD 254957 Unclassified

Wave motions of infinitesimal amplitude in a fully ionized plasma under a uniform transverse magnetic field have been analyzed by means of a 2-fluid theory. One basic transverse wave and 2 basic longitudinal waves, as they were found for the case without external magnetic field, appear to interact with one another through the influence of this applied magnetic field and there are 3 resultant waves. In an ideal plasma, in the low frequency range, only 1 of the 3 resultant waves is undamped. When the ion cyclotron frequency is much smaller than the ion plasma frequency, this undamped wave reduces to the effective sound wave of ordinary magnetogasdynamics. If the ion cyclotron frequency is not small, the speed of propagation of this wave is larger than the effective sound speed of magnetogasdynamics. On the very high frequency range, all the 3 waves are undamped. In a certain intermediate frequency range 2 of the waves are undamped. Finally the effects of finite electrical conductivity on these waves are briefly discussed. (Contractor's abstract)

1501

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

THE EFFECT OF COULOMB SCATTERING ON TWO-STREAM INSTABILITIES IN A PLASMA, by D. A. Tidman. [1961] 34p. incl. refs. (Technical note no. BN-242) (AFOSR-665) (AF 49(638)401) AD 255687 Unclassified

Also published in Phys. Fluids, v. 4: 1379-1386, Nov. 1961.

The effect of a small amount of 2-body scattering on the 2-stream instability that occurs in a plasma of contra-streaming electrons and ions is investigated mathematically. This is done by assuming the electron-ion collision frequency is small and making a perturbation expansion in this quantity. The Fokker-Planck scattering formula for the Coulomb interaction is used. As the ordered streaming energy of the electrons is thermalized enhanced Landau damping competes with the growth of the instability. (Contractor's abstract)

1502

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

DIFFUSION FROM A SLIGHTLY IONIZED REGION IN A UNIFORM FLOW, by A. C. Pipkin. Apr. 1961, 19p. (Technical note no. BN-240) (AFOSR-707) (AF 49(638)-401) AD 258226 Unclassified

Also published in Phys. Fluids, v. 4: 1298-1302, Oct. 1961.

A neutral gas is considered in steady one-dimensional motion, passing through a zone in which ionization takes place at a small given rate. The diffusion of the ions from the place where they are formed is investigated, with particular attention to the upstream diffusion. The neutral atom stream is regarded as a uniform background in which the ion diffusion takes place. Of great importance is the determination of the electric field which results from the diffusion of the ions and strongly

influences their motion. The application of the results to the case where a shock is present is discussed. (Contractor's abstract)

1503

Maryland U. Inst. for Fluid Dynamics and Applied Mathema[illegible] College Park.

ON TH[illegible]PLICATION OF TWO-PARTICLE DISTRIBUTION FUNCTIONS, by J. M. Burgers. [1961] 29p. (Technical note no. BN-243) (AFOSR-750) (AF 49(638)401) AD 258227 Unclassified

Also published in Proc. Symposium on Electromagnetics and Fluid Dynamics of Gaseous Plasma, New York (Apr. 4-6. 1961), Brooklyn, Polytechnic Press, v. 11: 81-96, 1962. (AFOSR-3388)

An expression for the electric conductivity of a fully ionized gas is derived by making use of the two-particle distribution function. The gas is subjected to a uniform time-independent electric field and magnetic fields are absent. The application of the two-particle distribution function is prompted by the hope that it will give a good evaluation of the aggregate effect of weak interactions, which in the case of Coulomb forces are more important than the effects of single collisions. The basic equation is the Boltzmann equation in which the usual expression for the effect of binary collisions is replaced by an integral depending upon the two-particle distribution function. (Contractor's abstract)

1504

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

THE USE OF A T-TUBE TO PRODUCE SHOCK-HEATED PLASMAS IN AN X-BAND WAVEGUIDE, by J. M. Schecher. [1961] 38p. incl. illus. (Technical note no. BN-245) (AFOSR-757) (AF 49(638)401) AD 258737 Unclassified

The shock wave produced by a T-tube with a sidearm expansion tube of 10-mm square cross section is investigated in order to determine whether it might be used to produce shock-heated plasmas in an X-band waveguide. Only weak shocks of Mach number less than 15 in argon at ambient pressures from 0.12 mm to 2 mm of mercury was studied. The theoretical and experimental results obtained by previous studies of strong shocks in T-tubes are applied to this tube where it is possible. Experimental studies were also made on the tube. At Mach numbers less than 16 the velocity of the shock front varies as the inverse square of the initial pressure and as the square of the applied voltage. The maximum volume of the shock-heated test plasma is found by theoretical considerations to be less than 1.2 cc. Drum camera pictures reveal the presence of additional fronts which move slightly faster than the shock front itself. Several shocks are produced by the ringing of the discharge circuit. A summary is given of the knowledge of the thermodynamic variables of the test gas behind the shock front which can be obtained from drum camera photographs. (Contractor's abstract, modified)

1505

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

THE INTERACTION BETWEEN A MAGNETIC FIELD AND AN ELECTRICALLY PRODUCED SHOCK WAVE, by J. P. Barach. [July 1961] 66p. incl. illus. tables. (Technical note no. BN-255) (AFOSR-1381) [AF 49-(638)401] AD 263247 Unclassified

Also published in Phys. Fluids, v. 4: 1474-1477, Dec. 1961.

Shock wave flows of speeds up to 1 cm/μ sec in krypton have been observed to interact with a magnetic field of 5700 gauss. A reflected shock is observed and the deceleration of the flow is measured. Gas flows of up to Mach 63 are produced by an annular electric shock tube powered by a discharge of long time constant. A radial magnetic field provides closed paths within the gas flow for the induced currents. The speed of the wave reflected off the magnetic field is found to increase with interaction strength. The flow momentum lost per particle as the flow traverses the field region, is calculated and compared to the impulse delivered each particle by the magnetic field. Agreement is found over a wide range of experimental conditions, validating the magnetohydrodynamic picture of the interaction and the use of the scalar gas conductivity. (Contractor's abstract)

1506

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics College Park.

CONSIDERATIONS ON THE OPTICS OF THE INTEGRATING SCHLIEREN INSTRUMENT, by P. C. T. de Boer and J. M. Burgers. Sept. 1961, 66p. incl. diagrs. (Technical note no. BN-258) (AFOSR-1857) (AF 49-(638)401) AD 268915 Unclassified

An analysis is presented of the optics encountered in the integrating schlieren arrangement as first described by Resler and Scheibe. Expressions were developed for the signal which will be received on the photomultiplier, both for the instrumentation using an inclined knife edge and for that which uses a vertical knife edge. Attention is given to the conditions which must be satisfied to guarantee that the response of the photomultiplier shall be proportional to the difference in refractive index at the beginning and the end of the test section. The signal to be expected in the case of a sudden discontinuity in refractive index, which is partly reflecting, partly transmitting, was calculated and is compared with the signal

obtained with a continuous change of refractive index. Throughout the analysis it is supposed that lens aberrations can be neglected and that diffraction phenomena may be left out of account. (Contractor's abstract)

1507

Maryland U. [Inst. for Fluid Dynamics and Applied Mathematics] College Park.

THE TWO-FLUID THEORY OF MAGNETOGASDYNAMICS AND ITS APPLICATIONS TO WAVE MOTION, by S. I. Pai. [1961] [19]p. incl. diagrs. (AFOSR-2405) (AF 49(638)401) Unclassified

Also published in Developments in Mechanics; Proc. of Seventh Midwestern Mechanics Conf., Michigan State U. (Sept. 6-8, 1961), New York, Plenum Press, v. 1: 484-502, 1961.

Some basic concepts of multifluid theory of magnetogasdynamics, especially the 2 fluid theory for the case of a fully ionized plasma are discussed. The relations between the 2-fluid theory and the "classical" single-fluid theory are analyzed and the limitations of the classical single-fluid theory are described explicitly. The 2-fluid theory is then applied to the investigation of wave motions of small amplitude in a fully ionized plasma under an arbitrarily orientated uniform magnetic field. It has been found that the interactions between plasma oscillations (which are not obtained in the single-fluid theory) and sound waves and Alfven waves are very important. They significantly affect the resultant wave motion, especially when both the frequency of the wave and the magnetic field strength are large. (Contractor's abstract, modified) P

1508

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

GASDYNAMIC EFFECTS ON ELECTRIC CURRENT DENSITY IN MAGNETOGASDYNAMICS, by S. I. Pai. [1961] [1]p. (AFOSR-2812) (AF 49(638)401) Unclassified

Also published in Jour. Aero/Space Sci., v. 29: 483-484, Apr. 1962.

In order to show the effect of the gasdynamic forces on the electric current density as well as the final flow field, a comparison is made between the results of a flow problem based on classical magnetogasdynamics and the corresponding results based on the 2-fluid theory of magnetogasdynamics. A uniform stream of a fully ionized plasma consisting of electrons and singly charged ions of a velocity U and under a uniform magnetic field of strength H_x in the direction of the U, passing over a thin body is considered. The flow is assumed to be 2-dimensional and steady so that all variables are functions of spatial coordinates x and y only. The fluid is assumed to be an ideal plasma which is inviscid, non-heat-conducting and infinitely electrically conducting.

1509

Maryland U. [Inst. for Fluid Dynamics and Applied Mathematics] College Park.

ON LANDAU DAMPING IN A FULLY IONIZED PLASMA AND ITS COMBINATION WITH COLLISIONAL DAMPING, by J. M. Burgers. [1961] [25]p. (AFOSR-J740) (AF 49-(638)401) Unclassified

Also published in Proc. Symposium on Fluid Dynamics and Applied Mathematics, College Park, Md. (Apr. 28-29, 1961), New York, Gordon and Breach Science Publishers, 1962, p. 79-103.

The purpose of the paper is to deduce the dispersion equation for free electron oscillations in a fully ionized plasma, not influenced by a magnetic field, the positive ions being fixed, without making use of integrals in a complex plane; and to find out how a small collisional damping combines with the Landau damping. For this purpose the Boltzmann equation for the electrons, with a collision term modeled on the linear approximation of Bhatnagar and Krook, is solved with an initial condition for the perturbation of the distribution function. It is asked how the initial condition must be chosen in order that free oscillations with a given spatial frequency shall result. The application of Poisson's equation gives a Fourier transform of the perturbation function; the condition that this transform must vanish at infinity leads to the dispersion equation. This equation is expressed by means of integrals over real variables, and combines terms responsible for Landau damping with terms dependent upon the collision frequency. The solution of this equation is discussed; for the case of vanishing collision frequency it agrees with the usual results for the electron plasma frequency and the Landau damping. (Contractor's abstract)

1510

Maryland U. [Inst. for Fluid Dynamics and Applied Mathematics, College Park]

SHOCK WAVES IN RADIATION-MAGNETOGASDYNAMICS (Abstract), by S. I. Pai and A. I. Speth. [1961] [1]p. [AF 49(638)401] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 41, Feb. 1, 1961.

The general Rankine-Hugoniot relations of a shock wave including both the electromagnetic forces and the radiation effect are presented. These results differ

considerably from those without radiation effect. It has been known that if the shock strength is very large, the radiation effect on the shock wave is noticeable. From the results, it is found that even the shock strength is very weak; the shock wave relations with radiation effect differ considerably from those without radiation effect, provided that the initial temperature of the medium is very high and that the radiation parameter is not small. The main effect of radiation on the shock wave is that the jump of temperature across a shock is reduced greatly because of the radiation effect. Some numerical examples were presented.

1511

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

STABILITY AND TRANSITION OF THE FREE-CONVECTION LAYER ALONG A VERTICAL FLAT PLATE, by A. A. Szewczyk. May 1961, 82p. incl. illus. diagrs. table, refs. (Technical note no. BN-247) (AFOSR-765) (AF 49(638)645) AD 258750 Unclassified

Presented at Eighty-second Winter annual meeting of the Amer. Soc. Mech. Engineers, New York, Nov. 26-30, 1961. (Paper no. 61-WA-338)

Also published in Internat'l. Jour. Heat and Mass Transfer, v. 5: 903-914, Oct. 1962.

The free-convection layer along a vertical flat plate is investigated theoretically and experimentally with a view to studying its instability and natural transition from laminar to turbulent flow. Stability calculations are carried out based upon the small perturbation theory for the exact velocity profile for the Prandtl number 10. Temperature profiles are measured along a vertical electrically-heated brass plate. By the use of a dye technique the natural transition mechanism is investigated, i.e., discrete vortex lines and their subsequent distortion into 3-dimensional pattern and eventual breakdown is carefully studied. In addition a double-row vortex system, which arises in the free-convection layer, is investigated. Its mechanics and over-all effect on the stability and transition of the free-convection layer are discussed. (Contractor's abstract)

1512

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

STREAKLINES IN A PERTURBED SHEAR FLOW, by F. R. Hama. [1961] [7]p. incl. diagrs. (AFOSR-1795) (AF 49(638)645) Unclassified

Presented at meeting of the Amer. Phys. Soc., Berkeley, Calif., Nov. 20-22, 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 7: 370, Apr. 23, 1962.

Also published in Phys. Fluids, v. 5: 644-650, June 1962.

Streaklines are numerically obtained for a shear flow perturbed by an unamplifying traveling sinusoidal wave. It is shown that, if a dye is injected from near the critical layer, the streaklines have an appearance of amplification and rolling as if to indicate that the flow develops into discrete vortices. The rolling-up of a streakline cannot therefore constitute a positive identification of the presence of discrete vortices. Away from the critical layer, the streaklines appear to show an alternating amplification and damping. Apparent wavelength and wave velocity are both incorrect except in the critical layer. Further, any information due to pathlines or obtained by tracing marked particles is equally improper in regard to the wave motion.

1513

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

PRODUCTION OF SECONDARY VORTICES IN THE FIELD OF A PRIMARY VORTEX, by J. R. Weske and T. M. Rankin. Apr. 1961, 24p. incl. illus. (Technical note no. BN-244) (AFOSR-623) (AF AFOSR-61-3) AD 255688 Unclassified

Conjectures based upon observations of the decay of larger vortices in shear flow, such as those which occur during transition in boundary layers, were confirmed when a range of secondary vortices were produced by imposing divergence upon the vortex tube in 2 controlled experiments for steady and nonsteady flow, respectively. Secondary vortex patterns were analyzed theoretically and experimentally. These flow patterns represent a possible mechanism for the transfer of energy from primary vortices to motions of higher wave number. (Contractor's abstract)

1514

Massachusetts General Hospital. [Neurophysiological Lab.] Boston.

THE EEG IN OPEN-HEART SURGERY AND IN SURGERY FOR AORTIC AND CEREBRAL ANEURYSMS, by M. A. B. Brazier. [1959] [12]p. incl. diagrs. refs. (In cooperation with Harvard Medical School, Cambridge, Mass. and Massachusetts Inst. of Tech., Cambridge) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)98], Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], National Institute of Neurological Diseases and Blindness, and Office of Naval Research) Unclassified

Published in Cerebral Anoxia and the Electroencephalogram, Internat'l. Colloq. on Anoxia and the EEG, Marseille (Oct. 5-9, 1959), Springfield, Ill., Charles C. Thomas, 1961, p. 256-267.

Experience in recording the EEG's of human subjects with extracorporeal circulation leads to the conclusion that there need be no adverse effect on the brain but that it is desirable to monitor the EEG for the unexpected mishap. In operations at normal body temperatures it has been found that slowing of the EEG is most usually the sign of hypoxia, though if this becomes severe it will be followed by flattening. A sudden drop of amplitude without the intermediate stage of slow waves is more usually the sign of acidosis, and gives the appearance of an activated record. A rather sharp and oversimplified differentiation has been made in this report between the effects of hypoxia and hypercapnia in these cases, but it shoud be remembered that the living organism will not tolerate the isolation of a single variable, and as soon as one factor begins to change, compensatory mechanisms are marshalled by the body to restore homeostasis. Artificial manipulations with hypothermia and anesthesia impede and impair but do not abolish the restoration of this balance, and hence it would be an exaggeration to describe a given EEG change as solely due to hypoxia and another as solely due to CO_2 accumulation. The differentiation suggested here is presented for what practical use it may be to electroencephalographers charged with monitoring cases in the operating room. (Contractor's abstract, modified)

1515

Massachusetts General Hospital. Neurophysiological Lab., Boston.

THE EFFECTS OF METHAMPHETAMINE AND PENTOBARBITAL ON TWO MEASURES OF ATTENTION, by G. C. Quarton and G. A. Talland. [1961] [6]p. incl. tables. (AFOSR-64-0169) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)-98 and National Institute of Mental Health)
AD 432740 Unclassified

Also published in Psychopharmacologia, v. 3: 66-71, 1962.

Subjective reports from patients and clinical observations suggest that some drugs which act on the central nervous system modify man's capacity to attend maximally to environmental stimuli. This paper is a report of a study of the effects of methamphetamine, pentobarbital, and saline placebo, administered intravenously, in a double-blind experimental situation on 2 parameters of attention in human subjects. A test of running memory span was used to measure the efficiency of short term storage of simple stimuli, 1 limit of man's capacity to process information. The Stroop test was used as a measure of the breadth of focus of attention in a replication of a study carried out by Callaway. This investigation was undertaken with the twofold objective of contributing to an understanding of these drugs and of clarifying the concept of attention. (Contractor's abstract)

1516

[Massachusetts Inst. of Tech., Cambridge]

HYPERSONIC FLOW RESEARCH: INTERNATIONAL HYPERSONICS CONFERENCE, Massachusetts Inst. of Tech., Cambridge, Aug. 16-18, 1961, ed. by F. R. Riddell. New York, Academic Press, 1962, 758p. incl. illus. diagrs. tables, refs. Unclassified

Published in Prog. in Astronaut. and Rocketry, v. 7: 1-758, 1962.

Five main topics were treated at this conference: (1) hypersonic flow at low Reynolds number, (2) chemical kinetic effects in hypersonic flow, (3) inviscid hypersonic flow, (4) experimental problems in hypersonic flow research, and (5) experimental problems dealing with the extreme conditions encountered by hypersonic vehicles.

1517

Massachusetts Inst. of Tech., Cambridge.

THE PERCEPTION OF PAIN, by R. Melzack. [1961] [9]p. incl. illus. diagrs. (AFOSR-1388) (AF 49(638)898) Unclassified

Also published in Scient. Amer., v. 204: 41-49, Feb. 1962.

Psychological evidence strongly supports the view of pain as a perceptual experience whose quality and intensity is influenced by the unique past history of the individual, by the meaning he gives to the pain-producing situation and by his state of mind at the moment. It is believed that all these factors play a role in determining the actual patterns of nerve impulses ascending to the brain and traveling with the brain itself. In this way pain becomes a function of the whole individual, including his present thoughts and fears as well as his hopes for the future.

1518

Massachusetts Inst. of Tech., Cambridge.

PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON HIGH MAGNETIC FIELDS, Cambridge, Mass., Nov. 1-4, 1961, ed. by H. [H.] Kolm, B. Lax and others. Cambridge, M.I.T. Press and New York, Wiley and Sons, 1962, 751p. incl. illus. diagrs. tables, refs. (AFOSR-2299) (AF AFOSR-61-31) AD 622614 Unclassified

High magnetic field reports are presented. They are grouped into 4 main divisions: (1) design of high field solenoids and supporting systems (field analysis and synthesis, continuous field magnets and power supplies, supeeconducting magnets, and transient field magnets and energy supplies), (2) high-magnetic-field research programs, (3) solid-state and low-temperature physics in high magnetic fields (resonance and oscillatory phenomena, magnetism and transport phenomena and superconducting materials), and (4) plasma and fusion physics in high magnetic fields.

1519

Massachusetts Inst. of Tech. Aeroelastic and Structures Research Lab., Cambridge.

TENSILE DEFORMATION AND FRACTURE OF BRAZED JOINTS, by W. G. Moffatt and J. Wulff. Sept. 1961 [11]p. incl. illus. diagrs. tables, refs. (ASRL-TR-94-1) (AFOSR-2292) (AF 49(638)775) AD 275282 Unclassified

Presented at Nat'l. fall meeting of the Amer. Welding Soc., Milwaukee, Wis., Oct. 1-4, 1962.

Also published in Welding Jour. Research Suppl., p. 115s-125s, Mar. 1963.

A study is being made on the nature of stress distribution in the brazed joint and the mechanism of joint failure. The tensile deformation of a prototype composite material, the brazed joint, was measured. Highly localized non-uniform straining in the axial direction was observed. Cleavage facets were detected on fracture surfaces in the case of silver filler and void formation in the case of lead filler, using mild steel as the base material. These voids, as indicated in microradiographs, are elongated and have a preferred orientation within an individual grain; it is suspected that the x-ray indications are of voids which originated in small patches of brittle fracture and opened up by plastic deformation, rather than of voids which nucleated and grew entirely by plastic deformation. (Contractor's abstract)

1520

Massachusetts Inst. of Tech. Aeroelastic and Structures Research Lab., Cambridge.

THE TRANSVERSE DEFORMATION OF DOUBLE BEAMS, by C. G. B. Mitchell. Sept. 1961, 33p. incl. diagrs. (ASRL-TR-100-1) (AFOSR-1477) (AF 49(638)-985) AD 265206 Unclassified

The response is analyzed of double beams to impulsive loads when the beams are joined together at either end and the pair is simply supported. The material of the two beams is assumed to exhibit rigid-plastic behavior. It is found that the effect of the end loads induced in the beams by their deformations have a comparatively small effect on the motions and final displacements of the two beams. Graphs are included to enable a particular system to be analyzed with a minimum of effort. (Contractor's abstract)

1521

Massachusetts Inst. of Tech. [Aerophysics Lab.] Cambridge.

THERMAL EFFECTS ON A TRANSPIRATION COOLED HEMISPHERE, by A. F. Golinick, Jr. [1961] [9]p. incl. diagrs. (AFOSR-137) (AF 49(638)245) AD 255911 Unclassified

Also published in Jour. Aerospace Sci., v. 29: 583-590, 595, May 1962.

An approximate method is used to obtain the injection distribution which would exist on an isothermal, transpiration-cooled hemisphere in a supersonic stream. This distribution is the same for both air and helium injection, and is independent of the blowing level. A model having this distribution was tested at a Mach number of 3.53. It is concluded that the design technique is reasonably accurate. Data taken near the nose are compared with the theories for helium and air injection. The agreement in the case of the reduction in heat-transfer coefficient is good. The values of insulated wall temperature obtained near the nose with helium injection are 8% above the local stagnation temperature and largely independent of injection rate. It is believed that this phenomenon may be attributed to the thermal diffusion of the helium within the boundary layer. Air injection causes a slight reduction in the insulated wall temperature. It is shown that injection of either air or helium at the hemisphere nose considerably reduces the heat flux at the surface. The additional reduction in the flux resulting from helium injection as opposed to air injection, and predicted by existing theory is largely absent. (Contractor's abstract)

1522

Massachusetts Inst. of Tech. Aerophysics Lab., Cambridge.

AN INTEGRAL METHOD FOR LAMINAR BOUNDARY LAYER CALCULATIONS: MOMENTUM THICKNESS AND MASS TRANSFER WITH ZERO PRESSURE GRADIENT, by F. E. C. Culick. July 1961, 37p. incl. diagrs. refs. (Technical rept. no. 10) (AFOSR-1411) (AF 49-(638)245) AD 265771 Unclassified

Work by Rott and Crabtree and by Hill is the basis of an integral method solution to the equation for the concentration of species in the binary mixture boundary layer. The principal result is a relatively simple integral relationship between wall concentration and surface mass transfer rate for arbitrary mass transfer distributions. Only the case of helium injection into an undissociated airstream, with zero pressure gradient,

is treated in detail but the method can be applied to problems involving other gases. The results agree quite well with exact similarity solutions and with numerical results for the problem of a solid leading edge followed by a porous region. Solution to the upstream-mass-transfer-problem is also obtained easily. (Contractor's abstract)

1523

Massachusetts Inst. of Tech. Aerophysics Lab., Cambridge.

THERMODYNAMIC COUPLING IN BOUNDARY LAYERS, by J. R. Baron. Oct. 1961 [29]p. incl. diagrs. refs. (Technical rept. no. 28) (AFOSR-1693) (AF 49-(638)245) AD 273308 Unclassified

Presented at ARS Space Flight Report to the Nation, New York, Oct. 9-15, 1961.

Also published in ARS Jour., v. 32: 1053-1059, July 1962.

Experimental results gathered in recent years for binary mixture mass transfer models are shown to yield consistent evidence of discrepancies with analytic considerations. Specifically, measured recovery temperatures are appreciably higher than those predicted, while heat transfer coefficients are satisfactorily reproduced. It is shown on the basis of both approximate and exact solutions for plates and stagnation points that the discrepancies are related to thermal diffusion effects, a major influence being apparent in application of the surface boundary condition for an adiabatic wall. As a result, some reexamination is necessary of past criteria for mass addition effects as they pertain to specific injected media. A prime example is the "equivalence" of helium and air as coolants despite the heretofore suggested preference for low density injectants on a perfect gas basis.

1524

Massachusetts Inst. of Tech. Aerophysics Lab., Cambridge.

AN INTEGRAL METHOD FOR LAMINAR BOUNDARY LAYER CALCULATIONS: HEAT AND MASS TRANSFER WITH ZERO PRESSURE GRADIENT, by F. E. C. Culick. Dec. 1961, 48p. incl. diagrs. refs. (Technical rept. no. 16) (AFOSR-2146) (AF 49(638)245) AF 275145 Unclassified

An integral method previously used successfully in several kinds of boundary layer problems has been extended to cover simultaneous heat and mass transfer in a binary mixture boundary layer when the pressure is uniform. The principal result is a pair of dual integral relationships connecting the surface temperature and heat transfer rate in the presence of surface mass transfer. In particular these formulas are applied to the leading edge cooling problem in which a finite injection region is followed downstream by an insulated impermeable surface. The approximate results agree quite well with measurements on a cone, for both helium and air injection, and with a numerical solution for air injection. (Contractor's abstract)

1525

Massachusetts Inst. of Tech. Dept. of Aeronautics and Astronautics, Cambridge.

OPTIMUM SOFT LANDING TRAJECTORIES. PART I. ANALYSIS, by L. J. Berman. Mar. 30, 1961, 29p. incl. tables. (AFOSR-519, Pt. 1) (AF 49(638)363) AD 258668 Unclassified

A variational calculus solution is obtained for the thrust program for minimum propellant consumption to achieve landing of a rocket vehicle from a space orbit with zero relative velocity at touchdown, under the simplifying assumptions of no atmospheric forces and a uniform (i.e., flat-earth) gravitational field. These assumptions are appropriate for lunar landing of a moderately high thrust rocket. The results of the variational solution are interpreted to provide an appreciation of the physical nature of the requirements established by different initial conditions, as specified by initial altitude and velocity vector. Representing the initial conditions parametrically by an equivalent energy altitude and the actual altitude, five different regimes are identified and the corresponding thrust programs described. (Contractor's abstract)

1526

Massachusetts Inst. of Tech. Dept. of Aeronautics and Astronautics, Cambridge.

OPTIMUM SOFT LANDING TRAJECTORIES. PART II. NUMERICAL RESULTS, by L. J. Berman. [Oct. 31, 1961] [33]p. incl. diagrs. tables. (AFOSR-519, Pt. 2) (AF 49(638)363) AD 267881 Unclassified

The optimum steering program for landing on an airless body is examined numerically with particular emphasis on the change in the form of the steering program and the degradation of performance under the influence of a restraint on the ignition altitude. It is found that for ignition altitudes not far below the optimum, the performance loss is small, and that the ignition altitude for which the optimum steering program is at a constant angle falls within this range. Thus it is concluded that the constant-thrust-angle trajectory is optimum in an operational system. This conclusion is valid only for relatively steep approach trajectories. (Contractor's abstract)

1527

Massachusetts Inst. of Tech. Dept. of Aeronautics and Astronautics, Cambridge.

OPTIMUM SOFT LANDING TRAJECTORIES, by L. J. Berman. [1961] [15]p. incl. diagrs. table, refs. (AF 49-(638)363) Unclassified

Published in Proc. Twelfth Internat'l. Astronaut. Cong., Washington, D. C., (Oct. 1961) Vienna, Springer-Verlag and New York, Academic Press, v. 1: 353-367, 1963.

The problem of optimizing the landing trajectory of a rocket vehicle on an airless planet is considered. Under simplifying assumptions, the variational calculus yields an analytic solution to the steering program, and shows that the thrust program is of the on-off type, consisting of at most 2 sub-arcs. The absolute optimum trajectory is determined, and local optima are found for the cases when the actual altitude for starting the control process is less than the absolute optimum. In the real situation, it is found that the "absolute optimum" defined using the approximations is not only not the absolute optimum, but is not even the best member of the simple family. More important, however, the use of a constant thrust-angle trajectory causes only very small losses. Since this trajectory requires the simplest control system, it is, from a practical point of view, the optimum trajectory. (Contractor's abstract)

1528

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

HOMOTOPY ASSOCIATIVITY OF H-SPACES. I, by J. D. Stasheff. [1959] [18]p. incl. diagr. refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)42] and Marshall Aid Commemorative Commission) Unclassified

Presented at Sixty-fifth annual meeting of the Amer. Math. Soc., Philadelphia, Pa., Jan. 20-22, 1959. (Title varies)

Presented at 557th meeting of the Amer. Math. Soc., New York, Apr. 23-25, 1959. (Title varies)

Published in Trans. Amer. Math. Soc., v. 108: 275-292, Aug. 1963.

The author defines a nested sequence of homotopy associativity conditions and calls a space an A_n-space if it satisfies the n-th condition. Every space is an A_1-space, every H-space is A_2, and every homotopy associative H-space is A_3. The main result is that a space is an A_n-space if and only if it admits an A_n-structure. (Math. Rev. abstract)

1529

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

HOMOTOPY ASSOCIATIVITY OF H-SPACES. II, by J. D. Stasheff. [1959] [20]p. incl. refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)42] and Marshall Aid Commemorative Commission) Unclassified

Presented at Sixty-fifth annual meeting of the Amer. Math. Soc., Philadelphia, Pa., Jan. 20-22, 1959. (Title varies)

Presented at 557th meeting of the Amer. Math. Soc., New York, Apr. 23-25, 1959. (Title varies)

Published in Trans. Amer. Math. Soc., v. 108: 293-312, Aug. 1963.

The author defines the tilde construction, an algebraic analogue of the geometric construction, which bears the same relation to the geometry involved as the bar construction has to the Dold-Lashof construction. Homology constructions called the Yessam operations are defined. These are analogous to the Massey operations in cohomology. In addition, maps of A_n-spaces are defined and studied. Several applications are made to the suspension homomorphism in cohomology and to 2-stage Postnikov systems. (Math. Rev. abstract)

1530

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

ON HOMOTOPY ABELIAN H-SPACES, by J. D. Stasheff. [1961] [12]p. incl. refs. (AFOSR-587) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)42 and Marshall Aid Commemorative Commission) AD 258250 Unclassified

Also published in Proc. Cambridge Philos. Soc., v. 57: 734-745, 1961.

Given an H-space X with multiplication $m : X \times X \to X$, the X-projective plane $XP(2)$ is defined as follows: Let $p: E \to SX$ be the quasi-fibration of Dold and Lashof in which E has the homotopy type of $X * X$. Then $XP(2) = CEU_p SX$, the collapsed mapping cyclinder of the map p. Criteria for X to be homotopy abelian are given in terms of $XP(2)$, and by using them it is shown that the space of loops on complex projective 3-space is homotopy abelian. (Math. Rev. abstract)

1531

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

ON MAXIMAL SOLUTIONS OF THE CAUCHY INITIAL

VALUE PROBLEM (FOR INTEGRAL MANIFOLDS OF NON-INVOLUTIVE DISTRIBUTIONS), by P. L. Dombrowski. June 1961, 33p. (AFOSR-888) (AF 49-(638)42) AD 260745 Unclassified

This analysis is mainly concerned with the problem of determining integral manifolds of non-involutive distribution on manifolds, more precisely how to obtain by the methods of Cauchy characteristic from a given initial, low dimensional integral manifold a higher dimensional integral manifold, which includes the initial one. The main objective is to investigate, under which conditions one may get by this procedure a maximal integral manifold. (Contractor's abstract)

1532

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

ON SUPER-POTENTIALS IN THE THEORY OF NEWTONIAN GRAVITATION, by S. Chandrasekhar and N. R. Lebovitz. [1961] [10]p. (AFOSR-3293) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)42 and Office of Naval Research) Unclassified

Also published in Astrophys. Jour., v. 135: 238-247, Jan. 1962.

The character of the gravitational equilibrium of bodies in rotation and with prevalent magnetic fields depends on the tensor potential,

$$\mathfrak{B}_{ij} = G \int_V \rho(x') \frac{(x_i - x'_i)(x_j - x'_j)}{|x - x'|^3} dx',$$

and the associated tensors,

$$\mathfrak{B}_{ij} = -\frac{1}{2} \int_V \rho \mathfrak{B}_{ij} dx \text{ and } \mathfrak{B}_{pq,ij} = \int_V \rho x_p \frac{\partial \mathfrak{B}_{ij}}{\partial x_q} dx.$$

This paper is devoted to a consideration of these fundamental tensors. It is shown, in particular, that the tensor potential can be expressed in the form

$$\mathfrak{B}_{ij} = \mathfrak{B}\delta_{ij} + \frac{\partial^2 \chi}{\partial x_i \partial x_j},$$

where $\mathfrak{B}$ is the gravitational potential as usually defined and χ is a super-potential determined by the equation

$$\nabla^2 \chi = -2\mathfrak{B}.$$

1533

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

EIGENVALUES OF JORDAN PRODUCTS, by W. G. Strang. [1961] [4]p. (AFOSR-3296) (AF 49(638)42) Unclassified

Also published in Amer. Math. Monthly, v. 69: 37-40, Jan. 1962.

The problem is to bound the eigenvalues of AB + BA, where A,B are Hermitian matrices with eigenvalues in the intervals $m \le \lambda(A) \le M$, $n \le \lambda(B) \le N$. The eigenvalues are the extreme values of $((AB + BA)x, x)$, x a vector of unit length. The author associates with the matrix A and the vector x another unit vector y and a real constant $0 \le \rho \le 1$ such that $Ax = mx + \rho(M-m)(x,y)y$; similarly, a vector z and a constant ρ' for B. A transformation of the three vectors thus involved to an orthogonal triad yields ultimately a simple expression in two variables whose extreme values have to be studied. These turn out to be either the expected cases 2MN, 2Mn, 2mN, 2mn or $[16\,MmNn-(M-m)^2(N-n)^2]/4(M+m)(N+n)$. The author also studies AB - BA and the set of all (Ax, Bx) for m = 0, M=1=N. (Math. Rev. abstract)

1534

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

COMMUTING BOOLEAN ALGEBRAS OF PROJECTIONS, by C. A. McCarthy. [1959] [13]p. (AFOSR-3297) (AF 49(638)42) Unclassified

Also published in Pacific Jour. Math., v. 11: 295-307, 1961.

Let X be a Banach space, E and F two bounded Boolean algebras of projection on X such that EF = FE for all $E \in E$, $F \in F$. Let G be the Boolean algebra of projections generated by E on F. In general, G is not bounded. A case when G is bounded has already been given by J. Werner (Pacific Jour. Math., v. 4: 355-361, 1954). In the present paper another such case is given. For this it is assumed that E is complete in the sense of W. G. Bade (Trans. Amer. Math. Soc., v. 80: 345-360, 1955) and fulfills a certain condition of finite spectral multiplicity. (Math. Rev. abstract)

1535

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

AN INTERPRETATION OF DOUBLE PERIODS IN BETA CANIS MAJORIS STARS, by S. Chandrasekhar and N. R. Lebovitz. [1961] [2]p. (AFOSR-3298) (AF 49(638)42) Unclassified

Also published in Astrophys. Jour., v. 135: 305-306, Jan. 1962.

The heat phenomena observed in several β Canis Majoris stars, indicating two oscillations with nearly equal frequencies is not satisfactorily understood. It is suggested that one of the frequencies corresponds to a second-order harmonic deformation and the other to a radial expansion and contraction.

1536

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

ON GLOBAL SOLUTIONS FOR PARTIAL DIFFERENTIAL EQUATIONS OF FIRST ORDER, by P. Dombrowski. [1960] [4]p. (AFOSR-65-0086) (AF 49-(638)42) Unclassified

Also published in Bull. Amer. Math. Soc., v. 67: 202-205, Mar. 1961.

A theorem is presented and carried through to a proof which guarantees the existence and uniqueness of a global solution for the Cauchy initial value problem for a complete, regular system of partial differential equations of the first order for one unknown function on a manifold—all data being of class C^{∞}. This result depends on one hand on an investigation of the following problem for a m-dimensional C^{∞}-manifold W, which is foliated by r-dimensional leaves, the leaf passing through $w \in W$ being denoted by $C_{(w)}$: Given a k-dimensional submanifold A of W with $k + r \leq m$, find a foliated C^{∞}-manifold S and a C^{∞}-immersion $j : S \to W$ such that (i) $j(S) = U_{a \in A} C_{(a)}$, (ii) each leaf of S is mapped under j onto a leaf of W. Concerning this problem it is proved that: If for all $a \in A$ the tangent spaces of A and $C_{(a)}$ at the point a have only the zero vector in common, and if — in case $r > 1$ — for all $a \in A$ the leaf $C_{(a)}$ is simply connected, then there exist S and j with the desired properties. From this result and from the theory of characteristics for the above mentioned systems the announced theorem is obtained

1537

Massachusetts Inst. of Tech. Dept. of Mathematics, Cambridge.

TOPOLOGICAL OBJECTS AND SHEAVES, by Y. N. Clifton and J. W. Smith. [1961] [17]p. incl. diagrs. (AFOSR-65-0087) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)42 and National Science Foundation) Unclassified

Also published in Trans. Amer. Math. Soc., v. 105: 436-452, Dec. 1962.

In a previous publication the authors have introduced a category $\mathfrak{S}$ extending the category of topological spaces, and intended to provide an appropriate context for studying such structures as foliations. Here they redefine this category in more intrinsic form. If X is a space and G the sheaf of germs of maps of X into itself then the points of the espace étalé are the morphisms of a category, using the obvious composition, and this category is provided with the usual topology from a sheaf theory. An open subcategory J defines an object (X, J) of $\mathfrak{S}$ if it satisfies the extension condition: a diagram $\uparrow \leftarrow$ in J can be extended to a commutative diagram $\uparrow \sqsubset \vec{\uparrow}$ in J, and the closure condition. $\bar{\sigma} \circ \in J$ implies $\sigma \in J$. Maps in $\mathfrak{S}$ are defined in the same spirit. Similiar procedures may be applied to subcategories of the category of topological spaces, giving subcategories of $\mathfrak{S}$. If $(X, J) \in \mathfrak{S}$, identify points of X having the same image under same $\alpha, \beta \in J$. This gives a functor on $\mathfrak{S}$ to topological spaces, making $\mathfrak{S}$ a local category. It thus has a natural Grothendieck topology and the notion of a sheaf on $\mathfrak{S}$ is defined accordingly. There is a canonical extension of a sheaf on the category of topological spaces to one on $\mathfrak{S}$. The authors provide an example to show that this extension is not exact and thus define homological invariants measuring the deviation of an object of $\mathfrak{S}$ from a topological space. (Math. Rev. Abstract)

1538

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

ADDITIVE FUNCTIONALS ON GROUPS, by A. Hayes. [1961] [10]p. incl. refs. (AF 49(638)42) Unclassified

Published in Proc. Cambridge Philos. Soc., v. 58: 196-205, Apr. 1962.

The author studies the homomorphisms of a group G into the additive group of the real numbers by relating them to the semigroups in G. For such a homomorphism φ, let $S(\varphi) = \{x \in G: \varphi(x) \geq 0\}$, $S^0(\varphi) = \{x \in G = \varphi(x) > 0\}$. It is proved that for any group G the sets $S(\varphi)$ corresponding to nontrivial φ are characterized as the invariant maximal proper semigroups in G, and that φ is determined by $S(\varphi)$ up to a positive multiple. For an abelian group G this result is strengthened, and a characterization is also given for the sets $S^0(\varphi)$. Applications are given to partially ordered and lattice-ordered groups to their representation by groups of real functions, and to a proof of the Hahn-Banach theory for Abelian groups. (Math. Rev. abstract)

1539

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

ON EXTENSIONS OF H-SPACES, by J. D. Stasheff. [1959] [10]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)42 and National Science Foundation) Unclassified

Presented at meeting of the Amer. Math. Soc., Jan. 22, 1959. (Title varies)

Published in Trans. Amer. Math. Soc., v. 105: 126-135, Oct. 1962.

The basic theorem presented is: Let Y be a space with

only two nonvanishing homotopy groups, $\pi_p(Y) = \pi$, $\pi_q(Y) = G$, $q > p$. Y admits a multiplication if and only if the k-invariant $k \in H^{q+1}(\pi,p;G)$ is primitive. The four main purposes of this paper are: (1) to give multiplications on Y explicitly in terms of a sputnik homotopy for a map representing k, (2) to examine more general conditions under which it is possible to define a multiplication in this way, (3) to relate these multiplications to additive secondary cohomology operations, and (4) to extend the results to homotopy associative H-spaces.

1540

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

GROUP VELOCITY AND ENERGY PROPAGATION FOR THREE-DIMENSIONAL WAVES, by G. B. Whitham. [1961] [17]p. incl. diagrs. refs. (AFOSR-2461) (AF 49-(638)708) Unclassified

Also published in Commun. Pure and Appl. Math., v. 14: 675-691, Aug. 1961.

The generalization to two and three-dimensional wave motions is considered. The results can be described as an analogue of simple geometrical optics. For a non-dispersive medium high frequency waves and discontinuities propagate in a certain sense along the rays which are the curves orthogonal to the surfaces of constant phase. The waves propagate along these rays with the phase velocity, and the amplitude variation agrees with the law that the flux of energy down a ray tube remains constant.

1541

Massachusetts Inst. of Tech. Dept. of Mathematics, Cambridge.

ON THE EXPANSION OF A GAS INTO VACUUM, by H. P. Greenspan and D. S. Butler. [1961] [19]p. incl. diagrs. table, refs. (AFOSR-2971) (AF 49(638)708) Unclassified

Also published in Jour. Fluid Mech., v. 13: 101-119, 1962.

A study is made of the flow into vacuum of a gas initially at rest in a state of uniform pressure and density; the analysis is based on a continuum model. Among the topics discussed are the notion of the gas-vacuum interface, the reflexion of a plane front off a rigid wall, the propagation of compressive waves within such expansion, the escape from a sphere and the collapse of a spherical cavity. (Contractor's abstract)

1542

Massachusetts Inst. of Tech. Dept. of Mathematics, Cambridge.

SIMILARITY SOLUTION FOR A CYLINDRICAL SHOCK-MAGNETIC FIELD INTERACTION, by H. P. Greenspan. [1961] [5]p. incl. diagrs. table. (AFOSR-3085) (AF 49-(638)708) AD 451549 Unclassified

Also published in Phys. Fluids, v. 5: 255-259, Mar. 1962.

A similarity solution is developed describing the propagation of a strong cylindrical shock in an applied azimuthal magnetic field. The stationary gas is nonconductive and the shocked gas is taken to have a finite electrical conductivity. The total axial current is maintained constant by external means. Upon comparison of flows for which the total gas energy is the same, it is found that the interaction reduces the shock velocity by only a few percent although the pressure distributions differ markedly. (Contractor's abstract)

1543

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

SOME EXACT SOLUTIONS OF MAGNETO-HYDRODYNAMIC VISCOUS FLOW PROBLEMS, by H. P. Greenspan and L. A. Peletier. [1961] [16]p. incl. diagrs. (AFOSR-3144) (AF 49(638)708) Unclassified

Also published in Jour. Math. and Phys., v. 41: 116-131, June 1962.

Two problems involving longitudinal motion in an obliquely incident applied magnetic field are discussed: the steady motion of a perfectly conducting semi-infinite plate and the oscillatory motion of a nonconducting plate. Both concern the propagation along magnetic field lines of diffusing Alfven waves which carry the disturbances produced at the plate into the fluid. The induced current, for steady motion, flows toward the plate edge from infinity, and completes a closed circuit by returning through the internal boundary layers. The magnitude of this current and the structure of the shear layers are unaffected by the inclination of the magnetic field. The dependence of the current distributions, drag per unit length and other important quantities on the basic parameters are discussed and compared. An exact oscillating plate solution is presented.

1544

Massachusetts Inst. of Tech. Dept. of Mathematics, Cambridge.

MASS, MOMENTUM AND ENERGY FLUX IN WATER WAVES, by G. B. Whitham. [1961] [13]p. (AFOSR-3599) (AF 49(638)708) Unclassified

Also published in Jour. Fluid Mech., v. 12: 135-147, 1962.

Longuet-Higgins and Stewart studied the amplitude variation of waves on a non-uniform steady stream and showed that work done by the "radiation stress" must be included in the wave-energy balance. The precise form of this work was not obvious and needed a long argument. In the present paper these and other results are derived more simpl, and naturally by considering the balance of mass momentum and energy of stream-plus-wave and taking suitable combinations. The results depend also on the assumptions made about the influx of momentum and energy. In the final section of the paper time-dependent propagation is treated. (Math. Rev. abstract)

1545

Massachusetts Inst. of Tech. Dept. of Mathematics, Cambridge.

THE INSTABILITY OF THE COLLAPSE OF A SELF-GRAVITATING GAS CLOUD, by C. Hunter. [1961] [15]p. [AF 49(638)708] Unclassified

Published in Astrophys. Jour., v. 136: 594-608, Sept. 1962.

A hydrodynamic description of the fragmentation of a model of a spherically symmetric gas cloud is presented. It is supposed that this cloud becomes unstable with respect to its own gravitation and begins to condense. The symmetric condensing motion of the cloud is shown to be dynamically unstable and to lead to fairly distinct regions of high density forming in the cloud.

1546

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

MATHEMATICAL CHARACTERIZATION OF THE PHYSICAL VACUUM FOR A LINEAR BOSE-EINSTEIN FIELD (FOUNDATIONS OF THE DYNAMICS OF INFINITE SYSTEMS, III), by I. E. Segal. [1961] [24]p. incl. refs. (AF 49(638)945) Unclassified

Published in Illinois Jour. Math., v. 6: 500-523, Sept. 1962.

It has been strongly conjectured that Lorentz-invariance alone uniquely determines the vacuum state of a quantized field. In this paper a counter-example is exhibited and expanded to an explicit construction of all states invariant under the action of the group of unitary transformations of the corresponding classical system. The case treated is that of a boson field admitting a free-field structure. Uniqueness is restored by a proof that among these invariant states only one, the usual frock vacuum, leads to a representation of the algebra of observables in which the Hamiltonian can be made positive definite.

1547

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. [1959] [10]p. incl. diagrs. (AF 49(638)375) Unclassified

Presented at Fall meeting, Western States Section, The Combustion Inst., Los Angeles, Calif., Nov. 2-5, 1959.

Published in Conf. on Kinetics, Equilibria, and Performance of High Temperature Systems, Los Angeles, Calif. (Nov. 2-5, 1959), Pacific Palisades, The Combustion Inst., 1959, Paper 59-24, p. 1-10.

A program has been developed for use in the IBM 704 Computer which yields the composition and thermodynamic properties of the products of combustion of stoichiometric hydrogen-oxygen mixtures. The calculations were based on the existence of 6 species in the products: H_2O, H_2, O_2, H, O, and OH, and covered 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 (enthalpy, entropy and composition) 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 dissociated 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 hydrogen and oxygen, but provision was made in the program so that properties and compositions corresponding to other proportions might be readily found. (Contractor's abstract)

1548

Massachusetts Inst. of Tech. [Dept. of Mechanical Engineering] Cambridge.

SOME EFFECTS OF INJECTION OF FOREIGN GASES IN A DECELERATING LAMINAR BOUNDARY LAYER IN SUPERSONIC FLOW, by S. W. Gouse, Jr., G. A. Brown, and J. Kaye. [1961] [10]p. incl. diagrs. table, refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)442 and Office of Naval Research under N5ori-07897) Unclassified

Published in Jour. Aerospace Sci., v. 29: 1250-1259, Oct. 1962.

The purpose of this research program was to investigate the effects of a diffusion field on a laminar boundary layer in a supersonic flow. Specifically, helium, nitrogen and argon were uniformly injected into the laminar boundary layer of a high-speed flow in a tube with the objective of determining the effects of such injection on the pressure, temperature and recovery factor distribution along and downstream of the injection region. A continuously operating axially-symmetric wind tunnel has been designed, constructed and operated. The experimental results of 38 runs (13 with zero injection, 12 with helium injection, 8 with nitrogen injection, and 5 with argon injection) are presented. For uniform injection of helium, nitrogen or argon gas, it was found that there was about a 1% change in the recovery factor and adiabatic wall temperature for the range of variables investigated. The effect of foreign gas injection on the pressure distribution was to increase an already adverse pressure gradient. (Contractor's abstract, modified)

1549

Massachusetts Inst. of Tech. [Dept. of Mechanical Engineering] Cambridge.

RANDOM VIBRATION OF BEAMS, by S. H. Crandall and A. Yildiz. Apr. 1961 [34]p. incl. diagrs. tables, refs. (AFOSR-484) (AF 49(638)564) AD 256549 Unclassified

Presented at Winter annual meeting of the Amer. Soc. Mech. Engineers, New York, Nov. 26-Dec. 1, 1961.

Also published in Jour. Appl. Mech., v. 29: 267-275, June 1962.

The mean square deflections, slopes, bending moments and shear forces were compared for 4 different dynamical models with 3 different damping mechanisms, subjected to a distributed transverse loading process which was uncorrelated space-wise and which was either ideally, white time-wise or band-limited with an upper cut-off frequency. The dynamic models were the Bernoulli-Euler beam, the Timoshenko beam and 2 intermediate models, the Rayleigh beam, and a beam which has the shear flexibility of the Timoshenko beam but not the rotatory inertia. The damping mechanisms were transverse viscous damping, rotatory viscous damping, and Voigt visco-elasticity. Many of the mean square response quantities were finite when the excitation was ideally white (i.e., when the input has infinite mean square), however some of the responses were unbounded. For these cases the rate of growth of the response was obtained as the cut-off frequency of the excitation was increased. (Contractor's abstract)

1550

Massachusetts Inst. of Tech. [Dept. of Mechanical Engineering] Cambridge.

RANDOM VIBRATION OF SYSTEMS WITH NONLINEAR RESTORING FORCES, by S. H. Crandall. June 1961, 15p. incl. refs. (AFOSR-708) (AF 49(638)564) AD 259493 Unclassified

Also published in Proc. Internat'l. Symposium on Nonlinear Oscillations, Kiev (USSR) (1961), Kiev, Izdatel'stvo Akademia Nauk (USSR), 1963, p. 306-313.

Two procedures are discussed for studying the response of nonlinear systems to random excitation. The Fokker-Planck method is potentially applicable to a wide class of problems but the integrations required have only been effected in a few special cases. The equivalent linearization method is easy to carry out but is limited to small nonlinearities. It is demonstrated that to first order in the nonlinearity the equivalent linearization estimate of mean square stationary response is identical with that provided by the Fokker-Planck equation. A new equivalent linearization procedure for estimating the expected frequency of zero crossings in the random response is described and shown to give the same result as the Fokker-Planck equation. (Contractor's abstract)

1551

Massachusetts Inst. of Tech. [Dept. of Mechanical Engineering] Cambridge.

RANDOM VIBRATION OF A NONLINEAR SYSTEM WITH A SET-UP SPRING, by S. H. Crandall. [1961] [31]p. incl. diagrs. refs. (AFOSR-709) (AF 49(638)564) AD 259320 Unclassified

Presented at Winter annual meeting of the Amer. Soc. Mech. Engineers, New York, Nov. 26-Dec. 1, 1961.

Also published in Jour. Appl. Mech., v. 29: 477-482, Sept. 1962.

Several aspects of the problem of random vibration in nonlinear systems are discussed in terms of a particular set-up spring system. Exact solutions for the mean square response and the expected frequency of zero crossings are obtained by means of the Fokker-Planck equation. These are compared with approximate solutions obtained from equivalent linearization techniques. The distribution of response peaks is then studied and a probability density is derived for the peaks on a relative frequency basis. The probability density of the response envelope is also obtained and the relationship between the 2 distributions is discussed. (Contractor's abstract)

1552

Massachusetts Inst. of Tech. [Dept. of Mechanical Engineering] Cambridge.

DYNAMIC RESPONSE OF SYSTEMS WITH STRUCTURAL DAMPING, by S. H. Crandall. Oct. 1961 [25]p. incl. diagrs. refs. (AFOSR-1561) (AF 49(638)564) AD 266299 Unclassified

Ths response of simple vibratory systems containing structural damping is studied analytically when ths excitation is an impulse and when the excitation is stationary random vibration. It is found that in a strict ssnss the assumption of ideal structural damping represents a physically unrealizabls model because a small prscursor response occurs before the application of an impulsive load. For stationary random excitation exact solutions for the mean square response are compared with approximate solutions obtained from two increasingly accurate equivalent viscous substitutes for structural damping. (Contractor's abstract)

1553

Massachusetts Inst. of Tech. [Dept. of Mechanical Engineering] Cambridge.

INTERACTIONS AMONG BURNING FUEL DROPLETS AND THEIR EFFECTS ON COMBUSTION STABILITY AND ROUGHNESS (Abstract), by T.-Y. Toong. [1961] [2]p. [AF 49(638)629] Unclassified

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

The main objective of this research program is to further a basic understanding of the general problem of combustion instability through a study of the effects of interactions among burning fuel droplets on combustion stability and roughness. In the steady-state phase, the mechanisms of interactions between 2 burning fuel cylinders wsre studied theoretically and experimentally. Thsse 2 cylindsrs were placsd parallel to each other with their axes in a horizontal plane and burning in an air stream which flows vsrtically upward. Local rates of evaporation and combustion for burning fuel cylinders wers predicted by the use of Meksyn's method on ths basis of potential-flow solutions obtained by means of an electrical analog and of boundary-layer solutions for wedge flow. Good quantitative agrssmsnt was observed between theoretical prsdictions and experimental rssults. It was also found that for small Reynolds numbsrs and large hsat ratios, interactions can become important even at rather large spacings betwsen the cylindsrs. In the oscillating phase, both forced and sslf-sustained oscillations of an array of candle flames were investigated. The flames of an array of candles uniformly spaced in a horizontal plane and burning in a natural-convective field were found to oscillate cyclically at a well-defined frequency, the value of which depends on the number of candles in the array, their arrangement and their spacing. The regular pattsrn of these oscillations disappeared when they were subjscted to external disturbances, random or otherwiss. However, for arrays of a large number of candles at rather small spacings, the intensity of disturbances required was quite high. In the case of fuel cylinders burning in a forced convective field, streak schlieren photography was employed to obtain the phase relationships betwsen the oscillating flame front and outer edge of the thermal boundary layer at different frequencies. A hot-wire anemometer was also used to measure velocity oscillations in the neighborhood of the oscillating flames.

1554

Massachusetts Inst. of Tech. Dept. of Mechanical Engineering, Cambridge.

HEAT TRANSFER TO COLD ELECTRODES IN A FLOWING IONIZED GAS, by J. A. Fay and W. T. Hogan. [1961] 14p. incl. illus. diagrs. (Rept. no. 61-2) (AFOSR-595) (AF 49(638)643) AD 258251 Unclassified

Also published in Phys. Fluids, v. 5: 885-890, Aug. 1962.

A slightly ionized gas was formed in the wake of a detonation wave in a shock tube by seeding with a potassium salt. Wire electrodes were placed with axes normal to the shock-tube axis and separated by a variable distance along the tube axis. The heating of each electrode was measured by determining the rate of change of electrical resistance of the electrode. Electrode heating in excess of that due to aerodynamic heat transfer was only observable in the range of 10^2 to 10^3 A/cm^2 and was found to be proportional to the current. The excess heating rate divided by the total current was measured to be 4.9 v for the anode and 3.2 v for the cathode. By varying the spacing of the electrodes, it was found that the gas resistance could be accounted for by the geometric effects alone in combination with the gas conductivity as measured by Basu for this mixture. (Contractor's abstract)

1555

Massachusetts Inst. of Tech. Dept. of Mechanical Engineering, Cambridge.

PLASMA BOUNDARY LAYERS, by J. A. Fay. June 1961 [18]p. incl. diagrs. (Rept. no. 61-8) (AFOSR-994) (AF 49(638)643) AD 260664 Unclassified

Also published in Proc. of Fourth Biennial Gas Dynamics Symposium on Magnetohydrodynamics, Northwestern U., Evanston, Ill. (Aug. 23-25, 1961), Evanston, Northwestern U. Press, 1962, p. 337-348. (AFOSR-2787)

Some aspects are considered of boundary layer type flows in gases which are partially or wholly ionized. The change in transport properties due to ionization are

estimated and the resulting effects on heat transfer in a monatomic gas are determined. A type of magnetohydrodynamic boundary layer encountered in channel flows where there exists an applied magnetic field normal to the wall is considered. Finally, the laminar diffusive mixing of a magnetic field and a compressible plasma are studied. (Contractor's abstract)

1556

Massachusetts Inst. of Tech. Dept. of Mechanical Engineering, Cambridge.

HEAT TRANSFER IN A COMPLETELY IONIZED GAS, by B.-M. Jepson. July 1961, 20p. incl. diagrs. (Rept. no. 61-7) (AFOSR-1562) (AF 49(638)643) AD 268459 Unclassified

Heat transfer rates and temperature profiles were calculated for a completely ionized gas in laminar boundary layer flow over a flat plate. Using the assumptions of low Mach number, zero Prandtl number, and no pressure gradient, the solutions were obtained by numerical integration of the differential energy equation utilizing an iterative method of solution. The gas considered was treated as a homogeneous perfect gas under no electric or magnetic fields. The thermal conductivity of the gas was assumed to vary as the absolute temperature to the B power. Solutions were obtained for B = 5/2 (completely ionized gas) as well as B = 1 and 1/2 for comparison with other solutions. By an approximate method of solution, a simple relationship for the heat transfer rate was found which depends upon B and the ratio of wall temperature to free stream temperature. (Contractor's abstract)

1557

Massachusetts Inst. of Tech. Fluid Dynamics Research [Group] Cambridge.

OSR-SPONSORED STUDIED ON UNSTEADY AERODYNAMIC AND NONLINEAR STRUCTURAL PROBLEMS OF AIRCRAFT AT MIT, 1957-1960, by H. Ashley and T. H. H. Pian. Final rept. Apr. 1961, 39p. incl. diagrs. refs. (MIT Fluid Dynamics Research Lab. rept. no. 61-4) (ASRL rept. no. 76-6) (AFOSR-588) (In cooperation with MIT Aeroelastic and Structures Research Lab.) (AF 49(638)160) AD 259048 Unclassified

The principal areas of effort presented under the aerodynamic phase are the following: the shock layer adjacent to an oscillating blunt nose in a hypersonic airstream; Prandtl-Meyer expansions in dissociational equilibrium; unsteady transonic airloads in the presence of a strong shock; the stability of combustion zones; the boundary-layer under conditions of time-dependent external flow; and radiation effects in hypersonic flow of real gases. The principal topics treated under the structural phase are the following: large deflections of curved strips and plates under thermal and pressure loadings; deflection and snap buckling of shallow spherical shells; yield conditions of plates and shells under combined bending moments and membrane stresses; inelastic diffusions of stiffened panels; dynamic response of rigid-plastic curved beams; dynamic buckling of shallow spherical shells; straight-crested waves in plates; and finite deflections of shallow arches taking shear deformation into consideration. (Contractor's abstract)

1558

Massachusetts Inst. of Tech. Fluid Dynamics Research Group, Cambridge.

A THEORY OF TRANSONIC AILERON BUZZ, NEGLECTING VISCOUS EFFECTS, by W. Eckhaus. [1961] [7]p. incl. diagrs. tables. (AFOSR-2838) (AF 49(638)-160) Unclassified

Also published in Jour. Aerospace Sci., v. 29: 712-718, June 1962.

Unsteady perturbations of two-dimensional transonic flow around an airfoil are considered, the situation being such that local supersonic regions terminated by shock waves are present in the vicinity of the airfoil. Viscous effects are neglected, and a linearized theory of the perturbations due to harmonic oscillations of an aileron is developed. A series solution for the pressure distribution is obtained, and numerical results for the nonsteady hinge moment, from the first approximation to the solution, are presented. As a result of flutter analysis a stability boundary for transonic aileron buzz is obtained. Comparison of the theoretical results with experimental observations shows satisfactory agreement. (Contractor's abstract)

1559

Massachusetts Inst. of Tech. Fluid Dynamics Research [Group] Cambridge.

A MONTE CARLO SOLUTION FOR HEAT TRANSFER IN RAREFIED GASES, by M. L. Lavin. May 1961 [151]p. incl. illus. (MIT Fluid Dynamics Research [Group] rept. no. 61-3) (AFOSR-627) (AF 49(638)207) AD 259049 Unclassified

The nonlinear heat transfer problem in the transition regime between free molecule and continuum flow is solved by an iterative Monte Carlo method, and the results are compared with both linear and nonlinear analytical solutions. The statistical procedure consists of constructing an improved distribution function by recording the history of a single test molecule which wanders through a phase space populated by molecules of the previous iterate. Molecular wanderings are determined by selecting events at random from the probability distributions that govern the interaction process. For a nominal Knudsen number of 2.0 and a temperature ratio of 4:1, the Monte Carlo results differ from both the linear and nonlinear analytical solutions by no more

than 10-15%. Moreover, these statistical results seem to substantiate Mott-Smith's prediction of a Knudsen layer adjacent to the boundary. (Contractor's abstract)

1560

Massachusetts Inst. of Tech. [Fluid Dynamics Research Group] Cambridge.

ON UNDAMPED WAVES IN AN INFINITELY LONG PLASMA JET, by L. Trilling and R. E. Kaplan. [1961] 24p. incl. illus. (AFOSR-695) (AF 49(638)207)
AD 298869 Unclassified

This paper discusses the conditions required for the existence of undamped small amplitude waves in an infinitely long plasma jet. The analysis consists of 3 steps: First, the equations of motion are derived for the perturbations from a uniform flow both inside and outside the jet, and appropriate solutions for cylindrical, harmonically oscillating waves are obtained. Then the boundary conditions and matching conditions are specified to relate the flow inside and outside the jet. Finally the neutral stability condition arises as the solution of an eigenvalue problem for certain dimensionless parameters of the system, and the stability boundaries in the (M, B) plane are drawn for a number of simple special cases. (Contractor's abstract)

1561

Massachusetts Inst. of Tech. [Fluid Dynamics Research Group] Cambridge.

ON PLANE LINEAR MAGNETOHYDRODYNAMIC WAVES, by L. Trilling. [1961] [17]p. incl. diagrs. refs. (AFOSR-939) [AF 49(638)207] AD 298159
Unclassified

Also published in Jour. Fluid Mech., v. 13: 272-288, 1962.

This paper investigates the perturbation modes of the steady parallel flow of a compressible fluid of finite constant viscosity and electrical conductivity in a uniform arbitrary oriented magnetic field. In particular, in addition to the classical fast and slow sound and Alfvén modes, some waves are obtained whose amplitude is finite whenever the diffusive coefficients are finite and which resemble the diffusion of vorticity from stream surfaces in classical hydrodynamics. This paper also re-interprets upward facing MHD waves and upstream wakes in a new way. (Contractor's abstract)

1562

Massachusetts Inst. of Tech. Fluid Dynamics Research [Group] Cambridge.

EXPANSION AND DIFFUSION OF A LAYER OF HOT GAS IN THE PRESENCE OF THERMAL RADIATION, by C.-Y. Chow. Mar. 1961, 41p. incl. diagrs. tables. (MIT Fluid Dynamics Research Group rept. no. 61-2) (AFOSR-979) (Sponsored jointly by Air Force Cambridge Research Lab. under AF 19(604)5698 and Air Force Office of Scientific Research under AF 49(638)207)
AD 259050 Unclassified

A radiating gas slab at very high temperature and moderate pressure expands and diffuses into the surrounding cold atmosphere. Under the assumption that the effect of adiabatic cooling is small compared to that of radiation cooling, and that the energy flux radiated from the interior of the gas slab is much greater than the influx, the equations of motion are solved to obtain the distributions of temperature, density, pressure, particle velocity and radiation flux inside the slab as functions of time and space coordinate. The positions and velocities of the slab's bounding surface at different times are also obtained. The magnitude of the neglected adiabatic cooling term in the energy equation is then computed and compared with the radiation term to show that it can be neglected. (Contractor's abstract)

1563

Massachusetts Inst. of Tech. Fluid Dynamics Research [Group] Cambridge.

MONTE CARLO APPLICATION TO MOLECULAR FLOWS, by J. K. Haviland. May 1961, 310p. incl. diagrs. tables, refs. (MIT Fluid Dynamics Research Lab. rept. no. 61-5; AFCRL Scientific rept. no. 648) (AFOSR-1504) (Sponsored jointly by Air Force Cambridge Research Lab. under AF 19(604)5698 and Air Force Office of Scientific Research under AF 49(638)207) AD 259672
Unclassified

Monte Carlo methods for two problems are programmed on the IBM 709. These two problems are: the heat flow between parallel walls using hard spheres and Maxwellian molecules and the normal shock wave, using hard sphere molecules. Three solutions to the heat flow problem were obtained and also three to the shock wave problems. These results based on the Monte Carlo method are compared with solutions arrived at by various other methods.

1564

Massachusetts Inst. of Tech. Fluid Dynamics Research Group, Cambridge.

APPLICATION OF A MOMENT METHOD TO HEAT TRANSFER IN RAREFIED GASES, by M. L. Lavin and J. K. Haviland. [1961] [6]p. incl. diagrs. [AF 49(638)-207] Unclassified

Published in Phys. Fluids, v. 5: 274-279, Mar. 1962.

A full-range moment method developed by Lees is applied to heat transfer across a large temperature

difference in a rarefied gas. Two solutions are obtained: a four-moment result for hard sphere molecules and a six-moment result for Maxwellian molecules. The four-moment solution for hard spheres exhibits the same behavior as Lees' result for Maxwellian molecules. Moreover, the six-moment result differs significantly from the lower-order solution for Maxwellian molecules only in the prediction of a varying pressure. (Contractor's abstract)

1565

Massachusetts Inst. of Tech. Fluid Dynamics Research [Group] Cambridge.

SOME STEADY AND UNSTEADY INVISCID HYPERSONIC FLOWS PAST BLUFF BODIES, by H. Kennet. [1961] 168p. incl. illus. tables, refs. (MIT Fluid Dynamics Research Lab. rept. no. 61-1) (AFOSR-1031) (AF 49(638)933) AD 267955 Unclassified

Both steady and unsteady inviscid fluid motion in detached hypersonic shock layers about axisymmetric bluff bodies are investigated, utilizing a variety of mathematical techniques. Time-dependent flows are determined from a power-series solution of the differential equations-of-change, by postulating small harmonic perturbations superposed on an approximate steady field. The direct problem of chemically reacting and thermally radiating transparent equilibrium air flow in time-independent inviscid shock layers is solved by extending the method of integral relations to non-isoenergetic imperfect gas flows. A two-parameter iteration scheme is developed for the first approximation, where both the shock stand-off distance at the axis and one of the state variables at the stagnation point are found from a singularity condition at the sonic point on the body. A variation principle applicable to three-dimensional time-dependent rotational flows is derived, utilizing the concept of particle functions of which three are required to determine each particle's motion. The possibility of extending the method of integral relations and the variational principle to time-dependent hypersonic flows is discussed. (Contractor's abstract)

1566

Massachusetts Inst. of Tech. [Fluid Dynamics Research Group] Cambridge.

ON THE STABILITY OF A LAMINAR INCOMPRESSIBLE BOUNDARY LAYER OVER A FLEXIBLE SURFACE, by M. T. Landahl. [1961] [24]p. incl. diagrs. refs. (AFOSR-3936) (AF 49(638)933) Unclassified

Also published in Jour. Fluid Mech., v. 13: 609-632, Aug. 1962.

The stability of small 2-dimensional traveling wave disturbances in an incompressible laminar boundary layer over a flexible surface is considered. A characteristic equation is deduced which, in the limit of zero wall flexibility, reduces to that occurring in the ordinary stability theory of Tollmien and Schlichting. Graphical methods are developed to determine the curve of neutral stability, as well as to identify the various modes of instability classified by Benjamin. A method is devised whereby the optimum combination of surface effective mass, wave speed, and damping required to stabilize any given unstable Tollmien-Schlichting wave can be determined by a simple geometrical construction in the complex wall-admittance plane. A complete physical explanation for the influence of an infinite flexible wall on boundary-layer stability is presented. The effect of damping in the wall is discussed. The seemingly paradoxical result that damping destabilizes class A waves is explained by considering the related problem of flutter of an infinite panel in incompressible potential flow, for which damping has the same qualitative effect. It is shown that class A waves are associated with a decrease of the total kinetic and elastic energy of the fluid and the wall, so that any dissipation of energy in the wall will only make the wave amplitude increase to compensate for the lowered energy level. The examples presented show that the increase in the critical Reynolds number that can be achieved with a wall of moderate flexibility is modest, and that some other explanation for the experimentally observed effects of a flexible wall on the friction drag must be considered. (Contractor's abstract, modified)

1567

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

STUDIES OF THE OPTICAL ABSORPTION SPECTRUM OF RUTILE SINGLE CRYSTALS, by B. H. Soffer. Aug. 1959, 24p. incl. diagrs. refs. (Technical rept. no. 140) (Sponsored jointly by [Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-184110] and Atomic Energy Commission) AD 227945 Unclassified

Published in Jour. Chem. Phys., v. 35: 940-945, Sept. 1961. (Title varies)

The optical absorption of single crystals of synthetic rutile was investigated in the spectral range 1200-2500 cm^{-1} and from room temperature to 1000°C. The electronic absorption exhibits dichronic behavior. The edge moves toward lower energies as temperature is increased, with the shift depending upon the absorption coefficient; for a decadic absorption coefficient (α) of 400 cm^{-1}, the shift is 7.1 x 10^{-4} ev/°K, while at 1 cm^{-1} it is 9.5 x 10^{-4} ev/°K. The broad band in the region of 6850 cm^{-1}, which occurs in reduced rutile, does not appear in fully oxidized rutile, even at high temperature. At high temperatures an additional wavelength-independent absorption appears which can be correlated in good agreement with dc conductivity by applying the Drude-Zener theory of free carrier absorption. New

bands in the 3300 cm^{-1} region are shown to stem from O-H valence vibrations. The main bands are unusually sharp, with peaks at 3277 and 3322 cm^{-1} and half-widths of 28 and 13 cm^{-1}. A satellite structure of combination and difference bands was also detected. Deuterium substitution produces an absorption band at 2442 cm^{-1}. The entire structure shows a marked dependence of the absorption on the polarization direction of the light. Some evidence is presented that these O-H groups cause a dielectric dispersion. Changes in carrier density were detected in transmission measurements on a current carrying crystal. (Contractor's abstract)

1568

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

MICROWAVE RESPONSE OF ETHANOL AND BROMOETHANE AND ITS PRESSURE DEPENDENCE, by E. B. Littlefield. July 1961 [31]p. incl. diagrs. tables, refs. (Technical rept. no. 165) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-184110)
AD 262026 Unclassified

Equipment has been designed for measuring the dielectric constant and loss of high-loss liquids from 3 x 10^8 to 5 x 10^9 cycles/sec at pressures up to 1000 atm. Bromoethane showed a pressure sensitivity for dielectric relaxation $\Delta \log \tau/atm$ about 5 times that of ethanol. This suggested that the relative insensitivity of ethanol is due to its H-bonded structure. Solutions of ethanol in cyclohexane, down to 25 mol-% ethanol, show a max in relaxation time near equimolar composition. This behavior is contrary to the prediction of the usual Debye theory, since the viscosity of the solution decreases monotonically in this composition range on dilution with cyclohexane. (Contractor's abstract)

1569

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

DIELECTRIC RELAXATION IN HYDROGEN-BONDED LIQUIDS, by M. W. Sagal. Oct. 1961, 23p. incl. diagrs. tables. (Technical rept. no. 166) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-184110)
AD 266376 Unclassified

Published in Jour. Chem. Phys., v. 36: 2437-2442, May 1, 1962. (Title varies)

The temperature dependence of the dielectric relaxation time has been investigated from -5° to 50°C for ethanol-cyclohexane solutions from 1.0 to 0.25 mol fraction ethanol. The previously observed maximum in the relaxation time around equimolar composition is explained by a hydrogen-bonded switching mechanism. Measurements of dielectric relaxation from 5° to 50°C have been carried out on the 3 isomeric butanediols which differ in the separation of the 2 OH groups along the carbon skeleton. The differences in relaxation time among the 3 isomers can be explained by the switching mechanism suggested by the results for the ethanol-cyclohexane solutions. The dielectric relaxation times of n-butanol from 5° to 50°C have also been determined. The chain-length dependence of the dielectric relaxation time of the normal aliphatic alcohols is discussed in terms of the proposed mechanism. (Contractor's abstract)

1570

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

DEFECTS IN MIXED CRYSTALS OF KCl-KBr, by A. Smakula, N. Maynard, and A. Repucci. [1961] [3]p. incl. illus. diagrs. refs. (Sponsored jointly by Air Force [Office of Scientific Research], Office of Naval Research, and [Signal Corps under Nonr-184110])
Unclassified

Presented at Internat'l. Conf. on Chemical Physics of Nonmetallic Crystals, Evanston, Ill., Aug. 28-31, 1961. (AFOSR-2143)

Published in Jour. Appl. Phys., Suppl., v. 33: 453-455, Jan. 1962.

Mixed crystals of KCl and KBr show strong internal strain evidenced by cracking. The minimum of the melting point occurs between 63 and 65 mol-% KBr. The microhardness between 25 and 65 mol-% KBr is more than twice that of either component. The lattice constant changes linearly with composition. The macrodensity deviates by several percent, indicating a high concentration of defects. The intensity of coloration by electrons shows that defects are not mainly due to vacancies, but presumably to larger aggregates of submicroscopic size or interstitials. The broadening of exciton bands, as measured by shifts of the ultraviolet absorption edge, is greatest at a 2:1 KCl-KBr ratio. This may indicate a certain short-range order in KCl-KBr mixed crystals (Contractor's abstract)

1571

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

DIELECTRIC AND X-RAY STUDIES OF $Ca_xBa_{1-x}TiO_3$ AND $Ca_xSr_{1-x}TiO_3$, by T. Mitsui and W. B. Westphal [1961] [6]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and [Signal Corps under Nonr-184110])
Unclassified

Published in Phys. Rev., v. 124: 1354-1359, Dec. 1, 1961.

Ceramics of $Ca_xBa_{1-x}TiO_3$ and $Ca_xSr_{1-x}TiO_3$ are prepared and their dielectric and structural properties investigated. Firing conditions were adjusted to obtain sharp x-ray back reflections. The Curie point of $Ca_xBa_{1-x}TiO_3$ increases with Ca concentration up to 136°C for x = 0.08, and then decreases. Both the tetragonal-orthorhombic and the orthorhombic-rhombohedral transition points of $Ca_xBa_{1-x}TiO_3$ decrease monotonically with increasing Ca concentration. $Ca_xSr_{1-x}TiO_3$ solid solutions with $0.01 \leq x \leq 0.10$ are ferroelectric at very low temperatures. $SrTiO_3$ assumes a tetragonal structure below about 80°K. (Contractor's abstract)

1572

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

PROTONS, DIPOLES, AND CHARGE CARRIERS IN RUTILE, by A. Von Hippel, J. Kalnajs and W. P. Westphal. [1961] [22]p. incl. illus. diagrs. table, refs. (Sponsored jointly by Air Force Office of Scientific Research and Office of Naval Research under [Nonr-184110]) Unclassified

Published in Jour. Phys. and Chem. Solids, v. 23: 779-799, June 1962.

After a short discussion of structure and infrared-vibration data of rutile, the presence of protons, replaceable by deuterons, is determined by the OH and OD stretching vibration and traced to specific lattice sites. Various reactions in hydrogen and oxygen and the effects of reduction on electron mobilization and the optical absorption spectrum are considered. Absorption spectra at high temperature and quenching experiments clarify the interrelation between absorption spectra, vacancies and conductivity. Space-charge polarization and blocking-layer effects are elucidated by dielectric relaxation spectra, discharge characteristics and the influence of prehistory and addition agents. Electron injection into the empty conduction band transforms unreduced rutile from an insulator into a very good conductor; incandescence and thermal breakdown at low voltage results; impulse voltage produces much higher electric strength. All observations show the extremely anisotropic conduction of unreduced rutile single crystals, with preference by orders of magnitude in the optic-axis direction, as expected from the crystal structure. This preference is being systematically destroyed by progressive reduction. Rutile is both an n- and a p-type conductor; the experiments reported here together with the facts known previously lead to a consistent picture of its properties. (Contractor's abstract)

1573

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

USE OF NUCLEAR EMULSIONS AS AN ANALYZER OF PROTON POLARIZATION: APPLICATION TO THE POLARIZATION OF PROTONS IN THE PHOTODISINTEGRATION OF THE DUETERON, by B. T. Feld, B. C. Maglić, and J. Parks. [1960] [12]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 Nuovo Cimento, Series X, Suppl., v. 17: 241-252, 1960.

The use of nuclear emulsions as an analyzer of proton polarization at an energy of 150 mev has been studied experimentally by 2 different methods of scanning. An analyzing power of $+ 0.47 \pm 0.08$ was obtained for scattering angles of $5° \div 20°$. As an application of the emulsion method, the authors measured the excitation function of the reaction $\gamma + d \rightarrow n + p$ from 150 to 500 mev, and the polarization of protons produced by photons of $E_\gamma =$ (250 ± 40) mev. The most likely value of the polarization was determined to be $+ 0.27^{+ 0.16}_{- 0.18}$ at 45° cm angle. (Contractor's abstract)

1574

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

CHARACTERISTICS AND FINE STRUCTURE OF THE LARGE COSMIC-RAY FLUCTUATIONS IN NOVEMBER 1960, by J. F. Steljes, H. Carmichael, and K. G. McCraken. [1960] [15]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under AT(30-1)2098, and National Science Foundation) Unclassified

Published in Jour. Geophys. Research, v. 66: 1363-1377, May 1961.

Measurements obtained at Deep River, Canada, from 2 large neutron monitors, and at Cambridge, Mass., from a high counting rate meson monitor, during the solar cosmic-ray injections of Nov. 12 and 14, 1960, are reported. In addition, rate-meter pen traces of the neutron increases and a magnetometer trace of H, obtained at Deep River, are reproduced. A unique feature of the solar cosmic-ray increase of Nov. 12 was the occurrence of a sharp Forbush decrease. Half an hr before the onset of the Forbush decrease, and coincident with a conspicuous increase of H, the intensity of the solar cosmic radiation doubled and then exhibited strong rapid oscillations. Arguments are advanced that the changes of intensity of the solar cosmic rays observed at high latitudes at the time of the magnetic disturbance and Forbush decrease are due to the earth sampling solar

cosmic rays trapped in the gas cloud responstble for these latter effects. The events of Nov. 12 and 15 are both shown to be in agreement with a recent model for the magnetic fields in the inner solar system. At the time of the solar cosmic-ray increase of Nov. 15, the earth was already inside a trapping region, and periodic oscillations of the solar cosmic-ray intenstty were observed lasting for about 2 hr. It is suggested that these oscillations may be closely connected wtth the storage mechanism. (Contractor's abstract)

1575

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

THE NUMERICAL SOLUTION OF COUPLED INTEGRO-DIFFERENTIAL EQUATIONS, by M. M. Pennell and L. M. Delves. [1960] [6]p. incl. diagrs. (In cooperation with Clarendon Lab., Oxford (Gt. Brtt.)) (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)2098]) Unclasstfied

Published tn Math. Comput., v. 15: 243-249, July 1961.

The purpose of this paper is to report on a method for the numerical solution of simultaneous integro-differential equations of the form

$$\int_0^{\infty} \sum_{n=0}^{n_{max}} ({}_1k_n(x,g)g^{(n)}(r))\,dy = \sum_{n=0}^{n_{max}} {}_1P_n(x)f^{(n)}(x)$$

$$\int_0^{\infty} \sum_{n=0}^{n_{max}} ({}_2k_n(r,\theta)f^{(n)}(x))\,d\theta = \sum_{n=0}^{n_{max}} {}_2P_n(r)g^{(n)}(r)$$

where the asymptotic forms of f(x) and g(r) are known; and where ${}_1k_n$ and ${}_2k_n$ are the kernels. The method, which is reasonably simple to program for a computer, has been tested on a problem arising in nuclear physics and yielded reasonable results.

1576

Massachusetts Inst. of Tech. [Lab. for Nuclear Science, Cambridge.

EXPERIMENTAL LIMIT ON THE "CHARGE" OF THE PHOTON (Abstract), by L. Grodzins, D. Engelberg, and W. Bertozzi. [1961] [1]p. (Sponsored jotntly by Air Force Office of Scientific Research, Atomic Energy Commtsston, and Office of Naval Research under [AT(30-1)2098]) Unclasstfied

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 63, Feb. 1, 1961.

The effect of an electric field on the energy of 14.4 kev photons emitted from Fe^{57} is betng tnvestigated with the use of recotiless resonance scattertng. The source, ~ 1 cm Co^{57} plated onto iron, is stationary, and 0.6-mtl natural iron absorber moves back and forth at a speed of 0.0107 cm/sec, the max slope point of the resonance absorption line. The counting rates for forward and backward motions are stored in separate scalers. An electric potential of +20,000 v on the source is periodically swttched off; the counttng rate wtth and wlthout potential are stored in separate registers. Neither an energy shift nor a line broadening has been observed due to the electric field. If a charge q_{ph}, is attributed to the photon which would lead to an energy shift $q_{ph}V$ as the photon crosses the potential V, then our present expertmental limtt on such a charge ts

$$q_{photon} \leq 1 \times 10^{-15} q_{electron}.$$

1577

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambrtdge.

THE LARGE SCALE FEATURES OF THE INTERPLANETARY MAGNETIC FIELD AS DEDUCED FROM COSMIC RAY OBSERVATIONS, by K. G. McCraken. [1961] [15]p. tncl. diagrs. table, refs. (Sponsored jointly by Atr Force Office of Scienttfic Research, Atomtc Energy Commtsston, and Office of Naval Research under AT(30-1)2098, and National Science Foundation) Unclasstfied

Published ln Space Research II; Proc. Second Internat'l. Space Science Sympostum, Florence (Italy) (Apr. 10-14, 1961), Amsterdam, North-Holland Publishtng Co., 1961, p. 813-827.

Observations of cosmic-rays produced in a solar flare can be used as an indirect method for determtning the general features of the interplanetary magnetic fteld, because the times of flight, the directions of arrtval and the degree of tsotropy of the cosmtc-ray flux at the earth are strongly influenced by thts fteld. The observattons of 8 solar flare effects by ground level cosmtc-ray detectors, and approx 30 by radio techniques are reviewed. They lead to a well-defined model for the magnettc fteld between the sun and the earth, whtch is further confirmed by the flare effects of May and Nov. 1960. On May 4 and Nov. 15 the interplanetary magnetic fteld stretched from the western portion of the solar disk and was inclined to the earth-sun line by about 60° at the orbtt of the earth. The overall configuration of the field is examined in the ltght of the observed decay ttmes. All observations are in good accord with a theorettcal model which envisages solar magnetic fields being carrted from the sun by the outflow of solar plasma. The various features of the model are summarized and suggestions are made for further experiments using satellites and space probes. (Contractor's abstract)

1578

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

g-VALUE OF THE 0.123 MEV STATE OF Sm^{152} (Abstract), by R. W. Bauer and M. Deutsch. [1961] [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. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 224, Apr. 24, 1961.

Recently published measurements of this g value have given contradictory results, largely because of the difficulty of evaluating the paramagnetic correction to the magnetic field. The rotation has been measured in a magnetic field of 26 k gauss, of the gamma ray angular correlation from liquid sources of Eu^{152} at 4 temperatures: 300°K (aqueous solution of $EuCl_3$), 1100°K, 1300°K and 1500°K (melt of $EuCl_3$). The rotation appeared to be independent of temperature within an experimental uncertainty of about 15%. This suggests that the paramagnetic correction is quite small, as suggested by the calculations of Karamori and Sugimoto. Without correction the weighted mean of our measurements is $g = 0.375 \pm 0.03$.

1579

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

THE (γ, n) CROSS SECTION OF C^{13} (Abstract), by S. Kowalski, W. Bertozzi and others. [1961] [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. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 236, Apr. 24, 1961.

The time of flight technique has been used to measure the (γ, n) cross section of C^{13} at photon energies from 6-18 mev. This technique has been previously employed in the determination of the Be^9 (γ, n) cross section. The cross section of γ absorption exhibits resonances at about 7.7, 8.9 mev and higher energies.

1580

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

COMPUTER SCANNING OF HODOSCOPE PICTURES (Abstract), by L. Q. Niemela and A. Boyarski. [1961] [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. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 242, Apr. 24, 1961.

Machine scanning of hodoscope pictures is in progress, using the MIT TX-0 computer. A small search caster hunts for events; upon finding one, approximate measurements are made to locate the position of the event on the film. A programmed spot scan then interrogates each possible light position. The machine is programmed to recognize and analyze only interesting events, to make cross checks and to print out range curves, angular correlations, and complete data on rare events.

1581

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

TIME-OF-FLIGHT MEASUREMENTS OF PHOTONEUTRON ENERGY SPECTRA IN THE KILOVOLT REGION. I. TECHNIQUE AND THE (n, γ) CROSS SECTION OF Ag (Abstract), by D. B. McConnell, W. Bertozzi and others. [1961] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commision, and Office of Naval Research under [AT(30-1)2098]) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 251, Apr. 24, 1961.

A modification of the time-of-flight technique developed at the M.I.T. Linear Accelerator has allowed measurements to be undertaken in the kilovolt region of neutron energy spectra produced by nuclear photodisintegration. Neutron flight times over a 1.6 m flight path are measured with a timing resolution of about 10^{-8} sec. Neutrons are detected with the aid of large liquid scintillators, by the (n, γ) reaction in silver. Using the known Be^9 (γ, n) cross section results are presented for the energy dependence of the (n, γ) cross section of silver in the energy range 10-500 kev.

1582

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

TIME-OF-FLIGHT MEASUREMENTS OF PHOTONEUTRON ENERGY SPECTRA. II. SPECTRA FROM Pb AND Bi IN THE KILOVOLT REGION (Abstract), by W. Turchinetz, W. Bertozzi and others. [1961] [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. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 251, Apr. 24, 1961.

The technique described in the preceding abstract has been used to extend to the kilovolt region the earlier measurements of photoneutron energy spectra from Pb and Bi. The neutron spectra produced by the absorption of 10-mev bremsstrahlung have been measured from 10-500 kev. Several lines appear in the Pb spectrum at about (20), (30), 40, 95, (120), 180, and 250 kev. The Bi spectrum is almost smooth. Data is related to the results of other experiments. The implications of such measurements in the determination of $\Gamma_{\gamma 0}$ and D are discussed.

1583

Massachusetts Inst. of Tech. [Lab. for Nuclear Science] Cambridge.

MULTIPLE-GAP SPECTROGRAPH FOR CHARGED-PARTICLE REACTION STUDIES (Abstract), by H. A. Enge and W. W. Buechner. [1961] [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. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 253, Apr. 24, 1961.

An 11-ton magnetic iron ring with magnetizing coils and 25 gaps provide magnetic fields for 25 broad-range magnetic spectrographs simultaneously facing a target in the center of the ring. Gaps are 7.5° apart, accepting reaction products at from zero to 172.5° in 7.5° steps. Geometry of each gap and associated nuclear-track plateholder is similar to the MIT-broad-range, single-gap spectrograph. An electrostatic quadrupole lens focuses a reduced image of the energy-defining slit for the electrostatic generator onto a rotating gas or solid target. The whole spectrograph is enclosed in a vacuum tank.

1584

Massachusetts Inst. of Tech. [Lab. for Nuclear Science] Cambridge.

LEVEL STRUCTURE OF Ar^{41} FROM THE $Ar^{40}(d,p)Ar^{41}$ REACTION, by E. Kashy, A. M. Hoogenboom, and W. W. Buechner. [1961] [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

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 260, Apr. 24, 1961.

Also published in Phys. Rev., v. 124: 1917-1922, Dec. 15, 1961.

The energy-level structure of Ar^{41} has been investigated by bombarding Ar gas with 7.5-mev deuterons and measuring the energy spectrum and angular distributions of the reaction protons. A Q-value of 3.874 ± 0.006 mev was measured. Fifty levels were observed, and their excitation energies, l_n values, reduced width, and shell-model configurations have been determined. Mean energies of the shell-model configurations were: $1f_{7/2}$, 0 mev; $2p_{3/2}$, 1.50 mev; $2p_{1/2}$, 3.53 mev; $3s_{1/2}$, 5.78 mev; $2d_{5/2}$, 4.86 mev; and $1f_{5/2}$, 5.55 mev.

1585

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

POLARIZATION OF COSMIC-RAY Mu MESONS UNDERGROUND AND AT SEA LEVEL (Abstract), by H. V. Bradt and G. W. Clark. [1961] [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. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 263, Apr. 24, 1961.

The polarization of cosmic-ray mu mesons that come to rest in a brass absorber has been measured at sea level with less than 20 g/cm^2 of material above the absorber and underground with about 3700 g/cm^2 of rock cover. The polarization was determined from the degree of asymmetry in the distribution of directions of decay electrons. The ratio of polarizations at the underground and sea level sites Pu/Ps was found to be 0.98 ± 0.18. A determination of the absolute polarizations from the observed effect was Pu = Ps = 0.26 ± 0.03. According

to the theory of Hayakawa the measured polarization depends, in part, on the proportion of K mesons among the parents of stopped muons. It is concluded that the measured results impose an upper limit on the K/π production ratio at the underground site.

1586

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

MEASUREMENT OF THE HIGH-ENERGY END OF THE μ-MESON SPECTRUM $K\mu$ DECAY (Abstract), by E. Loh, A. Boyarski and others. [1961] [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. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 301, Apr. 24, 1961.

The ranges of particles resulting from K^+ decay have been measured by means of a system of hodoscopes. One hundred thousand K^+ decays were examined yielding 106 μ-e tracks with the muon having an energy between 134 and 115 mev. Fifty-one out of the 106 tracks have 1 or 2 associated γ rays. The measured relative abundance of $K\mu_3$, in the energy region mentioned above is 0.68 ± 0.07%. The relative abundance of $K\mu_3$ obtained by this experiment together with that obtained by Taylor is compared with the calculations of Gatto and Bernstein.

1587

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

POSITIVE PARITY STATES OF Be^9 AND C^{13}, by F. C. Barker. [1961] [26]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

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 313, Apr. 24, 1961.

Also published in Nuclear Phys., v. 28: 96-121, Nov. 1961.

The states produced by weakly coupling a 2s- or 1d-neutron to a core consisting of the ground or first excited state of C^{12} are mixed by means of a 2-body spin-orbit interaction of the type normally used in intermediated-coupling calculations, to provide the low-lying positive-parity eigenstates of C^{13}. However, in order to obtain agreement with other data involving E1 radiative widths the single particle shell model wave functions must be modified so as to have the correct asymptotic forms. Similar calculations are performed for the Be^9 positive-parity states.

1588

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

EXTREMELY ENERGETIC COSMIC-RAY EVENT, by J. Linsley, L. Scarsi, and B. Rossi. [1961] [3]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)2098]) Unclassified

Published in Phys. Rev. Ltrs., v. 6: 485-487, May 1, 1961.

A large extensive air shower was observed with an array of scintillation counters covering an area of 2 km^2, at altitude 5800 ft. The size was derived as 5.5×10^9 particles, using a lateral distribution function found for smaller showers, and is probably underestimated. The primary energy is estimated to be at least 10^{19} ev, corresponding, for a proton, to a radius of curvature in the galaxy of 10^4 light yr. Arrival times of particles at distant detectors imply a shower radius greater than 7 km, but delayed particles observed up to 4μ sec late. It is concluded that the primary particle acquired its energy outside the galaxy.

1589

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

SOLUTION OF THE EQUATIONS FOR THE GREEN'S FUNCTIONS OF A TWO DIMENSIONAL RELATIVISTIC FIELD THEORY, by K. Johnson. [1961] [18]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. 20: 773-790, May 16, 1961.

The explicit solution of the coupled set of equations for the Green's functions for the self-coupled field theory model of Thirring is given. It is found that the infrared problem causes no special difficulty. The question of how to define products of singular field operators at coincident space-time points arises and it is shown that the commutation relations for such products are not consistently given by making use of the formal expressions and the canonical commutation relations. The problem of gauge invariance in an external field is

studied and it is shown that: (a) the current and charge density do not commute at equal times, and (b) this is necessary for and consistent with the gauge invariance of the field equations. (Contractor's abstract)

1590

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

CORRESPONDENCE PRINCIPLE APPROACH TO RADIATION THEORY, by F. E. Low. [1961] [2]p. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)2098]) Unclassified

Published in Amer. Jour. Phys., v. 29: 298-299, May 1961.

The classical law for the spontaneous radiation by a charged particle is expressed in such a way that its interpretation in terms of probabilities for transitions between stationary states is straightforward. (Contractor's abstract)

1591

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

STRIPPING ANALYSIS OF THE $Fe^{54}(d,p)Fe^{55}$ REACTION (Abstract), by A. Sperduto, W. W. Buechner and others. [1961] [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., Mexico City (Mexico), June 22-24, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 342, June 22, 1961.

The MIT-ONR Van de Graaff accelerator and broad-range spectrograph were used to study angular distributions of protons emitted from a thin target of iron enriched in Fe^{54} to 96.7%. The bombarding energy was 7.5 mev. Some preliminary results of the stripping analysis up to an excitation energy of 3 mev in Fe^{55} are as follows:

Ex (mev)	0	0.413	0.931	1.316	1.921	2.051	2.144
ln	1	1	3	(3)	1	1	3

Ex (mev)	4.474	2.944	3.03
ln	1	(1)	1

Groups corresponding to levels at 1.410, 2.210, 2.302, 2.542, 2.581, 2.877, and 2.988 do not show typical stripping distributions.

1592

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

STRIPPING ANALYSIS OF THE $Ni^{62}(d,p)Ni^{63}$ REACTION (Abstract), by H. A. Enge, W. W. Buechner and others. [1961] [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., Mexico City (Mexico), June 22-24, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 342, June 22, 1961.

The MIT-ONR Van de Graaff accelerator and the new multiple-gap, broad-range spectrograph have been used to study angular distributions of protons emitted from a thin enriched Ni^{62} target bombarded with 7.01 mev deuterons. The excitation energies and the l values for the captured neutron are for the lowest states:

Ex (mev)	0	0.085	0.155	0.513	0.995
ln	1	3	1	1	1

1593

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

CORE EXCITATIONS IN NONDEFORMED, ODD-A, NUCLEI, by A. de Shalit. [1961] [7]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. 122: 1530-1536, June 1, 1961.

The possibility of describing some excited state of odd-A nuclei in terms of excitations of even-even core is investigated. No assumption is made on the nature of the core excitation, but certain relations involving electromagnetic transitions and moments are deduced. These seem to fit well with some data available on Ag^{107}, Ag^{109}, Au^{197}, Hg^{199}, Tl^{203}, and Tl^{205}. More experimental data are required to test the validity of this picture in other cases. (Contractor's abstract)

1594

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

PROTON-PROTON INTERACTION, by H. Feshbach, E. Lomon, and A. Tubis. [1961] [4]p. incl. 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. Ltrs., v. 6: 635-638, June 1, 1961.

The applicability of the modified boundary condition model to the extensive proton-proton scattering data in the energy range extending up to 350 mev has been investigated. The success obtained with the model using a field-theoretical potential indicates the validity of the one- and two-pion exchange potentials in their appropriate range, and the physical significance of the energy-independent boundary condition employed to represent the shorter range interaction. The precision fit obtained requires only 9 parameters plus the acceptance of the usual fourth-order static "perturbation" theory results for the potential tail.

1595

Massachusetts Inst. of Tech. [Lab. for Nuclear Science] Cambridge.

CURRENT-CHARGE DENSITY COMMUTATION RELATIONS, by K. Johnson. [1961] [4]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 Nuclear Phys., v. 25: 431-434, June 1961.

It is shown that the non-vanishing of the current-charge density commutator at equal times is required by and is compatible with the continuity equation. (Contractor's abstract)

1596

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

ON THE PREPONDERANCE OF PROLATE DEFORMATIONS IN NUCLEI, by R. H. Lemmer and V. F. Weisskopf. [1961] [10]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 Nuclear Phys., v. 25: 624-633, June 1961.

An attempt is made to understand the preponderance of prolate nuclear deformations in terms of a simple Nilsson-type model for the deformed nucleus. (Contractor's abstract)

1597

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

PERSISTENCE OF STABILITY IN LAGRANGIAN SYSTEMS, by F. E. Low. [1961] [5]p. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)2098], and Texas Atomic Energy Research Foundation) Unclassified

Published in Phys. Fluids, v. 4: 842-846, July 1961.

It is shown for a large class of Lagrangian systems that a steady state configuration of the system which is linearly stable remains so under a small variation of the steady state, to all orders of perturbation theory in the variation. The principle is applied to two special systems: an incompressible ideal fluid, and a gas of charged particles interacting through their average fields. (Contractor's abstract)

1598

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

OPERATOR EQUATIONS IN TWO FIELD THEORY MODELS, by P. G. Federbush. [1961] [3]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 Prog. Theoret. Phys. (Japan), v. 26: 148-150, July 1961.

The field operators in the case of the following 2-dimensional models are shown to satisfy local field equations: (1) a boson field interacting with a fermion field through derivative coupling, and (2) two fermion fields interacting through coupled currents.

1599

Massachusetts Inst. of Tech. [Lab. for Nuclear Science] Cambridge.

PHOTOGRAPHY OF ČERENKOV LIGHT FROM EXTENSIVE AIR SHOWERS IN THE ATMOSPHERE, by D. A. Hill and N. A. Portier. [1961] [1]p. incl. illus. (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 Nature, v. 191: 690, Aug. 12, 1961.

An image intensifier system triggered by a photomultiplier was used to photograph the Čerenkov light. Thirty-two showers were photographed in 8 hr. Comparison of the film density produced by a shower and a star of

known magnitude provides an approximate estimate of the shower size. The direction of the showers can be determined with accuracy better than 0.5°.

1600

Massachusetts Inst. of Tech. [Lab. for Nuclear Science] Cambridge.

THE SCATTERING OF HIGH-ENERGY DEUTERONS FROM NUCLEI, by I. J. Campbell and A. K. Kerman. [1961] [2]p. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under AT(30-1)2098) Unclassified

Published in Proc. Rutherford Jubilee Internat'l. Conf., Manchester (Gt. Brit.) (Sept. 4-8, 1961), New York, Academic Press, 1961, p. 141-142.

A theory for high-energy nucleus-nucleus elastic scattering is obtained from extension of the formalism for nucleon-nucleus scattering at high energies. In particular, the momentum-space optical potential for the nucleus-nucleus interaction can be expressed in terms of the free nucleon-nucleon scattering amplitude and the form factors of each nucleus. The optical potential has been used to calculate the cross-section and vector polarization for deuteron-carbon elastic scattering in the Born approximation for incident deuteron laboratory energies of 125, 156, and 422 mev.

1601

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

NUCLEAR MAGNETIC MOMENT OF THE 158-KEV $5/2^-$ STATE OF Hg^{199}, by L. Grodzins, R. W. Bauer, and H. H. Wilson. [1961] [2]p. incl. diagr. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under AT(30-1)2098) Unclassified

Published in Proc. Rutherford Jubilee Internat'l. Conf., Manchester (Gt. Brit.) (Sept. 4-8, 1961), New York, Academic Press, 1961, p. 285-286.

Published in Phys. Rev., v. 124: 1897-1898, Dec. 15, 1961.

The nuclear magnetic moment of the 158-kev $5/2^-$ state has been measured by precessing, in a solid gold environment, the $3/2^-$ (334 kev) $5/2^-$ (158 kev) $1/2^-$ gamma ray-gamma ray angular correlation in an external magnetic field of 26,000 gauss. The value obtained, $\mu 5/2 = +1.03 \pm 0.08$ nm, includes a 5% correction for quadrupole attenuation as determined by studying the angular correlation as a function of the delay of the intermediate state. The value is compared to the recent prediction of de Shalit assuming that the $5/2^-$ state originates from the coupling of the $1/2^-$ ground state ($\mu_p = +0.504$ nm) with the 2+ excitation of the core. The magnetic moment of the core excitation was obtained from the M1 gamma-ray mean life of the 50-kev transition between the $3/2^-$ (208 kev) and $5/2^-$ (158 kev) core particle doublet. The mean life, determined to be $\tau_\gamma(50) = (4.46 \pm 1.0) \times 10^{-9}$ sec, leads to predicted magnetic moments of $\mu_{core} = (+0.33_{-0.25}^{+0.17})$ nm and $\mu_{5/2} = (+0.84_{-0.25}^{+0.17})$ nm.

1602

Massachusetts Inst. of Tech. [Lab. for Nuclear Science] Cambridge.

THE NUCLEAR MANY BODY PROBLEM IN THE BOUNDARY CONDITION MODEL, by E. L. Lomon. [1961] [2]p. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under AT(30-1)2098) Unclassified

Published in Proc. Rutherford Jubilee Internat'l. Conf., Manchester (Gt. Brit.) (Sept. 4-8, 1961), New York, Academic Press, 1961, p. 413-414.

The boundary condition model (BCM) is applied to the nuclear many body problem. The successful application of the BCM to the nuclear two body problem raises the question of its predictions for nuclear binding energy, etc. A pseudo-potential is used to exactly replace the boundary condition after which Brueckner equations can be applied, modified for "hole-hole" interactions. The simple solution of the short-range interaction allows for a reasonable numerical programme. The simplicity of the short-range contribution is further utilized to examine the size of various "correction" terms. (Contractor's abstract)

1603

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

ENERGY SPECTRUM AND STRUCTURE OF LARGE AIR SHOWERS, by J. Linsley, L. Scarsi, and B. Rossi. [1961] [12]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)2098] and National Science Foundation) Unclassified

Presented at Internat'l. Conf. on Cosmic Rays and the Earth Storm, Kyoto (Japan), Sept. 4-15, 1961.

Published in Jour. Phys. Soc. Japan, v. 17, Suppl. A-III: 91-102, Jan. 1962.

Preliminary results obtained during a 4000 hr running period in 1959-1960 at the MIT station Albuquerque, New

Mexico, latitude 35°N, at an elevation of 5800 ft (atmospheric depth 820 g cm^{-2}) are given. The results are discussed under the following headings: the lateral distribution of particle density; the proportion of penetrating particles; variation of shower intensity with atmospheric depth; shower size spectrum for atmospheric depth equivalent to sea level; largest shower; primary cosmic-ray energy spectrum; and isotropy of the primary cosmic radiation.

1604

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

PHOTOGRAPHY OF EXTENSIVE AIR SHOWERS IN CERENKOV LIGHT, by N. A. Porter and D. A. Hill. [1961] [3]p. incl. illus. (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 Internat'l. Conf. on Cosmic Rays and the Earth Storm, Kyoto (Japan), Sept. 4-15, 1961.

Published in Jour. Phys. Soc. Japan, v. 17, Suppl. A-III: 112-114, Jan. 1962.

An attempt to photograph the Čerenkov light from air showers directly is described. The apparatus consisted of an image intensifier system triggered by amplified pulses from a 5-in. photomultiplier. A Schmidt mirror of 30 cm diam, nominal aperture f/0.5, and an acceptance cone of half-angle 17° about the zenith, was focused for infinity on the photocathode of the image intensifier. The minimum detectable pulse corresponded to a shower size of about 5×10^4 particles at sea level.

1605

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

EXTENSIVE AIR SHOWERS AT THEIR MAXIMUM DEVELOPMENT, by G. W. Clark. [1961] [3]p. incl. diagrs. [Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under AT(30-1)2098] Unclassified

Presented at Internat'l. Conf. on Cosmic Rays and the Earth Storm, Kyoto (Japan), Sept. 4-15, 1961.

Published in Jour. Phys. Soc. Japan, v. 17, Suppl. A-III: 286-288, Jan. 1962.

Experimental results obtained on the characteristics of air showers near their maximum development are analyzed with particular reference to the quantities N(E, x), the average size of a cascade shower at depth x initiated by a primary particle of energy E, and J(E), the intensity of primaries with energy greater than E.

1606

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

THE POLARIZATION OF COSMIC RAY Mu-MESONS, by H. V. Bradt and G. W. Clark. [1961] [5]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)2098]) Unclassified

Presented at Internat'l. Conf. on Cosmic Rays and the Earth Storm, Kyoto (Japan), Sept. 4-15, 1961.

Published in Jour. Phys. Soc. Japan, v. 17; Suppl. A-III: 300-304, Jan. 1962.

The polarization of muons which come to rest in a brass absorber was measured at sea-level with 12,700 and 3,700 g/cm^2 (air equivalent) of cover above the absorber. The results obtained are compared with those of other workers and it is concluded that all of the results are consistent with there being no change in the polarization as the cover over the absorber is varied from 12 to 3700 gm/cm^2 (air equivalent).

1607

Massachusetts Inst. of Tech. [Lab. for Nuclear Science] Cambridge.

EFFECTS OF PARITY NON-CONSERVING INTERNUCLEON POTENTIALS ON THE PHOTOEFFECT IN H^2 AND H^3, by R. J. Blin-Stoyle and H. Feshbach. [1961] [10]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)

Published in Nuclear Phys., v. 27: 395-404, Oct. 1961.

Several effects on non-parity conserving potentials on the photodisintegration of the deuteron, on radiative neutron capture by hydrogen and deuterium have been estimated employing the non-parity conserving potential. Observation of the correlation of the circular polarization with the direction of emission of the γ-rays emitted in radiative neutron capture by deuterium appears to be the most promising experiment. (Contractor's abstract)

1608

Massachusetts Inst of Tech. Lab. for Nuclear Science, Cambridge.

MEASUREMENT OF THE REFRACTIVE INDEX OF LUCITE BY RECOILLESS RESONANCE ABSORPTION, by L. Grodzins and E. A. Phillips. [1961] [3]p. incl. diagrs. (Sponsored jointly by Air Force Office of

Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)2098]) Unclassified

Published in Phys. Rev., v. 124: 774-776, Nov. 1, 1961.

A method of frequency-modulating a monochromatic electromagnetic wave by varying the optical path length between the source and detector is described. The method has been applied to the measurement of the refractive index of Lucite for the 0.86A radiation emitted from Co^{57}; the small frequency shift was detected by recoilless resonance absorption. The refractive index was found to be $1 - n = (1.29 \pm 0.03) \times 10^{-6}$, in agreement with classical theory. (Contractor's abstract)

1609

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

EXCITATIONS OF TWO-PHONON SURFACE VIBRATIONS IN NUCLEI, by R. H. Lemmer, A. de Shalit and N. S. Wall. [1961] [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. 124: 1155-1162, Nov. 15, 1961.

The features of inelastic scattering leading to 2-phonon nuclear surface vibrations have been examined in Born approximation. Comparison is made with recent experimental results of inelastic α-particle scattering experiments on spherical nuclei. Good agreement is found between parameters derived from these experiments and Coulomb excitation, since the comparisons have been carried out in a relatively model-independent way. (Contractor's abstract)

1610

Massachusetts Inst. of Tech. [Lab. for Nuclear Science] Cambridge.

HIGH RESOLUTION STUDY OF THE $Bi^{209}(d,p)Bi^{210}$ REACTION (Abstract), by J. R. Erskine, W. W. Buechner, and H. A. Enge. [1961] [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., Chicago, Ill., Nov. 24-25, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 441, Nov. 24, 1961.

The $Bi^{209}(d,p)Bi^{210}$ reaction has been studied with 12-kev resolution using a multiple-gap magnetic spectrograph. The ground-state Q value was measured to be 2.362 ± 0.010 mev. The Q values and angular distributions of more than 38 energy levels have been obtained. The 7.5-mev bombarding energy which was used is much less than the size of the Coulomb barrier. The angular distributions are all peaked in the backwards direction with maxima at 180 degrees, as would be expected when the conditions for Oppenheimer-Phillips stripping are well met. The first 10 groups are well separated from the remainder, and on the assumption that their intensities follow the (2J + 1) rule they appear to arise from the expected $h_{9/2}g_{9/2}$ configuration. The best fit for the order of the spins starting with the ground state is J = 1, 0, 9, 2, 3, 5, 8, 4, 6, and 7. This order corresponds reasonably well with predictions which have been made using a zero-range interaction. The relative intensities of the different configurations show a dependence on the l value of the orbit into which the neutron is captured. This may furnish a new spectroscopic tool, since it may be possible to calculate this dependence on l.

1611

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

GENERALIZED FREE FIELDS AND MODELS OF LOCAL FIELD THEORY, by O. W. Greenberg. [1961] [19]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. 16: 158-176, Nov. 1961.

Generalized free fields are a generalization of the free field in which the commutator is a c-number but does not satisfy a homogeneous Klein-Gordon equation. Some properties of generalized free fields are examined including the appropriate generators of the inhomogeneous Lorentz group, the number operator, spectrum, locality, and asymptotic fields. These generalized free fields are used to construct a family of local field theory models which is not unitarily equivalent to any (generalized) free field. (Contractor's abstract)

1612

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

SCINTILLATION DETECTOR OF 4-M^2 AREA AND TRANSISTORIZED AMPLIFIER WITH LOGARITHMIC RESPONSE, by K. Suga, G. [W.] Clark, and I. Escobar. [1961] [3]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)-2098]) Unclassified

Published in Rev. Scient. Instr., v. 32: 1187-1189, Nov. 1961.

A scintillation detector with an area of 4 m^2 and a transistorized amplifier with a logarithmic height-to-time converter are described. The detector employs tapered sheets of plastic scintillator and a single 16-in. photomultiplier mounted in a pyramidal can, coated inside with a commercial 90% reflecting white paint. The response is uniform to within 5% over the entire sensitive surface. A traversal by 1 relativistic charged particle (energy loss ~10 mev) generates approximately 20 photoelectrons in the photomultiplier. The amplifier and converter yield a rectangular pulse whose duration is accurately proportional to the logarithm of the input pulse amplitude over a range of 4 decades. The gain is constant to 1 db from 10 to 45°C, and the equivalent noise input is 200 μv. (Contractor's abstract)

1613

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

LIMIT ON HIGH-ENERGY CROSS SECTION FROM ANALYTICITY IN LEHMANN ELLIPSES, by O. W. Greenberg and F. E. Low. [1961] [2]p. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)2098]) Unclassified

Published in Phys. Rev., v. 124: 2047-2048, Dec. 15, 1961.

High-energy limits on the scattering amplitude and the total cross section follow from that analyticity of the scattering amplitude in ellipses in $\cos\theta_{cm}$ which has been proved rigorously by Lehmann, together with unitarity. The limits for the scattering amplitude are $|T| < (\text{const})W^4 \ln^2 W$, for the forward and backward directions, and $|T| < (\text{const})W^3 \ln^{3/2} W$ for other fixed directions, where W is the total center of mass (cm) energy. For the total cross section the limit is $\sigma < (\text{const})W^2 \ln^2 W$. (Contractor's abstract)

1614

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

GAS TARGET FOR THE MULTIPLE-GAP, BROAD-RANGE SPECTROGRAPH, by A. M. Hoogenboom. [1961] [3]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)2098] Unclassified

Published in Rev. Scient. Instr., v. 32: 1395-1397, Dec. 1961.

A gas target with a very thin cylindrical window has been developed for use with the new M.I.T. multiple-gap, broad-range spectrograph. This gas target permits observation of reaction particles at all angles, except zero and 180°. It has been used with a window thickness of 0.5 μ and a gas pressure of 1 cm Hg for (d,p) angular-distribution experiments with a 7.5 mev, 0.5 μa deuteron beam. (Contractor's abstract)

1615

[Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge]

EXPERIMENTAL NUCLEAR ENERGY LEVELS OF Mg^{25} AND THEIR INTERPRETATION, by R. K. Sheline and R. A. Harlan. [1961] [22]p. incl. diagrs. tables, refs. (In cooperation with Florida State U., Tallahassee) (Sponsored jointly by [Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under AT(30-1)2098 and Atomic Energy Commission under AT(40-1)2434]) Unclassified

Published in Nuclear Phys., v. 29: 177-198, Jan. 1962.

Using the reaction $Al^{27}(d,\alpha)Mg^{25}$ and a magnetic spectrograph, 66 levels in Mg^{25} have been determined below 8.7 mev excitation. An interpretation of the levels utilizing the Bohr-Mottelson collective model and an empirical rule is attempted. Results indicate that below 4.4 mev, agreement with the model is good, while above this energy, deviations from experimental level density and energies can be qualitatively explained by additional intrinsic and vibrational states, Cariolis coupling and the uncoupling of paired nucleons in higher-spin rotational states. A statistical treatment, used in determining the nuclear temperature of Mg^{25} as $\approx$ 2.45 mev, indicates that the level spacing begins to become smaller than experimental energy resolution above 7.7 mev. (Contractor's abstract)

1616

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

THE COSMIC-RAY FLARE EFFECT. I. SOME NEW METHODS OF ANALYSIS, by K. G. McCracken. [1961] [12]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 Jour. Geophys. Research, v. 67: 423-434, Feb. 1962.

A systematic method for determining the angular dependence of the cosmic radiation in the vicinity of the earth during a cosmic-ray solar flare effect, and a method for determining the rigidity spectrum of the radiation during the anisotropic phase of a flare effect, are described. In the appendixes are presented (1) calculations of the asymptotic directions of approach particles using

a simulation of the geomagnetic field which includes spherical surface harmonics up to the sixth degree; (2) a method of correcting flare observations to a given atmospheric pressure level which takes into account the short attenuation length of the flare radiation; and (3) a comparison which shows that a number of high-latitude sea-level neutron monitors are strictly comparable despite differences in their geometries. (Contractor's abstract)

1617

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

THE COSMIC-RAY FLARE EFFECT. II. THE FLARE EFFECTS OF MAY 4, NOVEMBER 12, AND NOVEMBER 15, 1960, by K. G. McCracken. [1961] [12]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 Jour. Geophys. Research, v. 67: 435-446, Feb. 1962.

The observations of the flare effects of May 4 and Nov. 12 and 15, 1960, are analyzed, particular attention being given to obtaining an understanding of the anisotropies that existed in the cosmic-ray fluxes during the events. For each event it is found that the flux was greatest from a direction to the west of the sun. During the May 4 event the flux was greatest from, and symmetrical about, a direction 55° to the west of the sun, and 10° north of the ecliptic, for more than 9 hr after the commencement of the flare effect. The differential rigidity spectrum is investigated, the power-law exponent being calculated to be -5.0 at 1045 UT, and shown to be decreasing with time. For the Nov. 12 event, it is shown that an anisotropy persisted until about 1900 UT, when the radiation rapidly became isotropic. At this same time, the counting rates of all neutron detectors increased very suddenly and a Forbush decrease was observed by meson detectors. It is shown that at about 1600 UT an additional anisotropic flux of radiation arrived at the earth from within the hemisphere centered upon the sun, and between 1700 and 1800 UT an additional anisotropic flux arrived from the opposite direction. For the Nov. 15 event, it is shown that the radiation became isotropic within about 90 min of the commencement of the flare effect. The anisotropies at early times are studied, the most important observation being that particles were arriving from some directions in space for approx 30 min before any arriving from the opposite direction. (Contractor's abstract)

1618

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

THE COSMIC-RAY FLARE EFFECT. III. DEDUCTIONS REGARDING THE INTERPLANETARY MAGNETIC FIELD, by K. G. McCracken. [1961] [12]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 Jour. Geophys. Research, v. 67: 447-458, Feb. 1962.

The observations of cosmic-ray flare effects made at sea level are used to investigate the magnetic fields within the inner solar system. Considering the temporal dependence of intensity, the degree of anisotropy, and the direction in space from which the fluxes were greatest, it is concluded that when a large, active sunspot group is on the far western portion of the solar disk, magnetic lines of force essentially connect the sunspot group to the earth. It is shown that small-scale irregularities exist in these lines of force. The over-all configuration of the magnetic field regime is investigated; the trapping of cosmic rays injected by solar flares and the exclusion of galactic cosmic rays are discussed. The relative merits of two contemporary theoretical models of the interplanetary fields established by solar activity are discussed. (Contractor's abstract)

1619

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

A NOTE ON THE VERTICAL CUTOFF RIGIDITIES OF COSMIC RAYS IN THE GEOMAGNETIC FIELD, by A. Freon and K. G. McCracken. [1961] [3]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)2098]) Unclassified

Published in Jour. Geophys. Research, v. 67: 888-890, Feb. 1962.

Flare effects of Nov. 1960 provided the opportunity to test the Quenby and Webber approximation (1959). The equations of motion of a negatively charged particle in the Finch and Leaton (1957) simulation of the geomagnetic field were integrated numerically, the particle trajectory being computed from the point of interest on the surface of the earth to a point beyond which the geomagnetic field has an insignificant influence on the motion of the particles. It seems clear that the trajectory of the negatively charged particle leaving the point of observation P, and initially moving vertically away from the earth is identical to that of a positive particle of the same rigidity arriving at P from the vertical. Repeating this computation for numerous rigidities, it was found that at low rigidities the negative particle cannot escape from the earth. The maximum value for this situation is taken as an approximate lower limit for the vertical cutoff rigidity. The least value for which the particle escapes is taken as an approximate upper limit. The vertical cutoff rigidity at Port aux Francais

was calculated to be within the limits 1.27 bv ≤ R ≤ 1.30 bv. Discrepancies between Quenby and Webber estimates and the present estimates are indicated.

1620

Massachusetts Inst. of Tech. [Lab. for Nuclear Science] Cambridge.

THE HIGHER RESONANCES IN PION-NUCLEON SCATTERING, by P. G. Federbush, M. T. Grisaru, and M. Tausner. [1961] [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. 18: 23-46, Apr. 1962.

A model for calculating the pion-nucleon amplitude in the region of the higher resonances is presented. Using partial wave dispersion relations, it attempts to take into account the inelastic process $N + \pi \rightarrow N + \pi + \pi$ by assuming that the final particles interact strongly in pairs, and treating the interacting pairs as stable particles. In addition to the singularities required by unitarity, it is assumed that only the unphysical singularities due to single-particle exchanges are important. (Contractor's abstract)

1621

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

CYLINDRICAL SPARK CHAMBER, by M. A. Wahlig, A. Buffington and others. [1961] [3]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. 33: 539-541, May 1962.

A spark chamber consisting of 8 coaxial cylindrical gaps around a liquid hydrogen target has been built and used. The sparks are viewed by a single camera looking axially up into the chamber. Stereo information is provided in the same view by reflections of the sparks from tilted mirrors at the top of the chamber. (Contractor's abstract)

1622

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

THEORY OF INTERBAND FARADAY ROTATION IN SEMICONDUCTORS, by B. Lax and Y. Nishina. [1961] [4]p. incl. diagrs. (AFOSR-493) (Sponsored jointly by Air Force [Office of Scientific Research, Office of Naval Research, and Signal Corps] under AF 19(604)7344) Unclassified

Also published in Phys. Rev. Ltrs., v. 6: 464-467, May 1, 1961.

It is shown that calculations similar to a quantum mechanical approach to interpretation of large changes in rotation occurring at energies close to the energy gap can be made for the indirect and direct forbidden transitions to determine the interband Faraday rotation and its dependency on wavelength. The theory is approximate and makes a number of assumptions. One assumption is that the bands are quadratic and extend to large k values without changing the curvature. The theory also neglects the losses which can be taken into account phenomenologically in the final expressions. For more accurate analysis of the Faraday rotation in p-type Ge, it is also necessary to take statistics into account since the dispersion must be weighted by the number of empty states. In spite of these assumptions, however, the results obtained seem to be reasonable because they can explain the major features of the experimental observations, whereas the classical theory for bound electrons cannot.

1623

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

INTERBAND FARADAY ROTATION IN III-V COMPOUNDS, by B. Lax and Y. Nishina. [1961] [4]p. incl. diagrs. refs. (AFOSR-948) (AF 19(604)7344) Unclassified

Also published in Jour. Appl. Phys., Suppl., v. 32: 2128-2131, Oct. 1961.

Also published in Semiconducting Compounds; Proc. of Conf., Schenectady, N. Y. (June 14-16, 1961), New York, W. A. Benjamin, Inc., 1961, p. 2128-2131. (AFOSR-2010)

Experimental investigation of Faraday rotation in III-V compounds has exhibited a striking singularity at photon frequencies just below the energy gap. A quantum theoretical result associated with the direct transition has been developed to explain the phenomenon. The treatment has been extended to include forbidden transitions which are readily applicable to such materials as InAs, GaAs, and GaSb where interband transitions between the split-off valence bands have been observed. The treatment for observing Faraday rotation by reflection has also been considered and experimental results in InSb at optical frequencies will be presented. The calculations have also been performed for degenerate semiconductors at low temperature. (Contractor's abstract)

1624

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

SOME USEFUL INFORMATION FOR THE DESIGN OF

AIRCORE SOLENOIDS, PART I. RELATIONSHIPS BETWEEN MAGNETIC FIELD, POWER, AMPERE-TURNS AND CURRENT DENSITY. PART II. HOMOGENEOUS MAGNETIC FIELDS, by D. B. Montgomery and J. Terrell. Nov. 1961 [49]p. incl. diagrs. tables. (AFOSR-1525) (AF 19(604)7344) AD 269073 Unclassified

Relationships relating power, magnetic field, current density, and ampere-turns in terms of certain dimensionless factors are summarized for many types of coil geometries and current distributions. A number of plots of these factors are presented. The field homogeneity in magnet structures is presented in terms of a series expansion about the origin utilizing Legendre polynomials. A number of tables to facilitate design of homogeneous fields are presented. A method of achieving homogeneity in long solenoid structures by the use of determinants is discussed. Expressions for the axial field from uniform and radially varying current density coils are given. (Contractor's abstract)

1625

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

SOME USEFUL INFORMATION FOR THE DESIGN OF IRON MAGNETS. PART I. THE CALCULATION OF GAP FIELDS BY MEANS OF EQUIVALENT SURFACE POLES. PART II. THE CALCULATION OF GAP FIELDS BY MEANS OF DISTRIBUTED VOLUME DIPOLES. PART III. ANALYSIS OF EXISTING MAGNETS, by D. B. Montgomery. Nov. 1961 [36]p. incl. diagrs. tables. (AFOSR-1526) (AF 19(604)7344) AD 269074 Unclassified

The calculation of gap fields in iron magnets by means of equivalent surface poles has been explored by several authors. This work is enlarged and the results compared with the performance of a wide range of commercial magnets. Magnet circuits can also be analyzed by a volume integral of dipoles. This removes the restriction of uniform magnetization and allows the optimum direction of magnetization to be explored. General results are given for iron cylinders, and a number of specific tapered poles are analyzed. The homogeneity of fields in the gaps of magnets is presented in the form of a Taylor series of error coefficients. (Contractor's abstract)

1626

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

HIGH MAGNETIC FIELD RESEARCH, by B. Lax. [1961] [5]p. incl. diagrs. (AFOSR-3567) (AF 19(604)-7344) AD 612325 Unclassified

Presented at Seventh Conf. on Magnetism and Magnetic Materials, Phoenix, Ariz., Nov. 13-16, 1961.

Also published in Jour. Appl. Phys., Suppl., v. 33: 1025-1029, Mar. 1962.

The use of high magnetic fields as a research tool for a wide variety of physical phenomena is clearly recognized today and the subject of an International Symposium at Cambridge this fall. Another important step in promoting research with the help of large magnetic fields has been the sponsorship of the M.I.T. National Magnet Lab. by the Air Force. This paper reviews the highlights of the conference which included papers on research in plasma physics, low temperatures, solid state and the latest developments for generating high magnetic fields. The plans and objectives of the National Magnet Lab. and description of the physical facilities will be presented. In addition, a brief review will be given of a number of experiments already performed in the existing Magnet Lab. at M.I.T.

1627

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

NEW DEVELOPMENTS IN HIGH MAGNETIC FIELD RESEARCH, by F. Bitter. [1961] [16]p. incl. illus. diagrs. tables, refs. (AFOSR-3568) (AF 19(604)7344) Unclassified

Presented at Thirtieth Joseph Henry Lecture, Philos. Soc. of Washington, May 12, 1961.

Also published in Bull. Philos. Soc. of Washington, v. 16: 1-16, 1961.

Also published in Phys. Today, v. 14: 22-28, Sept. 1961.

A summary of what is known about magnetism and magnets past, present and future is presented.

1628

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

HYDROMAGNET: A SELF-GENERATING LIQUID CONDUCTOR ELECTROMAGNET, by H. H. Kolm. [1961] [9]p. incl. illus. diagrs. table refs. (AFOSR-3630) (AF 19(604)7344) Unclassified

Also published in Jour. Appl. Phys., v. 32: 1296-1304, July 1961.

A novel liquid electromagnet is investigated in which the exciting current is generated within the solenoid by forcing the liquid conductor radially inward through the space between 2 coaxial cylinders placed in an axial magnetic field. The tangential current thus generated within the flowing conductor adds to the initial applied field so that the device behaves like a self-excited, short-circuited homopolar generator. It is shown theoretically that for low values of the magnetic Reynolds

number, the amplification of the magnetic field is a quadratic function of this number and that the total dissipation depends on the square of the amplification and on the cube of the hydrodynamic Reynolds number. The experimental findings are in reasonable agreement with the theory. (Contractor's abstract)

1629

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

WATER COOLED MAGNETS, by F. Bitter. [1961] [8]p. incl. illus. diagrs. tables. (AFOSR-2631) (AF 19-(604)7344) Unclassified

Also published in Rev. Scient. Instr., v. 33: 342-349, Mar. 1962.

Also published in Proc. Internat'l. Conf. on High Magnetic Fields, Cambridge, Mass. (Nov. 1-4, 1961), Cambridge, M.I.T. Press and New York, Wiley and Sons, 1962, p. 85-99. (AFOSR-2299)

This paper discusses the construction of water cooled solenoids at power levels ranging from 1 to 100 mw and with cylindrical inner working spaces having radii ranging from 1 to 10 cm. A first limitation is due to the fact that the power density in the magnet cannot exceed a value set by the surface cooling rate allowable in the water passages. Present designs go up to a power density of 1.5×10^4 w/cm^3 and a surface cooling rate of 1.5×10^3 w/cm^2. With these limitations, useful coils can be built operating at power levels ranging from 1 to 10 mw and giving fields ranging from 100 to 250 kgauss. In the range of 200 to 300 kgauss, Zr-Cu or Cr-Cu alloys may be used to avoid plastic deformation at the inner surface. The strengthening and cooling of coils to operate at higher power levels is discussed. A preliminary design is presented for a high precision magnet for nuclear magnetic resonance experiments.

1630

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

ADVANCES IN THE GENERATION AND USE OF VERY HIGH, CONTINUOUS MAGNETIC FIELDS, by H. H. Kolm. [1961] [8]p. incl. illus. diagr. (AFOSR-3632) (AF 19(604)7344) Unclassified

Also published in Nature, v. 192: 299-302, Oct. 28, 1961.

A brief account is given of the applications of high magnetic fields, and of the difficulties of generating high continuous fields, especially over a large volume. Kapitza's work on pulsed fields is mentioned, and magnets invented by Bitter which can give 100 kgauss continuously are discussed. More recently, studies of cyclotron resonance have necessitated higher fields, and a solenoidal electromagnet has been built which is capable of giving 130 kgauss continuously. A new laboratory is under construction at which fields up to 250 kgauss will be available.

1631

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

PULSED CRITICAL FIELD MEASUREMENTS IN MAGNETIC SYSTEMS, by S. Foner and S.-L. Hou. [1961] [2]p. incl. diagrs. (AFOSR-3633) (AF 19(604)7344) Unclassified

Presented at Seventh Conf. on Magnetism and Magnetic Materials, Phoenix, Ariz., Nov. 13-16, 1961.

Also published in Jour. Appl. Phys., Suppl., v. 33: 1289-1290, Mar. 1962.

Pulsed field magnetic moment measurements in several magnetic systems are briefly summarized. Particularly high sensitivity is attained for systems which exhibit a nonlinear variation of magnetization versus applied field, e.g., "spin-flop." Changes of magnetization as small as 0.1 gauss could be observed with applied fields of over 100 kgauss under favorable circumstances. Critical fields for Cr_2O_3 and $(Cr_2O_3)_{0.9}\cdot(Al_2O_3)_{0.1}$ from 4.2°K to about 0.95 T_N and the corresponding calculated values of $(2\lambda K)^{\frac{1}{2}}$ are presented, where λ is the exchange constant and K is the anisotropy energy. The values of $(2\lambda K)^{\frac{1}{2}}$ agree with earlier antiferromagnetic resonance measurements in similar crystals. Results of measurements in antiferromagnetic MnF_2, CoF_2, and $FeTiO_3$, and in metamagnetic $FeCl_2$ and $CoCl_2$ are briefly discussed. Application of the method to paramagnets is also indicated. (Contractor's abstract)

1632

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

CYCLOTRON RESONANCE, by B. Lax. [1961] [8]p. incl. diagrs. refs. (AFOSR-3655) [AF 19(604)7344] Unclassified

Also published in Science, v. 134: 1333-1340, Oct. 27, 1961.

Cyclotron resonance (or electrical resonance) is used in the study of electronic energy bands in solids. Cyclotron resonance experiments may be performed with gases but different information is gained. With germanium and silicon the existence of "holes" in semiconductors was proved. A while later the difficulties posed by an impure semiconductor were overcome and the existence of "holes" in them proved with the aid of cyclotron resonance. From the study of cyclotron resonance, devices are being

designed which may make possible the scientific investigation of the far-infrared region of the electromagnetic spectrum. Plans for a cyclotron resonance maser are underway.

1633

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

INTENSE MAGNETIC FIELDS FOR RESEARCH, by D. Stevenson and H. [H.] Kolm. [1961] [4]p. incl. illus. diagr. (AFOSR-3657) (AF 19(604)7344) Unclassified

Also published in Dusquesne Sci. Counselor, v. 24: 101-103, 120, Dec. 1961.

A brief history of intense magnetic fields is presented along with proposed plans for the construction of continuously operating solenoids.

1634

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

IRON MAGNET DESIGN, by D. B. Montgomery. [1961] [14]p. incl. diagrs. [AF 19(604)7344] Unclassified

Published in Proc. Internat'l. Conf. on High Magnetic Fields, Cambridge, Mass. (Nov. 1-4, 1961), Cambridge, M.I.T. Press and New York, Wiley and Sons, 1962, p. 180-193. (AFOSR-2299)

The calculation of gap fields in iron magnets by means of equivalent surface poles has been explored by several authors. This work has been enlarged and the results are compared with the performance of a wide range of commercial magnets. Magnet circuits can also be analyzed by a volume integral of dipoles. This removes the restriction of uniform magnetization and allows the optimum direction of magnetization to be explored. (Contractor's abstract)

1635

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

A NIOBIUM-TIN SUPERCONDUCTING MAGNET, by L. C. Salter, S. H. Autler and others. [1961] [4]p. incl. diagr. table. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [AF 19(604)7344] and Advanced Research Projects Agency and National Science Foundation) Unclassified

Published in Proc. Internat'l. Conf. on High Magnetic Fields, Cambridge, Mass. (Nov. 1-4, 1961), Cambridge, M.I.T. Press and New York, Wiley and Sons, 1962, p. 344-347. (AFOSR-2299)

Measurements reported on short samples of niobium tin-core wire indicate that this material should be useful for the fabrication of high-field superconducting magnets. It is necessary to wind the magnet in its final form and insulate it before the heat treatment because of the brittle nature of the niobium-tin core. It was necessary to develop techniques for insulating and protecting the wire with a material which would withstand the high-temperature treatment, without liberating chemically incompatible decomposition products. It was found possible to fabricate a magnet from niobium-tin core wire which can generate significant magnetic fields.

1636

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

THE NATIONAL MAGNET LABORATORY, by D. T. Stevenson. [1961] [5]p. incl. illus. diagr. tables. [AF 19-(604)7344] Unclassified

Published in Proc. Internat'l. Conf. on High Magnetic Fields, Cambridge, Mass. (Nov. 1-4, 1961), Cambridge, M.I.T. Press and New York, Wiley and Sons, 1962, p. 398-402. (AFOSR-2299)

The National Magnet Lab. is a research laboratory sponsored by the Air Force Office of Scientific Research and operated by M.I.T. The major research activity will be in solid-state, low-temperature, and related fields of physics. In addition, there will be a strong program of research and development in magnetic field generation. The laboratory is described with reference to its floor plan, power supply and the type of magnets to be included. A brief listing of the projects under the laboratory's research program is given.

1637

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

MAGNETOSPECTROSCOPY IN SOLIDS, by B. Lax. [1961] [17]p. incl. diagrs. refs. [AF 19(604)7344] Unclassified

Published in Proc. Internat'l. Conf. on High Magnetic Fields, Cambridge, Mass. (Nov. 1-4, 1961), Cambridge, M.I.T. Press and New York, Wiley and Sons, 1962, p. 437-453. (AFOSR-2299)

This paper gives a brief account of a number of experiments which have already exploited or partially exploited magnetic fields in the study of the fundamental properties of solids. The experiments discussed are those concerned with magneto-optical effects, intraband effects, (magneto-plasma reflection, Faraday rotation and the Voigt effect), interband effects (magneto-absorption and magneto-reflection, intraband Faraday rotation and Voigt effects) and the Zeeman effect (magneto-tunneling, and the Mössbauer effect).

1638

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

PULSED-FIELD RESONANCE MEASUREMENTS, by S. Foner. [1961] [10]p. incl. illus. diagrs. refs. [AF 19(604)7344] Unclassified

Published in Proc. Internat'l. Conf. on High Magnetic Fields, Cambridge, Mass. (Nov. 1-4, 1961), Cambridge, M.I.T. Press and New York, Wiley and Sons, 1962, p. 489-498. (AFOSR-2299)

This paper summarizes a number of resonance experiments that were performed with high magnetic fields. Pulsed fields were used for most of the experiments although in many cases d-c fields could also have been employed. Specific examples are chosen to illustrate some of the advantages and limitations of these high-field resonance experiments. Related high-field magnetization measurements are also briefly discussed since, at times, they can augment the resonance experiments.

1639

Massachusetts Inst. of Tech. Naval Supersonic Lab., Cambridge.

PERFORMANCE DATA ON COOLING TURBINE SYSTEM FOR MASS TRANSFER CONES, by B. Rockower. June 9, 1959 [13]p. incl. diagrs. tables. (MTP-TM-31) (AFOSR-4086) (AF 49(638)245) Unclassified

This report contains a summary of performance data taken on the cooling turbine system which is to be used in testing porous cones. Most of the data was taken using air with some check point using helium. Two nozzles were used, one with a circular cross sectional area of 0.00581 in.^{2} and the other with a rectangular cross sectional area of 0.01275 in.^{2}.

1640

Massachusetts Inst. of Tech. Naval Supersonic Lab., Cambridge.

CALIBRATION OF COOLING TURBINE NOZZLE WITH RECTANGULAR SECTION (Dwg. D-7-290) USED IN MASS TRANSFER EXPERIMENT, by B. Rockower. June 16, 1959 [9]p. incl. diagrs. tables. (MTP-TM-29) (AFOSR-4087) (AF 49(638)245) Unclassified

This report contains information on the calibration of the turbine nozzle with rectangular section. The nozzle was designed and built in order to obtain a greater temperature drop in the cooling medium, helium, which flows through the porous cone. The sectional throat area is 0.01275 in.^{2} as compared to 0.00581 in.^{2} for the nozzle (Dwg. B-7-209A) with circular section.

1641

Massachusetts Inst. of Tech. Naval Supersonic Lab., Cambridge.

TRANSPORT PROPERTIES FOR MIXTURE BOUNDARY LAYER WEDGE SOLUTIONS, by P. B. Scott. June 29, 1959 [28]p. incl. diagrs. tables, refs. (MTP-TM-32) (AFOSR-4088) (AF 49(638)245) Unclassified

Preliminary to the machine solution of the binary mixture, non-vanishing pressure gradient, boundary layer equations, it is necessary to decide on some means of representation of the transport properties of the gas mixtures to be considered in the calculations. Mathematical relations representing the following fluid properties are considered: viscosity parameter, derivative of the viscosity parameter, Schmidt number, Prandtl number, and specific heat.

1642

Massachusetts Inst. of Tech. Naval Supersonic Lab., Cambridge.

EFFECT OF VARIABLE WALL THICKNESS ON INJECTION RATE-FLAT PLATE AND HEMISPHERE, by J. P. Moran. July 20, 1959, 29p. incl. diagrs. tables. (MTP-TM-34) (AFOSR-4089) (AF 49(638)245) Unclassified

There are 2 methods of approach used in this report to determine the geometric shape required to satisfy both pressure and velocity boundary conditions. The first is a general solution of the 2 dimensional Laplace equation and the second is a 1-dimensional solution based on the assumption that the velocity in the primary flow direction is everywhere much greater than the velocity component normal to that direction. Two simple geometric shapes are considered in this analysis, a flat plate and a hemispherical shell, both of varying thicknesses. By fixing geometric and pressure boundary conditions a comparison of the 1-dimensional and Laplace solutions of thickness variation for the same mass flux at the outside surface is made for both geometric shapes. A cross comparison of the thickness variation for the same mass flux is made between the incompressible and isothermal solutions for both the flate plate and the hemispherical shell.

1643

Massachusetts Inst. of Tech. Naval Supersonic Lab., Cambridge.

BINARY BOUNDARY LAYER SOLUTIONS BY MEANS OF A FINITE DIFFERENCE METHOD, by P. B. Scott. July 24, 1959, 33p. incl. diagrs. (MTP-TM-33) (AFOSR-2090) (AF 49(638)245) Unclassified

The equations of the binary boundary layer in the absence of thermal diffusion are considered. In this report only the Crocco formulation, which is applicable to many of the interesting situations, is discussed.

1644

Massachusetts Inst. of Tech. Naval Supersonic Lab., Cambridge.

FINITE DIFFERENCE FORMULATION OF THE BINARY BOUNDARY LAYER WITH VELOCITY OVERSHCOT, by P. B. Scott. Aug. 3, 1959 [15]p. incl. diagr. (MTP-TM-35) (AFOSR-4091) (AF 49(638)245) Unclassified

A general formulation for the solution of the binary boundary layer equations is presented. The major advantage of the general formulation is its applicability to cases of velocity over-shoot. In addition, an implicit difference representation is used, which allows a relaxation of the mesh size restrictions imposed by stability considerations.

1645

Massachusetts Inst. of Tech. Naval Supersonic Lab., Cambridge.

RECALCULATION OF THE DISTRIBUTION OF THE LOCAL BLOWING RATE ON AN ISOTHERMAL, POROUS HEMISPHERE, by A. F. Gollnick, Jr. Sept. 3, 1959 [13]p. incl. diagrs. tabls. (MTP-TM-37) (AFOSR-4092) (AF 49(638)245) Unclassified

In another paper (see item no. 1656, Vol. V), an approximate method for calculating the local blowing rate on a porous hemisphere with constant skin temperature was discussed. It is now known that these solutions are incorrect. New wedge solutions have been computed, using much the same computer program as before, with a few minor exceptions. These changes are in regard to the mathematical representation of the transport properties of the binary mixture.

1646

Massachusetts Inst. of Tech. Naval Supersonic Lab., Cambridge.

I.B.M. 704 PROGRAM FOR BINARY MIXTURES, PRESSURE GRADIENT BOUNDARY LAYER EQUATIONS, by C. V. McCarthy. Aug. 27, 1959, 2p. (MTP-TM-36) (AFOSR-4093) (AF 49(638)245) Unclassified

A program has been written for the IBM 704 computing machine to give a solution to the 3 simultaneous boundary layer equations of momentum, concentration and energy. The method used for forward integration is the Gill-Kutta method.

1647

Massachusetts Inst. of Tech. Naval Supersonic Lab., Cambridge.

MASS FLOW AND COOLING REQUIREMENTS FOR A POROUS HEMISPHERE, by A. F. Gollnick, Jr. Sept. 25, 1959, 12p. incl. diagrs. (MTP-TM-38) (AFOSR-4094) (AF 49(638)245) Unclassified

In a later paper (see item no. 1656, Vol. V) an approximate method for obtaining the injection distribution required to maintain a constant wall temperature on a hemisphere is discussed. In another paper (see item no. 1645; AFOSR-4092) the normalized distribution corresponding to free stream conditions of $M_\infty = 3.50$ and $T_0 = 570°$ R was computed. A model having the specified distribution is under construction, and will be tested at the appropriate conditions. The accuracy of the pressure gradient of Ref. 1 will be checked, together with the effect of different gases as coolants at various stagnation blowing rates. The purpose of this report is to indicate the mass flow levels necessary for the test, the coolant temperatures required, and the pressure drops through the hemisphere wall. The effect of tunnel operating conditions on these quantities will be evaluated. (Contractor's abstract)

1648

Massachusetts Inst. of Tech. Naval Supersonic Lab., Cambridge.

INCORPORATION OF THE EXISTING GAS COOLING AND SUPPLY SYSTEM IN THE TEST OF A POROUS HEMISPHERE, by A. F. Gollnick, Jr. Nov. 3, 1959, 12p. incl. diagrs. tables. (MTP-TM-39) (AFOSR-4095) (AF 49(638)245) Unclassified

It is concluded that, on the basis of the available data, the nozzle-turbine cooling system can furnish sufficient cooling, in conjunction with an alcohol-dry ice heat exchanger, over the desired range of flow rates. In order to operate at low rates, it will be necessary to run the turbine at its optimum inlet pressure, and dump the surplus coolant into the boundary layer scavenging system. This is particularly true for helium.

1649

Massachusetts Inst. of Tech. Naval Supersonic Lab., Cambridge.

THE CALIBRATION OF POROUS WEDGES, by A. F. Gollnick, Jr. Dec. 9, 1959, 12p. incl. diagrs. tables. (MTP-TM-40) (AFOSR-4096) (AF 49(638)245) Unclassified

This report describes the second step in the preliminary study intended to evaluate the slip casting of a suitable stainless steel powder as a possible technique for

fabricating a variably permeable hemisphere to be tested in the supersonic tunnel. The thickness variation predicted on the hemisphere for α (resistance coefficient) was built into a series of wedge-shaped samples. The calibration of 3 such wedges is discussed.

1650

Massachusetts Inst. of Tech. Naval Supersonic Lab., Cambridge.

AN EXPLICIT FINITE DIFFERENCE FORMULATION ON SPACE COORDINATES APPLIED TO THE BINARY BOUNDARY LAYER EQUATION, by J. Moran. Feb. 15, 1960, 15p. incl. diagr. (MTP-TM-43) (AFOSR-4097) (AF 49(638)245) Unclassified

An explicit finite difference formulation on space coordinates as applied to the binary boundary layer equation is considered. This formulation becomes more stable as $\frac{\partial u}{\partial y}/W$ increases; this is the reverse of the trend in the Crocco formulation. This program will therefore be unstable near separation while the Crocco form has no defined stability requirements at separation. By employing the proper program it should be possible to solve all possible flow configurations. It should be noted that the wall values which are expanded in power series will be in greatest error under condition of maximum stability.

1651

Massachusetts Inst. of Tech. Naval Supersonic Lab., Cambridge.

COOLANT INJECTION PARAMETERS FOR COOLING OF HYPERSONIC NOZZLE, by R. P. Bernicker. Dec. 23, 1959, 13p. incl. diagrs. (MTP-TM-42) (AFOSR-4098) (AF 49(639)245) Unclassified

It is the purpose of this report to investigate the dependence of the reduction in adiabatic wall temperature near the throat upon the type of injection used in the upstream subsonic region. In particular, the parameters to be examined will be the ratio of coolant supply temperature to tunnel stagnation temperature, the position of the injection section (local Mach number in the external flow field), and the ratio of coolant mass flow to mainstream mass flow. No attempt will be made to evaluate the effects of such parameters upon the exit plane of the nozzle: the experimental investigation will be restricted to the neighborhood of the throat and a small length in the expansion section. It is necessary to estimate the amount of coolant required for given conditions, and to predict the injection distribution for a given nozzle.

1652

Massachusetts Inst. of Tech. Naval Supersonic Lab., Cambridge.

NOZZLE DESIGN FOR CONSTANT PRESSURE GRADIENT PARAMETER β, by R. [P.] Bernicker. Dec. 15, 1959, 19p. incl. diagrs. tables. (MTP-TM-41) (AFOSR-4099) (AF 49(638)245) Unclassified

It is the purpose of this report to determine geometric conditions such that the pressure gradient parameter β will be constant. In particular, analysis will be directed towards a nozzle geometry, though the requirements that β be constant depend only on the external flow field, and by the somewhat arbitrary choice of an origin for the s coordinate.

1653

Massachusetts Inst. of Tech. Naval Supersonic Lab., Cambridge.

FLOW CALIBRATION OF POROUS HEMISPHERES WITH NONUNIFORM WALL THICKNESS, by A. F. Gollnick, Jr. Apr. 18, 1960, 25p. incl. diagrs. (MTP-TM-44) (AFOSR-4100) (AF 49(638)245) Unclassified

This report describes the completion of the design study for a porous hemispherical wind tunnel model, as well as the calibration of the actual model tested in the supersonic tunnel. The work described falls into 2 parts. First a 6 in. diam hemisphere was designed. Four hemispheres based on this design were delivered by Mott Metallurgical Corp., Hartford, Conn. These were calibrated and a revised thickness distribution was based upon this data. New molds were fabricated and 2 new hemispheres were obtained. One of these, upon calibration, became the actual model used in the tunnel.

1654

Massachusetts Inst. of Tech. Naval Supersonic Lab., Cambridge.

PREDICTED POROUS CONE AND COOLANT TEMPERATURES UNDER TUNNEL TEST CONDITIONS, by R. [P.] Bernicker. June 10, 1959, 13p. incl. diagrs. tables. (MTP-TM-30) (AFOSR-4101) (AF 49(638)245) Unclassified

It is the purpose of this report to apply the procedures and results of a previous paper (item no. 1071, Vol. III) to a porous cone under tunnel operating conditions, and thereby to predict the equilibrium temperatures under given conditions of coolant supply temperature and injection rate. This analysis will be applied, both for air and helium as coolants, for 2 sections; 1 near the nose (x = 3.0 in.), and 1 farther downstream toward the base (x = 12 in.). The correlation for Nusselt number

as a function of Peclet number and porosity obtained previously will be extrapolated to the range of Peclet numbers involved in the cone test, and the results obtained for air will be assumed to be valid for helium as well.

1655

Massachusetts Inst. of Tech. Naval Supersonic Lab., Cambridge.

THICKNESS EFFECTS IN FLUID FLOW THROUGH POROUS DISCS, by A. F. Gollnick, Jr. May 1, 1959 [13]p. incl. diagrs. tables. (MTP-TM-27) (AFOSR-4102) (AF 49(638)245) Unclassified

Results indicate the desired level of α, the viscous resistance coefficient, cannot be achieved using the material of which these discs were made: a stainless steel powder consisting of particles which will pass through a No. 325 sieve. The variation of the flow resistance properties on each disc is under 5% and is satisfactory. Unless geometric shape has some effect, this is the order of magnitude that might be expected on the final model at a given station relative to the nose. In other words, in the absence of thickness settling effects, the properties should be constant to within 5%. It is concluded that the flow resistance coefficient α is independent of thickness.

1656

Massachusetts Inst. of Tech. Naval Supersonic Lab., Cambridge

REQUIRED VARIATION OF THE LOCAL BLOWING RATE OVER AN ISOTHERMAL, POROUS HEMISPHERE, by A. F. Gollnick, Jr. Mar. 24, 1959 [44]p. incl. diagrs. tables. (MTP-TM-26) (AFOSR-4103) (AF 49(638)245) Unclassified

It is the purpose of this paper to calculate the distribution of blowing rate necessary to maintain a constant skin temperature on a porous hemisphere. It is assumed that the hemisphere is to be tested in the supersonic tunnel, with helium and possibly air being used as the coolant. The method used is an approximate one first used by Stine and Wanless to calculate heat transfer rates on an isothermal hemisphere at high speed, and extended by C. J. Scott to include air injection. In this report the analysis is further extended to treat the problem in which gases other than air are used as coolants. Briefly, the analysis takes the equations of motion for the boundary layer on an axisymmetric body and makes use of a Mangler transformation to obtain the corresponding 2-dimensional equations. It is then assumed that at every station on the transformed hemisphere, or cylinder, the local flow may be replaced by some wedge type flow, in which the free stream velocity varies as a power of the streamwise distance. The appropriate wedge is obtained by equating the distance along the wedge, the free stream velocity, and the free stream velocity gradient to the corresponding quantities at the station on the cylinder at which matching is to take place. At this point the problem is reduced to that of obtaining a number of wedge solutions for compressible flow, with the appropriate boundary conditions.

1657

Massachusetts Inst. of Tech. Naval Supersonic Lab., Cambridge.

THE LAMINAR ISOTHERMAL BOUNDARY LAYER ON A FLAT PLATE WITH UNIFORM INJECTION, by A. F. Gollnick, Jr. Mar. 24, 1958, 11p. incl. diagrs. table. (MTP-TM-18) (AFOSR-4104) (AF 49(638)245) Unclassified

The laminar isothermal boundary layer on a flat plate with uniform injection is analyzed mathematically. The validity of the analysis must rest on experimental verification. In addition, the restriction to an isothermal layer is severe, and limits the practical usefulness. In view of the simplicity of the actual computations, it would appear worth while to look into both an experimental program, and the extension of the method to non-isothermal boundary layers.

1658

Massachusetts Inst. of Tech. Naval Supersonic Lab., Cambridge.

SOME APPROXIMATIONS TO THE SOLUTION TO THE BINARY BOUNDARY LAYER PROBLEM, by E. Covert. Jan. 23, 1959, 20p. incl. diagrs. (MTP-TM-25) (AFOSR-4105) (AF 49(638)245) Unclassified

The binary boundary layer, that is a boundary layer with 2 gas components, has not been extensively analyzed. The purpose of this report is to find approximate relations between the shear, heat transfer, mass transfer, temperature and concentration of foreign gases. The methods that will be used to find these approximate relations will closely parallel that of Liepmann, although in some cases Lighthill's technique can be used.

1659

Massachusetts Inst. of Tech. Naval Supersonic Lab., Cambridge.

DECAY OF WALL CONCENTRATION DOWNSTREAM OF AN INJECTION REGION, by F. E. C. Culick. Apr. 20, 1961, 8p. incl. diagr. (MTP-TM-46) (AFOSR-4106) (AF 49(638)245) Unclassified

In connection with measurements to be made on a partially porous cone, it is desirable to be able to predict both wall concentration of helium and adiabatic wall temperature downstream of a finite injection region. The

subject of this paper is a simple analysis which apparently yields at best qualitative information relating to this problem.

1660

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

[MATERIAL CONCERNING MACHINE TRANSLATION] Materialy po mašinnomu perevodu, reviewed by M. Haile. 1958, 6p. (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 240918 Unclassified

Published in Language, v. 36: 112-117, Jan.-Mar. 1960.

A review is presented of a collection of papers on various aspects of machine translation.

1661

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

EXPERIMENTAL STUDY OF A PLASMA COLUMN IN A MICROWAVE CAVITY, by S. J. Buchsbaum, E. I. Gordon, and S. C. Brown. [1959] [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, and Atomic Energy Commission) Unclassified

Presented at 1959 Internat'l. Plasma Physics Institute, Washington U., Seattle, Aug. 31-Sept. 5, 1959.

Published in Plasma Physics, Accelerators, Thermonuclear Research, v. 2: 164-168, Jan. 1961.

Experiments designed to study the production of a steady-state plasma column by microwave cavity means are described. At low plasma densities electrons are heated by cyclotron resonance in crossed microwave electric and static magnetic fields. Phenomena associated with large energies which the electrons possess near cyclotron resonance are discussed. Large plasma densities are achieved by resonating the plasma column by suitably varying the static magnetic field, the microwave frequency and the input power. In this manner, densities of the order of 10^{12} cm^{-3} are obtained at a neutral gas pressure in the micron range. (Contractor's abstract)

1662

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

THE DESIGN OF COMMUNICATIONS SYSTEMS, by E. J. Baghdady. [1959] [2]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) Unclassified

Published in I.R.E. Trans. on Commun. Systems, v. CS-7: 228-229, Dec. 1959.

A brief analysis of contemporary communications theory is given. It is also shown that the synthesis of ideas provided by a symposium on communication system theory and design is a necessity for stimulating rapid development of a satisfactory discipline in this area.

1663

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

LINEAR SPACE-CHARGE THEORY OF GAP INTERACTION BETWEEN AN ELECTRON BEAM AND ELECTROMAGNETIC FIELDS, by A. Bers. [1960] [8]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 Microwave Tubes, Proc. of the Third Internat'l. Cong., Munich (Germany) (June 7-11, 1960), New York, Academic Press, 1961, p. 53-60.

The system under consideration consists of a waveguide with perfectly conducting walls having a gap. External to the gapped waveguide is an electromagnetic circuit (usually a resonator) which can support electromagnetic fields. Inside the waveguide an electron stream is assumed in either confined or Brillouin flow, with uniform time-average density and drift velocity across its cross section. Collisions are neglected and a zero temperature stream is assumed. Results are presented which are restricted to electron beams with $\omega_p/\omega \ll 1$ and gaps whose extent is short compared to a free-space wavelength. The weak coupling approach used here describes the fields of the circuit in the absence of the beam, and the electron beam waves in the absence of the circuit. Subsequently, the fields of these 2 systems are coupled by considering the motion of the electron stream under the influence of the circuit fields. Only the case of longitudinal interaction is considered.

1664

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

CONFIGURATION MIXING AND THE EFFECTS OF DISTRIBUTED NUCLEAR MANGETIZATION ON HYPERFINE STRUCTURE IN ODD A NUCLEI, by H. H. Stroke and R. J. Blin-Stoyle. [1960] [3]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], and Atomic Energy Commission) Unclassified

Published in Proc. Internat'l. Conf. on Nuclear Structure, Kingston, Ont. (Canada) (Aug. 29-Sept. 3, 1960), Toronto U. Press, 1960, p. 518-521.

For abstract see item no. 1705, Vol. V.

1665

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

PROGRESS IN INFORMATION THEORY IN THE U.S.A., 1957-1960, by P. Elias, A. Gill and others. [1960] [17]p. incl. refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Presented at Thirteenth General Assembly of the Internat'l. Scientific Radio Union, London (Gt. Brit.), Sept. 5-15, 1960.

Published in I.R.E. Trans. on Information Theory, v. IT-7: 128-144, July 1961.

This report is comprised of five parts. Part 1 is concerned with contributions centering on Shannon's theory and the theory of coding. Part 2 deals with those results in the theory of random processes which are of relevance to communication problems. Part 3 surveys advances of a basic nature in pattern recognition. Part 4 is concerned primarily with the detection of signals in noise. Part 5 is given over to prediction and filtering, centering on Wiener's theory and its extensions.

1666

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

THE THERMIONIC CONVERSION OF HEAT TO ELECTRICITY, by W. B. Nottingham. [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) AD 260110 Unclassified

Published in Advances in Electron Tube Techniques, Proc. of the Fifth Nat'l. Conf. (Sept. 1960), New York, Pergamon Press, p. 72-76.

A thermionic converter is a diode with an electron emitter and an electron collector. The emitter must be at a higher temperature than the collector and the net electrical flow correspond to an electron current flowing from the emitter to the collector. Energy, in the form of heat, is supplied to the emitter and a smaller amount of heat energy must be removed from the collector, either by radiation or by means of a heat sink which can conduct the excess heat away, possibly for use in some other heat conversion device. The difference between the heat supplied and the heat removed is available for the direct conversion of heat to electricity. The importance is described of the emitter properties and the transport properties of the interelectrode space in the determination of the current that can flow across the thermionic diode. A better understanding of the lowering of surface work-function by the presence of absorbed cesium will, through its control of the collector work-function, increase the voltage available in the converter. The voltage output thus depends both on the transport mechanism and the surface potential of the collector relative to its Fermi level. (Contractor's abstract)

1667

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

HOLLOW CATHODE HIGHLY IONIZED DISCHARGE (Abstract), by C. Michelson and D. J. Rose. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], Atomic Energy Commission and National Science Foundation) Unclassified

Presented at the Thirteenth Annual Gaseous Electronics Conf., Monterey, Calif., Oct. 12-15, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 385, June 22, 1961.

A highly ionized plasma is made by the prescription: gas flow (H_2, He, A, N_2) 0.3-2 cc STP/sec through a refractory hollow cathode tube; any anode; 30-200 v dc. An axial induction 100-1000 gauss is used for collimation and assistance in rf starting; the induction can be removed during operation. The discharge runs from the cathode interior, where $p_0 d \approx 1$ cm x mm Hg. If the ions sputter or vaporize the cathode material, the cathode interior forms a cavity. Typical conditions are: 3-mm diam cathode, 50-amp, 35-v, 0.5-cc/sec argon, external pressure 3×10^{-4} mm Hg, cavity pressure 40 mm Hg, cathode temperature 2500°C, electron temperature 1-2 ev with high energy tail. Currents 2-200 amp have been run; the configuration can be modified considerably at will. Charge densities are 10^{13}-10^{14}/cm^3 in the exterior plasma and 10^{16}-10^{17}/cm^3 inside the cavity. Calculations show that a neutral gas molecule has little chance of reaching the external plasma without being ionized, consistent with observations.

1668

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

PROPAGATION OF WAVES IN A PLASMA IN A MAGNETIC FIELD, by W. P. Allis. [1960] [4]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108, Atomic Energy Commission and National Science Foundation) Unclassified

Published in I.R.E. Trans. on Microwave Theory and Tech., v. MTT-9: 79-82, Jan. 1961.

The propagation of electromagnetic waves in a plasma in a magnetic field as given by the Appleton-Hartree theory is discussed in terms of the wave normal surfaces instead of the more conventional propagation vector plots, and the ordinary and extraordinary waves are defined in terms of their polarizations instead of using a continuity argument. This gives a different picture of a wave which has some advantages. In particular, whistlers become obvious, as are regions of high reflection and high absorption. The Appleton-Hartree theory is then extended to include the effect of electron temperature, and this results in a third wave whose velocity is of the order of electron thermal motions. (Contractor's abstract)

1669

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

OFF-RESPONSES FROM THE AUDITORY CORTEX OF ANESTHETIZED CATS: EFFECTS OF STIMULUS PARAMETERS, by T. T. Sandel and N. Y.-S. Kiang. [1960] [16]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], and National Institutes of Health)
AD 258[illegible]6 Unclassified

Also published in Arch. Ital. Biol., v. 99: 105-120, Apr. 1961.

The effects of various stimulus parameters in evoking auditory off-responses are investigated. It is found that off-responses do occur when the terminal transient of the stimulus covers a broad band of frequencies. A simple model has been proposed to explain the phenomena as they occur with low-intensity stimuli. Another model has been proposed to account for off-responses that are seen when high-intensity stimuli are used. This latter model incorporates the idea of an inhibitory "halo" surrounding a[illegible] area of intense local activation of the cortex. (Contractor's abstract)

1670

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ELECTROHYDRODYNAMIC AND MAGNETOHYDRODYNAMIC SURFACE WAVES AND INSTABILITIES, by J. R. Melcher. [1961] [7]p. incl. illus. diagrs. refs. (AFOSR-3375) (Sponsored jointly by Air Force Flight Accessories Lab.; and Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Also published in Phys. Fluids, v. 4: 1348-1354, Nov. 1961.

Low-frequency dynamics of a plane fluid interface stressed by tangential or perpendicular electric or magnetic fields is studied emphasizing the duality of the magnetic and electric cases. Both configurations are shown to be controlled by an effective Alfvén velocity for the magnetic cases, and by an electrohydrodynamic dual to this velocity for the electric cases. A wavelength and threshold for instability are predicted for a surface stressed by a perpendicular field, and correlated with experimental results. This makes possible a critical experiment to determine the nature of interfacial electrostriction in dielectrics. A dielectric interface stressed by a tangential electric field supports incompressible electrohydrodynamic transverse waves that propagate along the lines of electric field intensity at a velocity strongly influenced by interfacial electrostriction. Experimental results indicate the existence of such waves. (Contractor's abstract)

1671

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

REPLY TO COMMENTS OF J. D. JUKES, by J. L. Hirshfield and S. C. Brown. [1961] [1]p. (AFOSR-3405) (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. Fluids, v. 4: 1185, Sept. 1961.

The authors have re-evaluated their original estimate of the reduction in radiation losses resulting from the use of reflectors, in order to see if they did present too pessimistic a result and thus should not have suggested that "... any fusion reactor of the mirror machine type would face a catastrophic loss...".

1672

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

MAGNETIC RESONANCE IN RADIATING OR ABSORBING ATOMS, by F. Bitter. [1961] [10]p. incl. diagrs. refs. (Technical rept. no. 394) (AFOSR-3619) (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 Appl. Opt., v. 1: 1-10, Jan. 1962.

In the last ten years a great deal of work has been done on the experimental investigation of atomic energy levels using magnetic resonance techniques. This paper concerns itself primarily with a review of some of the studies of atomic vapors in connection with level structures, on the one hand, and the mutual interactions of light oscillating magnetic fields and the effects of collisions, on the other. (Contractor's abstract)

1673

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ELECTROHYDRODYNAMIC SURFACE RESONATORS by J. R. Melcher. [1961] [2]p. incl. diagrs. (AFOSR-J122) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], and Air Force Systems Command, Aeronautical Systems Division under AF 33(616)7624) AD 400079 Unclassified

Also published in Phys. Fluids, v. 5: 1130-1131, Sept. 1962.

A fluid-fluid interface stressed by an electric field supports electrohydrodynamic surface waves that depend intimately on the electromechanical surface traction. The properties of these waves in resonance are considered for a planar surface bounded by a rigid rectangular box with an unperturbed electric field that is perpendicular (type I) or tangential (type II) to the interface. Resonances of both types were measured and verify earlier experimental results. The resonators were constructed with care taken to avoid fringing fields. The surface was excited by vibrating the resonator, and the resulting waves were illuminated by a point source to detect the resonant frequency.

1674

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

HIGHLY IONIZED HOLLOW CATHODE DISCHARGE, by L. M. Lidsky, S. D. Rothleder and others. [1961] [8]p. incl. diagrs. table, refs. (AFOSR-J993) (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 Jour. Appl. Phys., v. 33: 2490-2497, Aug. 1962.

A hollow cathode discharge (HCD) is described that produces a highly ionized steady state plasma ($n_e \approx 10^{13}$-10^{14}/cm^3) at a temperature 1-10 ev, in a volume as large as 10^4 cm^3, with background neutral gas density $\approx 10^{13}$/cm^3. The HCD is generated by the prescription; gas flow (H_2, He, A, or N_2) 0.05-2 cc STP/sec through a refractory metal hollow cathode tube into a vacuum; any anode; 20-200 v dc applied. An axial induction 100-1000 G is used to collimate the discharge and to aid in starting by rf excitation. The HCD runs from the cathode interior. deep enough that $p_0 d \approx 1$ cm x mm Hg. Current range is 2.0-300 A. Various electrode configurations and a wide range of operating parameters have been studied. The external plasma density and temperature were measured by Langmuir probes. A discussion is given of the confinement mechanism and of the energy balance, both in the external plasma and in the region of the cathode itself. (Contractor's abstract)

1675

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

COUPLING BETWEEN ELECTROMAGNETIC AND ELECTRON WAVES IN A PLASMA, by W. P. Allis and S. J. Buchsbaum. [1961] [5]p. incl. diagrs. refs. (AFOSR-J1123) (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 and National Science Foundation) Unclassified

Also published in Nuclear Fusion, v. 2: 49-53, Sept. 1962.

The coupling between electromagnetic and electron plasma waves in a uniform plasma in the presence of a static magnetic field is studied. The transport equations are used to represent the plasma and Maxwell's equations to represent the fields. These yield a dispersion relation which is discussed here only for ions of infinite mass. Eight topologically different phase velocity surfaces suffice to represent the system of combined electromagnetic and electron waves for all values of plasma density and magnetic field strength. The plasma waves have cutoffs (phase velocity infinite) wherever the electromagnetic wave has a resonance (phase velocity zero); the coupling between the 2 waves is strong there and their respective velocity surfaces join smoothly one onto the other. Elsewhere the waves are distinct. (Contractor's abstract)

1676

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

RADIOFREQUENCY EMISSION FROM PLASMAS NOT IN THERMODYNAMIC EQUILIBRIUM, by S. C. Brown and G. Bekefi. [1961] [11]p. incl. diagrs. table, refs. (AFOSR-J1544) (Sponsored jointly by Air Force Command and Control Development Division under AF 19-(604)5992, 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 Conf. on Plasma Physics and Controlled Nuclear Fusion Research, Salzburg (Austria), Sept. 4-9, 1961.

Also published in Nuclear Fusion, Suppl., Pt. 3: 1089-1099, 1962.

Calculations of the propagation constant of a plane

electromagnetic wave in a tenuous unbounded plasma show that under suitable conditions the wave grows exponentially in amplitude. For this to happen (a) the population of electrons should increase with increasing energy and (b) the emission cross-section for the process in question must decrease sufficiently rapidly with increasing energy. Detailed calculations of the rate of amplification and the range of frequencies in which it occurs are given for bremsstrahlung and cyclotron emission. Amplification of bremsstrahlung occurs in plasmas of low ionization and for low electron energies. Amplification of cyclotron emission is particularly favorable in highly ionized, high-energy plasmas. Here even small departures of the electron distribution of energies from Maxwellian distribution lead to a very significant increase of cyclotron emission. Experiments, designed to measure the amplification of cyclotron emission, are described. (Contractor's abstract)

1677

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

DEPOSITION OF METALLIC FILMS BY ELECTRON IMPACT DECOMPOSITION OF ORGANOMETALLIC VAPORS, by A. G. Baker and W. C. Morris. Jan. 13, 1961 [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 Bureau of Ships) AD 258157 Unclassified

Also published in Rev. Scient. Instr., v. 32: 458, Apr. 1961.

An electron beam with a current density of approximately 5 ma/cm^2 operated with potentials between 50 v and 1 kv has been used to decompose organometallic vapors to produce thin metallic films. Two modes of operation have been investigated. A molecular starving is achieved by having more electrons arrive in unit time than are needed to decompose the molecules arriving at the substrate during that time. This mode gives films which do not show the nonuniformity of the electron beam. A second mode of operation can be realized by allowing more molecules to strike the substrate than the electron beam can accommodate. The films produced with this mode of operation show nonuniformities which appear to be due to the nonuniform beam density. Films between 50 and 1500 A in thickness have been produced. Highly reflecting tin films with surface resistances from 50 ohms per sq to about 1000 ohms per sq have been made. Other films have resistances as high as 1 meg per sq and have a brown appearance.

1678

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

SOME REQUIREMENTS FOR THE OPERATION OF MAGNETOHYDRODYNAMIC INDUCTION GENERATORS, by H. H. Woodson and A. T. Lewis. [1961] [17]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], and Wright Air Development Division under AF 33(616)3984) Unclassified

Published in Engineering Aspects of Magnetohydrodynamics; Proc. Second Symposium, Philadelphia, Pa. (Mar. 9-10, 1961), New York, Columbia U. Press, 1962, p. 277-293.

The usual analysis of an MHD induction generator starts with assumed gas properties and proceeds to the terminal properties. In this investigation the process is reversed. Here, it is assumed that single-frequency ac power is to be generated. This leads to an equivalent circuit that is necessary to satisfy this assumption. Analysis of the equivalent circuit shows some general properties of the system in terms of circuit parameters, and circuit parameters are shown to be related to gas properties by using experimental results obtained with magnetically driven shock tubes. This process yields an unambiguous specification of the gas properties (mainly magnetic Reynolds number) that must be achieved to obtain certain performance characteristics. More exact data on gas behavior are needed to make the analysis accurate enough for engineering design.

1679

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

A MAGNETOHYDRODYNAMIC POWER CONVERTER, by W. D. Jackson, E. S. Pierson, and D. A. East. [1961] [13]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 Science Foundation: and Wright Air Development Division under AF 33(616)7624) Unclassified

Published in Engineering Aspects of Magnetohydrodynamics; Proc. Second Symposium, Philadelphia, Pa. (Mar. 9-10, 1961), New York, Columbia U. Press, 1962, p. 294-306.

The interchange of electrical power between dc systems having different voltage levels is currently achieved with a variety of schemes involving rotating machinery, controlled mercury-arc rectifiers, or solid-state devices. The method proposed and examined in this paper has been termed magnetohydrodynamic power conversion and uses a channeled, electrically conducting fluid, an electromagnetic pump, and a MHD generator to replace, respectively, the mechanical coupling, drive motor and generator of a conventional rotating machine converter set. Consideration is restricted to the case of voltage transformation in dc systems and to MHD converters in which a liquid metal serves as the working fluid. The pump and generator sections for this type of converter

are essentially homopolar machines in which the rotating disc of Faraday's original unipolar inductor has been replaced by a flowing fluid.

1680

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

PRODUCTION OF A PLASMA WITH HIGH-POWER, PULSED MICROWAVES, by T. Fessenden. Aug. 29, 1961 [13]p. incl. illus. diagrs. table. (Technical rept. no. 389) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-73108], and National Science Foundation) Unclassified

Published in Engineering Aspects of Magnetohydrodynamics; Proc. Second Symposium, Philadelphia, Pa. (Mar. 9-10, 1961), New York, Columbia U. Press, 1962, p. 529-544.

A dense plasma in a resonant cavity can be produced in a few microseconds by a high-power pulse of microwave energy. The cavity should be excited at frequencies near the resonant frequency of a cavity mode obtained when the volume normally occupied by the plasma is replaced by a perfect conductor. That is, a cavity mode should be used that requires the presence of the plasma for its existence. The electron density and collision frequency of a dense plasma in a resonant cavity can be related to the amount of detuning produced by the plasma. A perturbation theory that assumes that the plasma is a perfect conductor in the unperturbed case can be used for calculating the parameters of the plasma from measurements of the detuning of the cavity.

1681

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

APPLICATION OF STOCHASTIC APPROXIMATION METHODS TO OPTIMUM FILTER DESIGN, by D. J. Sakrison. [1961] [9]p. incl. diagr. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Presented at I.R.E. Internat'l. Convention, New York, Mar. 20-23, 1961.

Published in I.R.E. Internat'l. Convention Record, Pt. 4: 127-135, 1961.

For a filter containing a number of variable parameters, the input and desired output of which are the outputs of stationary ergodic sources, it is required that a parameter setting be selected which minimizes the average value of some positive function of the error (not necessarily the mean square error). An iterative approach is made to the problem and conditions guaranteeing convergence are discussed, as well as estimates made of the rate of convergence. The iterative procedure is stated to be approximate and to involve considerable computing but has the advantages (1) of minimizing any convex function of the error, not just the mean error, and (2) it does not require the preliminary measurement of correlation functions or other statistics.

1682

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

HYPERFINE-STRUCTURE SEPARATIONS, ISOTOPE SHIFTS, AND NUCLEAR MAGNETIC MOMENTS OF THE RADIOACTIVE ISOTOPES Tl^{199}, Tl^{200}, Tl^{201}, Tl^{202}, AND Tl^{204}, by R. J. Hull and H. H. Stroke. Mar. 1961 [10]p. incl. illus. diagrs. tables, refs. (Technical rept. no. 393) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) AD 268488 Unclassified

Also published in Jour. Opt. Soc. Amer., v. 51: 1203-1212, Nov. 1961.

The hyperfine structure and isotope shift of 5 radioactive isotopes of thallium were measured spectroscopically. Thallium-199 (7.4 hr) and thallium-200 (27 hr) were produced by alpha bombardment of gold; thallium-201 (3 day), thallium-202 (12 day), and thallium-204 (4 yr) were produced by deuteron bombardment of liquid mercury. The isotopes were excited in electrodeless-discharge lamps. Previously measured values of the nuclear spins of the odd-even isotopes were verified. Nuclear magnetic moments or upper limits on the moments were calculated by comparison of the hyperfine splittings of the radioactive isotopes with the known splittings and moments of the stable thallium isotopes. A definite dependence of the relative isotope shifts on neutron number was observed.

1683

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

DETECTION THEORY AND PSYCHOPHYSICS: A REVIEW, by J. A. Swets. [1961] [15]p. incl. refs. [Technical rept. no. AFCCDD-TR-61-3] (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108, and Air Force Operational Applications Office) Unclassified

Published in Psychometrika, v. 26: 49-63, Mar. 1961.

The application of the general theory of signal detection to psychophysics is discussed in this critique of Fechner's principal concepts and methods. It is shown how the theory of signal detection deals with the problem of the

definition of the observers criterion for making a positive response. The likelihood ratio criterion, the observer's criterion and the optimal criterion, and the theory of ideal observers are explained and the implications for psychophysical methods and examples of substantive problems studied in this framework are expressed.

1684

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

COLLISION FREQUENCY OF A PLASMA AS A FUNCTION OF APPLIED ac FREQUENCY (Abstract), by S. Yoshikawa. [1961] [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. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 290, Apr. 24, 1961.

The Coulomb collision frequency, ν_c, was calculated by means of the time-dependent Fokker-Planck equation derived from the 6N-dimensional Liouville equation. The collision frequency was found to depend on the frequency, ω, of the applied external field. The first-order approximation leads to the result previously obtained by Ginsburg in dc external field. The frequency dependence is contained only inside the Coulomb logarithm, Λ, which is replaced by $\Lambda\omega_p/\omega$ whenever ω exceeds the plasma frequency, ω_p. The result can be interpreted as a decrease of the effective radius of the Debye sphere. Before an electron can travel a distance v_0/ω the external field reverses its sign; hence the lesser of v_0/ω and the Debye length v_0/ω_p should enter as the cutoff of the Coulomb interaction. The former becomes shorter, if $\omega > \omega_p$.

1685

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

COMMENTS ON THE BARNES COLD CATHODE GAUGE, by W. B. Nottingham. [1961] [2]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Published in Rev. Scient. Instr., v. 32: 464-465, Apr. 1961.

Two papers have been published by Dr. G. Barnes (Rev. Scient. Instr., v. 31: 608, 1960, and v. 31: 1121, 1960) which were intended to describe the construction and properties of a new type of vacuum gauge. For such communications to be of value, a new gauge design should incorporate features which either give greater simplicity in the gauge construction itself or its auxiliary measuring equipment or offer higher reliability, greater ease of calibration, or greater extension in the range of pressure which it can evaluate. It is not at all clear from these 2 papers that Dr. Barnes has accomplished any of these purposes. The Barnes device is useless as a means of evaluating vacuum conditions and no evidence presented in these papers is valid as a scientific evaluation of the usefulness and accuracy of Bayard-Alpert type gauges.

1686

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

THE RECOGNITION OF SPEECH BY MACHINE, by G. W. Hughes. May 1, 1961 [62]p. incl. illus. tables, refs. (Technical rept. no. 395) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) AD 268489 Unclassified

The problem of engineering a mechanical (automatic) speech recognition system is discussed in its theoretical and practical aspects. Performance of such a system is judged in terms of its ability to act as a parallel channel to human speech recognition. The linguistic framework of phonemes as the atomical units of speech, together with their distinctive feature description, provides the necessary unification of abstract representation and acoustic manifestation. A partial solution to phoneme recognition, based on acoustic feature tracking, is derived, implemented, and tested. Results appear to justify the fundamental assumption that there exist several acoustic features that are stable over a wide range of voice inputs and phonetic environments. (Contractor's abstract)

1687

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

"CORKSCREW"—A DEVICE FOR CHANGING THE MAGNETIC MOMENT OF CHARGED PARTICLES IN A MAGNETIC FIELD, by R. C. Wingerson. [1961] [3]p. incl. diagr. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], and National Science Foundation) AD 258927 Unclassified

Also published in Phys. Rev. Ltrs., v. 6: 446-448, May 1, 1961.

A helix gives rise to a field which can perturb an initially axial field causing a steady change in the transverse energy of particles in the field, and hence their magnetic moment. This may allow trapping of a high-energy beam

injected axially into a mirror device. There must be a close match between the pitch of the helix locally and the particle trajectory. The particles are thus trapped by a resonance effect whereas losses will occur by random scattering. It is hoped that the difference between trapping and loss mechanisms will allow increased containment times by modifications to the basic configuration. The necessary equations are derived briefly. Trapping was observed in the experiments on an electron beam.

1688

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

EFFECTS OF VOWEL CONTEXT ON THE ARTICULATION OF STOP CONSONANTS (Abstract), by O. Fujimura. [1961] [2]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-first meeting of the Acoust. Soc. Amer., Philadelphia, Pa., May 10-13, 1961.

Published in Jour. Acoust. Soc. Amer., v. 33: 842-843, June 1961.

Movements of the lips and the mandible were studied by means of a stroboscopic motion picture technique during the production of intervocalic velar (palatal) and alveolar stop consonants. Three subjects pronounced English words like veto, echo, cookie, okay, etc., in which significantly different labial articulations are required for the first vowel and the second vowel. A film speed of 50 frames/sec was employed for the experiment. Results indicate that during the closure period of nonlabial stops, the labial configuration changes considerably in anticipation of the following vowel. In echo, for example, the lips start to close during the production of the first vowel, and the most conspicuous change in their shape occurs during the closure period of /k/. In general, there is substantial disagreement between the movement of the lips and that of the mandible. Some details of the relation between the articulatory movement and the boundaries found in the sound spectrogram are given. Implications concerning the acoustic structures of the output sound, such as the "target" of formant transition, are discussed.

1689

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ON THE PROPERTIES OF VOICELESS FRICATIVE CONSONANTS, by J. M. Heinz and K. N. Stevens. [1961] [8]p. incl. diagrs. table, refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Published in Jour. Acoust. Soc. Amer., v. 33: 589-596, May 1961.

According to an acoustical theory of speech production, the spectra of voiceless fricatives can be characterized by poles and zeros whose frequency locations are dependent on the vocal-tract configuration and on the location of the source of excitation within the vocal tract. The locations of the important poles and zeros in the spectra of fricatives can be determined by a matching process whereby comparison spectra synthesized by electric circuits are matched against the spectra under analysis. This method has been used to determine the frequencies and bandwidths of the important poles and zeros for several versions of /f/, /s/, and /S/. Based on these findings, a simplified electrical model is developed for the synthesis of voiceless fricatives. The model consists of a noise-excited electric circuit characterized by a pole and a zero whose frequency locations can be varied. Stimuli generated by this model, both in isolation and in syllables, are presented to listeners for identification. The results of the listening tests are consistent with the data from the acoustic analyses and with the findings of other investigators. (Contractor's abstract)

1690

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

NUCLEAR MOMENTS AND ISOTOPE SHIFTS OF Tl^{199}, Tl^{200}, Tl^{201}, Tl^{202}, AND Tl^{204} ISOTOPE SHIFTS IN ODD-ODD NUCLEI, by R. J. Hull and H. H. Stroke. [1961] [2]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 Phys. Rev., v. 122: 1574-1575, June 1, 1961.

The hyperfine-structure separations and isotope shifts of several radioactive isotopes of thallium have been measured by optical spectroscopic techniques. The results are: $\mu^{193} = 1.57$ nm; $\mu^{201} = 1.58$ nm; and both $|\mu^{200}|$ and $|\mu^{202}| \leq 0.15$ nm. The isotope shift measurements, which include the first data of this kind obtained for heavy odd-odd nuclei, permitted a comparison of the relative isotope shifts for isotopes in mercury and thallium. A marked similarity in the shifts was observed. (Contractor's abstract)

1691

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

LOCAL MAGNETOHYDRODYNAMIC INSTABILITIES IN A COLLISIONLESS PLASMA WITH ANISOTROPIC PRESSURE, by K. F. Voyenli. June 8, 1961, 19p. incl. diagrs. (Technical rept. no. 388) (Sponsored jointly by Air Force

Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108, and Royal Norwegian Council for Scientific and Industrial Research) AD 264725 Unclassified

The local magnetohydrodynamic stability of static equilibrium states in a collisionless plasma in a magnetic field with anisotropic pressure is discussed by using an energy principle. The discussion is mainly limited to 1 class of static equilibrium states. In this class the difference between the components of the pressure perpendicular and parallel to the magnetic field is proportional, along each field line, to the square of the magnetic field strength. For each equilibrium state in this class it is possible to define an associated equilibrium state with isotropic pressure, in terms of which the possible equilibrium states can be completely discussed. It is also shown that the stability of any anisotropic equilibrium state can conveniently be discussed in terms of the stability of its associated isotropic state. Complete conditions for stability are found for the uniform equilibrium state. The additional complications that are introduced by nonuniformity of the equilibrium state can be completely understood from the associated isotropic state. Certain comparison theorems for nonuniform equilibrium states are found and, finally, a class of nonuniform equilibrium states with straight field lines is discussed, for which it is shown that stability conditions are the same as in the uniform case. (Contractor's abstract)

1692

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ON ERROR MINIMIZING NEURONAL NETS, by L. A. M. Verbeek. [1961] [13]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108, and National Institutes of Health and Teagle Foundation) Unclassified

Published in Principles of Self-Organization, Trans. of the Ill. U. Symposium on Self-Organization, Robert Allerton Park (June 8-9, 1961), New York, Pergamon Press, v. 9: 121-133, 1962.

One specific kind of error in formal neurons (threshold devices) is considered. Procedures are given for minimizing its effect on the functioning of networks constructed from these neurons. The nature and the location of this error is such that the investigation takes into account breakdown of the connections between neurons. That is, the structure of the net may be fallible.

1693

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

MANY-VALUED LOGICS AND RELIABLE AUTOMATA, by J. D. Cowan. [1961] [45]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) Unclassified

Published in Principles of Self-Organization, Trans. of the Ill. U. Symposium on Self-Organization, Robert Allerton Park (June 8-9, 1961), New York, Pergamon Press, v. 9: 135-179, 1962.

Many-valued logics are used to analyze discrete noisy automata. It is shown that the functionally incomplete logic of Lewis, in which not all truth-values are informationally significant, provides an appropriate model for the description of the redundant automata of von Neumann and Elias. A study is made of methods of reducing the redundancy in such automata, and it is shown that the functionally incomplete Lukasiewicz logic, and the functionally complete Post logics provide models for the description of the more efficient automata of McCulloch et al. Advantage is taken of the fact that these logics have varying structures corresponding to different ways of coding and processing information. An approach is made to the problem of achieving arbitrarily high reliability of computation with nets of unreliable components, so that these nets are not completely redundant. No solution is obtained to this problem, but it is concluded that the functionally complete Post logics may provide one. (Contractor's abstract)

1694

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

NUCLEAR RELAXATION IN ADULTERATED HYDROGEN, by C. S. Johnson, Jr. and J. S. Waugh. [1961] [7]p. incl. diagrs. table, refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Presented at meeting of the Amer. Phys. Soc., Mexico City, June 22-24, 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 363, June 22, 1961. (Title varies)

Published in Jour. Chem. Phys., v. 36: 2266-2272, May 1, 1962.

The proton spin-lattice relaxation time T_1 has been measured in normal hydrogen and in mixtures with 12 other gases as a function of density and composition at room temperature. Cross sections for m_J transitions of the H_2 molecule deduced from the Bloembergen-Schwinger formula are interpreted qualitatively on the basis of electric multipole moments as measures of the anisotropy of the intermolecular forces, using the transient approximation. This approximation is justified in the case of H_2-CO_2 mixtures on the basis of the temperature

dependence of T_1. The assumptions of the Bloembergen-Schwinger formula are discussed, and an experiment is proposed to determine the connection between two correlation times which appear in the theory. (Contractor's abstract)

1695

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

SUGGESTS RELATION OF LINGUISTIC THEORY, SPEECH THERAPY NOT APPRECIATED, by A. S. House. [1961] [4]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. Speech and Hearing Research, v. 4: 194-197, June 1961.

This report attempts to develop the antitheses that Curtis and Hardy have both (1) demonstrated the relations between linguistic (i.e., phonemic) theory and speech therapy, and (2) failed to appreciate these relations. Furthermore, it emphasizes that an opportunity to point out a glaring deficiency in the armamentarium and/or training of speech therapists has been overlooked.

1696

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

DIGITAL RADIOMETER, by S. Weinreb. [1961] [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-73108], and National Science Foundation) AD 260109 Unclassified

Also published in Proc. Inst. Radio Engineers, v. 49: 1099, June 1961.

This note describes a system that combines the Dicke radiometer, digital data processing, and 2 concepts from statistical communication theory to form a multichannel radiometer that shows promise of achieving very high stability. The 2 concepts are summarized as follows: (1) Instead of measuring an estimate of the power spectrum directly, an estimate of the Fourier transform, the autocorrelation function is measured and then transformed to give an estimate of the power spectrum. Its utility lies in the fact that it can be instrumented digitally quite easily and accurately, especially when the second concept is brought into use. (2) By making use of the Gaussian statistics of the input signal (a rather safe assumption for all signals now being observed in radio astronomy), it is possible to obtain the autocorrelation function of the signal only from a knowledge of the polarity of the signal relative to its mean.

1697

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

DISCRETE REPRESENTATIONS OF RANDOM SIGNALS, by K. L. Jordan, Jr. July 14, 1961, 87p. incl. illus. refs. (Technical rept. no. 378) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108)
AD 274492 Unclassified

An investigation of the possibility of efficient, discrete representations of random signals is discussed. In many problems a conversion is necessary between a signal of continuous form and a signal of discrete form. This conversion should take place with small loss of information but still in as efficient a manner as possible. Optimum representations are found for a finite time interval. The asymptotic behavior of the error in the stationary case is related to the spectrum of the process. Optimal solutions can also be found when the representation is made in the presence of noise. These solutions are closely connected with the theory of optimum linear systems. Some experimental results have been obtained by using these optimum representations. (Contractor's abstract)

1698

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

IS THERE A SENSORY THRESHOLD?, by J. A. Swets. [1961] [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 Air Force Operational Applications Lab.)
Unclassified

Published in Science, v. 134: 168-177, July 21, 1961.

In measuring sensitivity it is desirable to manipulate the response criterion so that it lies in a range where it can be measured, to include enough catch trials to obtain a good estimate of this response criterion, and to use a method of analysis that yields independent measures of sensitivity and the response criterion. Estimation of the response criterion in a forced-choice experiment may be eliminated. Under the forced-choice procedure, few observers show a bias in their responses large enough to affect the sensitivity index d' appreciably. Those who do show such a bias initially can overcome it with little difficulty. As a result, the observer can be viewed as choosing the interval most likely to contain a signal, without regard to any criterion. For this reason, the forced-choice procedure may be used to advantage in studies having an emphasis on sensory, rather than on motivational or response processes.

1699

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

REPORT ON MATHEMATICS IN THE MEDICAL SCIENCES, by D. D. Rutstein, M. Eden, and M. P. Schützenberger. [1961] [6]p. incl. refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) Unclassified

Published in New England Jour. Med., v. 265: 172-176, July 27, 1961.

This article is based on a conference held under the auspices of the Dept. of Preventive Medicine, Harvard Medical School, Boston, Mass., Jan. 16-17, 1961. The meeting was concerned with both the nature of mathematics and the technics for its application that have been useful to biology and medicine in the past or may be applicable in the near future. In this report—which is not a complete summary of the meeting—the lectures and discussions are focused on the principles governing the interrelation of mathematical theory and the biologic and medical sciences. After the summary there is a general statement that epitomizes the present status of "The Role of Mathematics in the Medical Sciences".

1700

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

THERMIONIC CONVERSION OF HEAT TO ELECTRICITY, by W. B. Nottingham, G. N. Hatsopoulos, and E. N. Carabateas. [1961] [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-78108) Unclassified

Published in Aerospace Eng., v. 20: 14-15, 82-85, July 1961.

Direct conversion of heat to electricity demand a device which accepts heat at its input, rejects excess heat at its output, and generates a driving voltage which can put current through an external load. The thermionic diode is such a device. It has an electron emitter which accepts the heat and delivers electrons for transport through an intervening space to the electron collector. The collector also receives heat which must be discharged by some cooling mechanism. A detailed discussion of each of the 3 essential components of the thermionic diode energy converter is presented.

1701

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

EMISSION OF RADIO-FREQUENCY WAVES FROM PLASMAS, by G. Bekefi and S. C. Brown. [1961] [25]p. incl. diagrs. refs. (Technical rept. no. 387) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108, and Atomic Energy Commission) AD 263425 Unclassified

Also published in Amer. Jour. Phys., v. 29: 404-428, July 1961.

Observations of the radio-frequency emission from extraterrestrial plasmas and plasmas produced in the laboratory are described, and various attempts at interpretation of the results are reviewed. Estimates are made of the probable loss of radiant energy from plasmas in proposed thermonuclear reactors. (Contractor's abstract)

1702

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

A THERMISTOR FLOWMETER FOR BLOOD FLOW MEASUREMENT, by D. H. Pruslin and W. D. Jackson. [1961] [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 Digest Fourth Internat'l. Conf. on Medical Electronics, New York, N. Y. (July 1961), Conf. Comm. for Publication, 1961, p. 87.

Thermistors are solid-state, temperature-sensitive resistors with large negative temperature coefficients and have been applied to instrumentation situations in which the detection of small temperature changes is required. The ability of a thermistor flowmeter to detect flows in the range encountered in blood flow measurements has been confirmed experimentally using a flow system of the recirculating type with tap water as the working fluid. A bead thermistor of 0.01 in. diam was mounted in the center of a section of plastic tubing of 3/8 in. internal diam and was connected in the one arm of an equal-arm Wheatstone bridge. The results show that the thermistor flowmeter can provide a nonlinear indication of flow rate, although several factors must be taken into account in developing a flowmeter with an accurate and reliable calibration. The quantitative treatment of the experimental situation may be made in terms of heat transfer across a laminar boundary layer. The thermistor flowmeter is sensitive to changes in both location of the bead relative to the channel center and the temperature of the fluid. In the latter case, a change of 1°C produced a bridge voltage change equal to that of the max recorded flow rate. The thermistor-flowmeter principle has characteristics which make it an attractive candidate for development as a catheter-flowmeter for clinical application, but, it is pointed out, much work is required to produce an instrument of acceptable overall performance.

1703

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

DETECTION OF AUDITORY SINUSOIDS OF UNCERTAIN FREQUENCY, by D. M. Green. [1961] [7]p. incl. diagrs. table, refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) Unclassified

Published in Jour. Acoust. Soc. Amer., v. 33: 897-903, July 1961.

The decrease in the detectability of a gated sinusoidal signal in noise caused by deliberately introducing uncertainty about the signal's frequency is no greater than 3 db, even in an extreme condition of uncertainty. In this extreme condition the signal duration is 0.1 sec, and the signal frequency is varied between 500 and 4000 cps. This effect is not critically dependent on signal duration. Moreover, the observers not only detect the signal but display at least gross information about the frequency of the signal in the uncertain frequency conditions. Several models, suggested in previous studies, are considered. The magnitude of the decrease observed in the data falls far short of the predictions of these models. An interpretation suggested by the data is that the observers in a detection task, even when a signal of fixed frequency is used, are highly uncertain as to the exact physical parameters of the signal. Another way of stating this assumption is to say that the observer never tests for the presence or absence of a signal on the basis of one simple hypothesis. From this assumption little decrease is expected in detectability from deliberately introducing frequency uncertainty. This interpretation would suggest the same result would be obtained if time were the major experimental variable. (Contractor's abstract)

1704

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

SOME COMMENTS AND A CORRECTION OF "PSYCHOACOUSTICS AND DETECTION THEORY", by D. M. Green. [1961] [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 Jour. Acoust. Soc. Amer., v. 33: 965, July 1961.

Some clarifying statements are made regarding the author's paper entitled "Psychoacoustics and Detection Theory" (Jour. Acoust. Soc. Amer., v. 32: 1189, 1960). These remarks pertain chiefly to terminology used in this work and to an interpretation of the scales of pressure and energy.

1705

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

CONFIGURATION MIXING AND THE EFFECTS OF DISTRIBUTED NUCLEAR MAGNETIZATION ON HYPERFINE STRUCTURE IN ODD-A NUCLEI, by H. H. Stroke, R. J. Blin-Stoyle, and V. Jaccarino. Aug. 15, 1961 [23]p. incl. diagrs. tables, refs. (Technical rept. no. 392) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) Unclassified

Published in Phys. Rev., v. 123: 1326-1348, Aug. 15, 1961.

The theory of Blin-Stoyle and of Arima and Horie, in which the deviations of the nuclear magnetic moments from the single-particle model Schmidt limits are ascribed to configuration mixing, is used as a model to account quantitatively for the effects of the distribution of nuclear magnetization on hyperfine structure (Bohr-Weisskopf effect). A diffuse nuclear charge distribution, as approximated by the trapezoidal Hofstadter model, is used to calculate the required radial electron wave functions. A table of single-particle matrix elements of R^2 and R^4 in a Saxon-Woods type of potential well is included. Explicit formulas are derived to permit comparison with experiment. For all of the available data satisfactory agreement is found. The possibility of using hyperfine structure measurements sensitive to the distribution of nuclear magnetization in a semiphenomenological treatment in order to obtain information on nuclear configurations is indicated. (Contractor's abstract)

1706

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

MICROWAVE MEASUREMENTS OF THE RADIATION TEMPERATURE OF A PLASMA IN A MAGNETIC FIELD, by H. Fields, G. Bekefi, and S. C. Brown. [1961] [9]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], Air Force Command and Control Development Division under AF 19(604)5992, and Atomic Energy Commission) Unclassified

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. 1: 367-375, 1962.

The microwave-frequency emission from the positive column of a dc glow discharge has been used to determine its radiation temperature. The positive column was subjected to an axial magnetic field not exceeding 2000 gauss. The emission was measured with a radiometer at a frequency of 3000 mc/sec, and a technique was adopted that rendered the interpretation of the

temperature independent of the plasma absorptivity. The main departure of the measured radiation temperature from the predicted electron temperature is observed at a frequency equal to the electron cyclotron frequency. Here large resonances of the radiation temperatures were observed in neon, argon, and xenon, while no resonances were observed in hydrogen and helium. These results are shown to be consistent with calculations of the radiation temperature from plasmas with non-Maxwellian electron distributions. (Contractor's abstract)

1707

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

DEPENDENCE OF SUCCESSIVE JUDGMENTS IN DETECTION TASKS: CORRECTNESS OF THE RESPONSE, by E. F. Shipley. [1961] [2]p. incl. tables. (In cooperation with Pennsylvania U.) (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. 33: 1142-1143, Aug. 1961.

Greater-than-chance temporal grouping of correct and of incorrect responses was found in both forced-choice and yes-no detection tasks. This dependence is small. The findings suggest that criterion correction contributes to the phenomena: (1) more dependence (more positive r_1's) with tone than with noise signals and (2) more dependence (larger r_1's) with higher intensity signals. The larger effect with higher intensity signals is not incompatible with the finding that giving the subject information about the signal has a greater effect with lower intensity signals on the overall proportion of correct responses. Those results indicate that the same information has a greater effect with low-intensity signals, but the results here can be interpreted as showing that high-intensity signals offer more information. (Contractor's abstract)

1708

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

POWER AND ENERGY RELATIONS IN BIDIRECTIONAL WAVEGUIDES, by P. Chorney. Sept. 1, 1961 [65]p. incl. illus. tables, refs. (Technical note no. 396) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) AD 277030 Unclassified

A broad class of uniform waveguides is defined as bidirectional because the waves supported by these waveguides propagate with the same dispersion relation in either direction along the waveguide axis. The requirements for bidirectionality are defined, and several examples of bidirectional waveguides are given; typical examples are waveguides containing isotropic media, and waveguides containing properly oriented magnetized ferrites and plasmas. For lossless, passive bidirectional waveguides, some general theorems are derived which relate the power carried by the waves with a quantity called pseudo energy. The energy-like terms in the complex Poynting theorem do not truly represent energy when a medium is dispersive: hence, the name, pseudo energy. The theorems apply to 3 types of waves: (a) purely propagating, (b) cutoff, and (c) complex. Several examples are given which illustrate the physical implications of the theory. A good deal of attention is paid to waves having complex propagation constants in lossless, passive waveguides. (Contractor's abstract)

1709

[Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge]

RANDOM GENERATION OF ENGLISH SENTENCES, by V. H. Yngve. [1961] [18]p. (Paper no. 6) (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. Internat'l. Conf. on Machine Translation of Languages and Applied Language Analysis, Teddington (Gt. Brit.) (Sept. 5-8, 1961), London, Her Majesty's Stationery Office, v. 1: 65-82, 1962.

This paper reports the results of writing and running a program which constructs English sentences. The sentences are chosen at random by the program from among those English sentences that conform to certain rules of sentence structure. The work is a continuation of a line of research begun several yr ago. (Contractor's abstract)

1710

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

STRUCTURE AT THE LEXICAL LEVEL AND ITS IMPLICATIONS FOR TRANSFER GRAMMAR, by E. S. Klima. [1961] [12]p. (Paper no. 13) (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. Internat'l. Conf. on Machine Translation of Languages and Applied Language Analysis, Teddington (Gt. Brit.) (Sept. 5-8, 1961), London, Her Majesty's Stationery Office, v. 1: 97-109, 1962.

Preliminary results are presented from an investigation

of structuring within the lexicon of a language. The results suggest that in certain areas of the lexicon, lexical items must be characterized in terms of the presence or absence of specific recurring lexico-semantic components. Furthermore, there seems to be some promise that correspondence between lexical items of different languages may be reducible to mutual correspondence between their more discrete lexico-semantic components. In this discussion, the more detailed descriptive statements about English as well as the general remarks about correspondence between English sentences and those of other languages are considered in the framework of transfer grammar. Attention is directed toward possible refinements in correspondence analysis entailed by further structural characterization of lexical items, and in particular, of verbs in terms of their relationship to subject and object.

1711

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

ANALYSIS BY SYNTHESIS OF SENTENCES OF NATURAL LANGUAGES, by G. H. Matthews. [1961] [11]p. incl. diagr. refs. (Paper no. 10) (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. Internat'l. Conf. on Machine Translation of Languages and Applied Language Analysis, Teddington (Gt. Brit.) (Sept. 5-8, 1961), London, Her Majesty's Stationery Office, v. 2: 53-1542, 1962.

The first part of this paper offers a precise formulation of a mechanical fail-safe sentence-recognition routine that, in principle, cannot fail to give all and only the possible syntactic analyses for any string of symbols with respect to a given grammar. In the second part of the paper a description is presented of some subroutines that make possible a practical analysis-by-synthesis computer program. The last part discusses some advantages of this type of recognition routine over others that have been proposed.

1712

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

ON THE SEMANTICAL INTERPRETATION OF LINQUISTIC ENTITIES THAT FUNCTION STRUCTURALLY, by E. K. Charney. [1961] [17]p. (Paper no. 8) (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. Internat'l. Conf. on Machine Translation of Languages and Applied Language Analysis, Teddington (Gt. Brit.) (Sept. 5-8, 1961), London, Her Majesty's Stationery Office, v. 2: 543-559, 1962.

A method is described which applies the techniques of modern symbolic logic, for giving a semantical interpretation to those entities of natural language systems that function in a structural capacity. Such entities do not perform the task of denoting the individuals, properties, and relations of those individuals a language talks about; they are linguistic devices that serve to combine the denotative terms into meaningful utterances. They function in many ways, such as to express syntactic relations and to express generality. Words like "each", "all", "either-or", "any", "ago" are a few examples of terms that belong in this category. Because these words are analogs in the natural language systems of logical constants in the symbolic language systems, they are called here "structural constants". For the purposes of this discussion, a structural constant is defined as an entity whose meaning is known only when its proper use is known; therefore it can be defined only by a set of rules determining its behavior.

1713

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

APPLICATION OF THERMODYNAMIC GREEN'S FUNCTION FORMALISM TO FERROMAGNETISM, by G. W. Pratt, Jr. and R. D. Puff. [1961] [4]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

Presented at Internat'l. Conf. on Magnetism and Crystallography, Kyoto (Japan), Sept. 25-30, 1961.

Published in Jour. Phys. Soc. Japan, v. 17, Suppl. B-I: 60-63, Mar. 1962.

The magnetic behavior of a lattice where there is a single localized orbital at each lattice site which is either vacant, singly, or doubly occupied is studied. The principal interactions are nearest neighbor exchange and the Coulomb repulsion which tends to prevent doubly occupied sites. The description is in terms of 1 and 2 particle thermodynamic Green's functions. Three different treatments of the correlations are used in finding the 2 particle Green's functions. Writing G_2 as a product of 1 particle Green's functions G_1 reduces to the Heisenberg first approximation when there are no ionic states. A second approximation where $G_2 = \Omega G_1 G_1$, Ω being a correlation matrix, results in a theory to some extent similar to the constant coupling method. Results are given for Curie point for several different lattices. A third approximation capable of accurately describing the limit of very large Coulomb repulsion is briefly discussed. (Contractor's abstract)

1714

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ON VOWEL DURATION IN ENGLISH, by A. S. House. [1961] [4]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office Cambridge Research Labs.; and 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. 33: 1174-1178, Sept. 1961.

Average durations of 12 vowels of American English measured in bisyllabic nonsense utterances are reported. The vowels occurred in 14 symmetrical consonantal environments and the utterances were produced by 3 male talkers. The consonant environments consisted of the voiced and voiceless versions of 3 stop, 1 affricate, and 3 fricative consonant articulations. Four determinants of the characteristic durations of stressed vowels are identified and discussed. The hypothesis is advanced that the primary lengthening of vowels in English—that found in tense vowels and in vowels before consonants—is a part of the phonology of the language and is learned by speakers of the language, and that the secondary lengthening of vowels in English—that found in open vowels and in vowels before fricative constants—is a function of the articulatory process itself. (Contractor's abstract)

1715

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

AVAILABLE POWER FROM A NONIDEAL THERMAL SOURCE, by P. Penfield, Jr. [1961] [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: 1793-1794, Sept. 1961.

The efficiency under optimum power-output conditions is independent of the total thermal resistance. Since all physical sources may be expected to have some finite thermal resistance, it appears that if a Carnot (reversible) engine is operated between practical heat reservoirs in such a way as to have a maximum power-output, then the efficiency must be reduced from the Carnot efficiency calculated from the reservoir temperatures, regardless of the size of the thermal resistances.

1716

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ON THE MECHANISM OF NUCLEAR RELAXATION IN GASEOUS AND LIQUID CHF_3, by C. S. Johnson, Jr., J. S. Waugh, and J. N. Pinkerton. [1961] [2]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], and National Science Foundation) Unclassified

Published in Jour. Chem. Phys., v. 35: 1128-1129, Sept. 1961.

The ratio of proton and F^{19} relaxation times in gaseous CHF_3 is greater than 100. In both the liquid and gaseous states, spin rotational interactions are important for F^{19}.

1717

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

BILABIAL STOP AND NASAL CONSONANTS: A MOTION PICTURE STUDY AND ITS ACOUSTICAL IMPLICATIONS, by O. Fujimura. [1961] [15]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. Speech and Hearing Research, v. 4: 233-247, Sept. 1961.

The movements of the lips when bilabial stops and nasals are produced in various phonetic environments have been photographed for study by means of a stroboscopic technique. It has been found that immediately following the plosion the rate of increase in the lip opening is relatively high. A significant portion of the change of the resonant frequencies of the vocal tract, in consequence, takes place in 5 or 10 msec, and in this brief interval the acoustic output cannot be characterized by transitions of formants that are described in a quasi-static manner. The effect of the environment of the consonant upon the initial speed of the lip opening process is considerable; the movement is particularly rapid when a tense bilabial stop consonant is in work-initial position. There is a significant difference in the physical mechanism of the motion of the lips during the production of the nasal bilabial, compared to that for the stops, because of the overpressure built up behind the closure in the case of stops. The relation of the articulatory data to the acoustic structure of the output speech signals has been discussed in some detail. (Contractor's abstract)

1718

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

ORTHOGONAL AMBIPOLAR DIFFUSION CURRENTS IN A MAGNETIZED PLASMA (Abstract), by D. R. Whitehouse and H. B. Wollman. [1961] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], and Atomic Energy Commission) Unclassified

Presented at meeting of the Amer. Phys. Soc., Schenectady, N. Y., Oct. 11-13, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 134, Feb. 23, 1962.

The magnetoambipolar diffusion theory of a plasma in a conducting cavity has been derived by several authors. In this paper the relationship between the boundary conditions at the walls and the required ionization frequency to maintain a steady-state plasma is shown. The interesting conditions are the Simon and Allis diffusion limits, the congruence and short circuit limits, and 2 other limits obtained when the radial ion current or axial electron current is equal to zero. The theory is checked by measurements of the diffusion currents made in a vacuum, metal, cylindrical cavity whose end walls are insulated from the radial wall. The cavity is also fed with microwave to produce the steady-state plasma, and wall probes have been placed throughout the cavity to monitor the current distributions.

1719

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

PLASMA GENERATION AND CONFINEMENT MECHANISMS IN THE HOLLOW-CATHODE DISCHARGE (Abstract), by L. M. Lidsky, S. D. Rothleder and others. [1961] [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., Schenectady, N. Y., Oct. 11-13, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 134, Feb. 23, 1962.

A description of the hollow-cathode discharge plasma source has previously been presented (see item no. 1667, Vol. V). Recent experimental data confirm that the exterior plasma is generated in the interior of the hollow cathode and that ionization in the exterior region plays a small secondary role. Analysis of the cathode power balance indicates that the probability of ionization of the input gas in the cathode interior is very high. The external plasma (of characteristic density $10^{13}/cm^3$) is confined by low magnetic fields (100-500 gauss). Application of the hydromagnetic momentum conservation equations demonstrates that a hybrid confinement mechanism operates with electrons confined by the magnetic field and ions trapped in the resulting space-charge field. The solution of the hydromagnetic equations in the special case of constant temperature indicates a simple scheme for independent measurement of ion temperature. Relations between the ion and electron temperatures are shown both experimentally and by analysis of the steady-state energy transfer equations.

1720

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

BINARY CONTROLS FOR ERROR CONTROL, by W. W. Peterson. [1961] [6]p. incl. diagrs. table, refs. (In cooperation with International Business Machines Research and Development Labs.) (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 Fall General meeting of the AIEE, Detroit, Mich., Oct. 15-20, 1961.

Published in Trans. Amer. Inst. Elec. Engineers, v. 80 (Part I): 648-652, 1961.

The model of a communication channel used in the study of binary codes, its relation to real data transmission channels, and assumptions about noise, is reviewed briefly. Several error-correcting codes are listed with brief description of their error-correcting capabilities and feasibility of their implementation. The most promising class of codes for implementation at present are cyclic codes. The burst-error-correcting cyclic codes are especially attractive from the point of view of implementation and a simplified block diagram for implementing a practical example of such a code is shown and discussed. (Contractor's abstract)

1721

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

BIOMEDICAL ENGINEERING IN BASIC RESEARCH, by W. T. Peake. [1961] [4]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 The Role of Biomedical Engineering in Universities and Hospitals, Digest of Conf. Proc., Omaha, Neb., Oct. 26-27, 1961, p. 7-10.

The relationship between biology and engineering in basic research is discussed. The contributions of engineers

to the field of biology are considered. The need for a research environment in which individuals from different disciplines can meet and communicate is also discussed.

1722

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

PERCEPTION OF SOUNDS CHARACTERIZED BY A RAPIDLY CHANGING RESONANT FREQUENCY, by P. T. Brady, A. S. House, and K. N. Stevens. [1961] [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-78108, and National Science Foundation) Unclassified

Published in Jour. Acoust. Soc. Amer., v. 33: 1357-1362, Oct. 1961.

The perception of sounds characterized by a moving resonance was investigated. Stimuli were generated by exciting a tuned circuit with a short train of pulses of repetition rate 100/sec. The resonant frequency of the tuned circuit was changed in a piecewise-linear manner over a 500-cps range. Subjects matched the test stimuli by adjusting the resonant frequency of a fixed (i.e., nonvarying in time) resonant circuit until the test and comparison stimuli were judged to be most alike. The results indicate a strong tendency for subjects to adjust the frequency of the fixed resonant circuit until it is close to the terminal resonant frequency of the time-varying circuit. This tendency depended to some extent on the directional and rate of the frequency change in the test stimulus. The implications of the results for auditory theory and speech perception are discussed briefly. (Contractor's abstract)

1723

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

REFLECTION OF AN ELECTRON BEAM FROM HIGH-FREQUENCY FIELDS, by R. B. Hall and S. C. Brown. [1961] [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 Atomic Energy Commission) Unclassified

Published in Jour. Appl. Phys., v. 32: 1835-1836, Oct. 1961.

Experimental verification of time-average forces due to an rf field acting on charged particles is obtained by measuring the transmission of an electron beam through the high-frequency fields of a cavity. By adjusting the external dc magnetic field so that cyclotron resonance is approached, it is possible to reflect high-energy beams; that is, 66 w of microwave power completely reflected a 24-v beam. There is close agreement between experiment and theory. (Contractor's abstract)

1724

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

CONCEPTION AND DESIGN OF LARGE VOLUME SUPERCONDUCTING SOLENOID, by L. J. Donaldieu and D. J. Rose. [1961] [12]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 Advanced Research Projects Agency and National Science Foundation) Unclassified

Published in Proc. Internat'l. Conf. on High Magnetic Fields, Cambridge, Mass. (Nov. 1-4, 1961), Cambridge, M.I.T. Press and New York, Wiley and Sons, 1962, p. 358-369. (AFOSR-2299)

For a large volume magnetic field, superconducting solenoids appear to be the only possible solution to the problem caused by the tremendous power requirements of a conventional solenoid large enough for controlled fusion research. The conception and design of these machines involves the loose coupling of 2 different systems—the magnetic system proper and a satisfactory dewar vessel. Each of these is discussed separately and in some detail.

1725

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

PERFORMANCE OF THE ARTICULATORY ANALOG OF THE SPEECH MECHANISM: A STATUS REPORT (Abstract), by M. H. L. Hecker, A. S. House, and K. N. Stevens. [1961] [1]p. (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 Sixty-second meeting of the Acoust. Soc. of Amer., Cincinnati, Ohio, Nov. 8-11, 1961.

Published in Jour. Acoust. Soc. Amer., v. 33: 1665, Nov. 1961.

During the past few yr an electrical dynamic analog of the vocal tract and various experiments performed with this equipment have been reported. The control system of the synthesizer specifies articulatory parameters such as the configuration of the vocal tract, glottal excitation, fundamental frequency, noise excitation, and velopharyngeal coupling as piece-wise functions of time. Previous reports have described the synthesis of some fricative, stop, and nasal consonants in a few vowel environments usually in consonant vowel syllables. The vocabulary has

now been extended to include a larger number of consonants and vowels arranged in a variety of 1- and 2-syllable structures. Advantages and limitations of the present synthesizer and control system are discussed. The acoustic output of the device is demonstrated by means of a tape recording of samples of syllabic utterances and of short sentences constructed from groups of these utterances.

1726

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ARTICULATORY ANALOG OF THE VOCAL TRACT AND NASAL CAVITIES (Abstract), by M. H. L. Hecker. [1961] [1]p. (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 Sixty-second meeting of the Acoust. Soc. of Amer., Cincinnati, Ohio, Nov. 8-11, 1961.

Published in Jour. Acoust. Soc. Amer., v. 33: 1665, Nov. 1961.

A modified version of the dynamically controllable electrical analog of the vocal tract (G. Rosen, Jour. Acoust. Soc. Amer., v. 30: 201-209, 1958) that includes a recently developed analog of the nasal cavities is described. The acoustical coupling between the vocal tract and the nasal cavities is electronically varied in the same way as the effective cross-sectional area of each section making up the transmission line representing the vocal tract. Formal listening tests have been conducted to determine the most suitable vocal-tract configurations for the production of nasal consonants in consonant-vowel and vowel-consonant syllables. Other listening tests have determined the most suitable patterns of temporal variables for the production of these syllables. In general, it is found that more natural-sounding syllables are obtained when the velopharyngeal coupling varies slowly with time compared to changes in the configuration of the vocal tract. The results compare favorably with cineradiological data recently reported and are interpreted to support the point of view that studies of the performance of an articulatory synthesizer reveal important details concerning the production and perception of natural speech. The experiments demonstrate that speech can by synthesized from articulatory information in a straightforward and natural manner.

1727

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

SHORT-TIME AFTEREFFECTS OF NOISE ON AUDITORY NERVE RESPONSES (Abstract), by W. T. Peake and J. F. Buoncristiani. [1961] [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 Sixty-second meeting of the Acoust. Soc. Amer., Cincinnati, Ohio, Nov. 8-11, 1961.

Published in Jour. Acoust. Soc. Amer., v. 33: 1670, Nov. 1961.

Auditory nerve responses to clicks have been recorded from cats by means of a gross electrode placed near the round window of the cochlea. If the clicks are preceded by a burst of wideband noise, the amplitude of the click response is reduced. The amplitude of N_1 as a function of noise-burst intensity I_N, noise-burst duration D, time interval between the cessation of the noise and the occurrence of the click T, and intensity I_C have been measured. The ranges of I_N and D were restricted so as to produce aftereffects lasting less than 10 sec. For fixed values of T and I_C, a family of values of I_N and D can be found which produce equivalent aftereffects on N_1. Results show, however, that pairs of D and I_N values which are equivalent at 1 value of T are not equivalent for other values. In particular, recovery to a long, low-intensity burst takes place more slowly than recovery to the "equivalent" short, high-intensity burst. Also, equivalence for a given value of I_C does not necessarily imply equivalence for other click intensities.

1728

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

SOME MEASUREMENTS ON HEAT-MAINTAINED OSCILLATIONS (Abstract), by G. C. Maling, Jr. and U. Ingard. [1961] [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

Presented at Sixty-second meeting of the Acoust. Soc. of Amer., Cincinnati, Ohio, Nov. 8-11, 1961.

Published in Jour. Acoust. Soc. Amer., v. 33: 1672-1673, Nov. 1961.

The Rijke tube is a well-known example of a device in which oscillations are maintained by the presence of a heat source in a medium. The onset of oscillation of a Rijke tube, as well as the intensity of oscillation, have been studied as a function of the acoustic damping in the tube and the air velocity through the tube. The results of the measurements are compared with theoretical analysis.

1729

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

ANALYTIC DESCRIPTION OF A CORKSCREW TRAP (Abstract), by R. C. Wingerson, J. S. Tulenko, and D. J. Rose. [1961] [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., Colorado Springs, Colo., Nov 15-18, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 153, Feb. 23, 1962.

A properly designed modified helical field source (a corkscrew) can perturb the midregion of a magnetic mirror pair to form an effective trap for particles injected through a mirror with appropriate momentum. The handedness of the corkscrew, in combination with a resonance condition between field and particle, results in a trap approaching the ideal, i.e., injected particles initially experience a strong non-adiabatic effect that leads to their entrapment, but thereafter have only small velocity changes that look much like an almost random "scatter." An analytic solution for the "scatter" (based on expansion in powers of the field perturbation) has been obtained that leads to an optimum design in which the magnitude of the field perturbation increases linearly from zero at the ends of the corkscrew, the spatial period of the structure changes quadratically at the ends, and particles are injected with as large a magnetic moment as is feasible.

1730

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

PROPOSED THERMONUCLEAR MIRROR WITH CORKSCREW TRAP (Abstract), by D. J. Rose, J. S. Tulenko, and R. C. Wingerson. [1961] [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., Colorado Springs, Colo., Nov. 15-18, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 153, Feb. 23, 1962.

A steady-state thermonuclear plasma experiment is proposed, based on the properties of the corkscrew trapping field. The device resembles DCX-2 or OGRA except for the axial injection of molecular ions which are almost all temporarily trapped by the twisted field of length L in the midregion of the mirror pair. Molecular ion containment time ($\tau_m \propto L^2$) is about 0.01 sec for a device on the scale of OGRA. The corkscrew field "scatters" atomic ions after breakup at a rate ($\tau_a \propto L^4$) negligible compared to conventional scattering. Preliminary burnout and plasma buildup calculations indicate that the long molecular ion containment results not only in efficient ion breakup, but contributes substantially to burnout through charge transfer and collisions of other types. Optimum injection energy is thus lower than in DCX-2 or OGRA and a dense ($\approx 10^{12}$/cc) plasma can be obtained from 50 ma molecular ion current at about 100 kev with a background pressure of 3×10^{-8} mm Hg.

1731

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

STRONG INTERACTIONS BETWEEN AN ELECTRON BEAM AND A PLASMA (Abstract), by W. D. Getty and L. D. Smullin. [1961] [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., Colorado Springs, Colo., Nov. 15-18, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 157, Feb. 23, 1962.

Strong interactions have been observed between an electron beam and a plasma through which it drifts. In these experiments a 10-kv, 1-amp, 3 1/2-μsec pulsed beam is projected into a drift region containing Ar at about 1 μ pressure. The beam gradually builds up a plasma by ionizing collisions with the neutral gas. After a time delay of about 1 μsec, an intense burst of radio frequency power, a strong burst of light, and essentially complete scattering of the 10-kv beam is observed. Frequencies between 500 and 2000 mc/sec are observed. A theoretical model of a beam drifting through a plasma where $\omega_{pe} < \omega_{ce}$ predicts a backward-wave amplifying mechanism that appears to describe our experimental results.

1732

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

OBSERVATION OF 1/B DIFFUSION ACROSS A MAGNETIC FIELD (Abstract), by S. Yoshikawa. [1961] [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., Colorado Springs, Colo., Nov. 15-18, 1961.

Published in Bull Amer. Phys. Soc., Series II, v. 7: 158, Feb. 23, 1962.

The diffusion of electrons across a magnetic field B is measured in a hollow-cathode discharge. The linear discharge parallel to B is maintained between a hot cathode of diameter 3 mm and an anode. The auxiliary ring anode of major diameter 6 cm collects electrons across B. It is found that for sufficiently small radial currents, there is a proportionality between applied potential and radial current. The mobility thus measured is converted to a diffusion coefficient by means of the Einstein relation. The diffusion coefficient is found to be proportional to 1/B. The fluctuation of the floating potential is seen to increase as the radial current increases, in spite of the fact that the radial current is less than 10% of the axial current. The theoretical interpretation, which relates the diffusion with density fluctuation, will also be presented.

1733

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

STIMULUS VS RESPONSE UNCERTAINTY IN RECOGNITION, by J. A. Swets and S. T. Sewall. [1961] [7]p. incl. diagrs. refs. (Technical rept. no. AFCCDD-TR-60-44) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], and Air Force Operational Applications Lab.) Unclassified

Published in Jour. Acoust. Soc. Amer., v. 33: 1586-1592, Nov. 1961.

The question of the relative efficacy of specifying the stimulus alternatives before and after the stimulus is raised. Experiments show information given before the observation to facilitate recognition and information given after the observation to have little, if any, effect. It is concluded that the facilitative effect of restricting alternatives, in the task studied, depends on a perceptual mechanism rather than on a response mechanism. These experiments are discussed in connection with 2 current psychological theories: (1) the theory of signal detectability (essentially a perceptual theory), and (2) the theory of individual choice behavior (essentially a response theory). The results of another experiment, the only other experiment discovered to date for which these 2 theories make different predictions, are also reported. In this experiment, too, the results are in agreement with the detection theory. (Contractor's abstract)

1734

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

PROTON MAGNETIC RESONANCE STUDY OF FERROELECTRIC POTASSIUM FERROCYANIDE TRIHYDRATE, by R. Blinc, M. Brenman, and J. S. Waugh. [1961] [6]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Published in Jour. Chem. Phys., v. 35: 1770-1775, Nov. 1961.

Proton magnetic resonance and vibrational spectra of potassium ferrocyanide trihydrate have been studied between 77° and 300°K. From the observed 2 sets of O—H stretching frequencies it has been possible to suggest the probable positions of 4 previously undetermined water molecules in the unit cell. Changes in the vibrational spectra and in the proton resonance second moment in the neighborhood of the Curie point indicate that the onset of ferroelectric behavior is associated with a dynamical orientational ordering of the hydrogen-bonded water molecules. Apparently there is also a contribution to the spontaneous polarization and internal field from displacements and polarizability of the K^+ and $Fe(CN)_6^{-4}$ ions. (Contractor's abstract)

1735

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ERRATUM AND FURTHER COMMENTS: EXACT ANALYSIS OF THREE-SPIN NMR SPECTRA, by J. S. Waugh and S. Castellano. [1961] [2]p. incl. diagr. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], and National Institutes of Health) Unclassified

Published in Jour. Chem. Phys., v. 35: 1900-1901, Nov. 1961.

The relationship between the sum of the 3 spin-spin coupling constants in the vinyl group and the electronegativity of the element immediately attached to it is illustrated. This graph also permits a rapid check of the correctness of previous spectral analyses for vinyl compounds.

1736

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

NUCLEAR RELAXATION IN GASES: MIXTURES OF METHANE AND OXYGEN, by C. S. Johnson, Jr. and J. S. Waugh. [1961] [5]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], and National Science Foundation) Unclassified

Published in Jour. Chem. Phys., v. 35: 2020-2024, Nov. 1961.

Three previously proposed mechanisms of nuclear relaxation in fluids are qualitatively discussed: (1) modulation of intramolecular fields by collisions, (2) transient, and (3) diffusively modulated dipolar interactions with paramagnetic impurities. It is shown that the dependence of T_1 for the protons in methane-oxygen mixtures on composition, density, and temperature is adequately described by a superposition of these contributions to $1/T_1$, and that the magnitudes involved are consistent with a priori estimates. It is suggested that the spin-rotation interaction provides an important relaxation mechanism in both gaseous and liquid methane. (Contractor's abstract)

1737

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

REDUCTION OF SPEECH SPECTRA BY ANALYSIS-BY-SYNTHESIS TECHNIQUES, by C. G. Bell, H. Fujisake and others. [1961] [12]p. incl. illus. diagrs. refs. (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) Unclassified

Published in Jour. Acoust. Soc. Amer., v. 33: 1725-1736, Dec. 1961.

Procedures are described for reducing the speech wave to a specification in terms of the time-varying vocal-tract resonances and source characteristics. The basic method, which has been called analysis by synthesis, involves the comparison of speech spectra with a series of spectra that are synthesized within the analyzer. Each comparison spectrum is generated according to a set of rules based on an acoustical theory of speech production. The result of the analysis of each input spectrum is a set of parameters that describes the synthesized spectrum providing the best match. In 1 version of the method convergence towards the best match is controlled by the experimenter; in another version convergence to a match is accomplished automatically without the intervention of the experimenter. All the operations have been programmed on a general purpose digital computer and have been applied to the analysis of vowels and some consonants. The advantages of the analysis techniques are discussed. (Contractor's abstract)

1738

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ATTAINMENT OF HIGH-RESOLUTION GRATINGS BY RULING UNDER INTERFEROMETRIC CONTROL, by G. W. Stroke. [1961] [19]p. incl. illus. diagrs. refs. (In cooperation with Inst. d'Optique, Paris) (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]) Unclassified

Published in Jour. Opt. Soc. Amer., v. 51: 1321-1339, Dec. 1961.

Outstanding high-resolution gratings have now been obtained by ruling under interferometric control on the M.I.T. ruling engine, as a result of considerable improvements which have followed the application of 2 separate studies carried out for this purpose: (1) a general theory of the effects of grating errors on the distribution of light in the spectral images; and (2) a theory of the uncalled-for corrections introduced into an interferometric servomechanism by incorrect translation of the grating-blank motion into representative interferometric fringe signals. The errors found to be most detrimental to high-resolution gratings, in that they affect the close neighborhood of the line centers, are rather extended small-amplitude deviations in the wave fronts. These can be caused in particular by errors of run in the ruling, as a result of inadequate temperature and servocontrol, by defects in flatness of the grating blanks and of the aluminum coatings, as well as by incorrect adjustments of the control interferometers. Reduction of these errors to less than $\lambda/10$ at 5431A and corresponding improvements in the diamond-carriage adjustments have resulted in improvements on the order of 4 to 9 in the spectral quality of the high-angle gratings when compared to the 10-in. gratings previously described by G. R. Harrison and G. W. Stroke (Jour. Opt. Soc. Amer., v. 50: 1153, 1960). Precision replicas of these gratings permit high-resolution studies in spectrometers as short as 1 m and in spectrographs with as few as 10^{12} atoms in the source. Considerable further gains in luminosity, compactness and resolution should result from the use of gratings and echelles blazed at 76° in autocollimation rather than at 64°, as has been customary so far. (Contractor's abstract)

1739

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

AN ALIGNMENT INTERFEROMETER FOR PRECISION STRAIGHTNESS-MEASUREMENTS AND CONTROL EVEN OF RAPIDLY MOVING CARRIAGES, by G. W. Stroke. [1961] [2]p. incl. diagr. 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]) Unclassified

Published in Jour. Opt. Soc. Amer., v. 51: 340-1341, Dec. 1961.

A new, easily adjusted and very stable interferometer, defining a semistatic fringe field by reflection on 2 mirrors, has permitted a simple solution to the problem of rapid and accurate alignment of moving carriages, of

fixed reference beams, and of carriage-ways in the interferometric domain. Precisions in the 0.1-sec-of-arc range are easily obtained in visual work in rotations up to minutes of arc, without the usual limitations of slow fringe counting and of loss of fringe-contrast at large path differences in particular. In fact, the fringe contrast is independent of the distance from the reference-support to the moving mirrors in this interferometer, and permits measurements and alignments over traverses and distances of many feet if required. Precisions in the 0.01-sec-of-arc range and better can be obtained with the help of electronic location of interference fringes. Experiments with carriages moving at rates up to 1-ft/sec and over distances of the order of 1½ ft have demonstrated the versatility of the alignment interferometer in various applications, in particular in the alignment of ways on a velocity-of-light apparatus and on ruling engines. (Contractor's abstract)

1740

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

LINEAR MODELS FOR CONTRAST PHENOMENA, by J. C. Bliss and W. B. Macurdy. [1961] [7]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 33-039-sc-78108]) Unclassified

Published in Jour. Opt. Soc. Amer., v. 51: 1373-1379, Dec. 1961.

Discrete and continuous linear models are defined to describe contrast phenomena such as Mach bands. Two-sided z transforms are used to describe the discrete systems and Fourier transforms are used to describe continuous systems. A psychological model is defined based on the work of v. Békésy on skin and vision which suggests a "neural unit" consisting of an area of sensation surrounded by an area of inhibition. A physiological model is also defined based on the experiments of Hartline et al , describing lateral neural interaction in the eye of Limulus. It is shown that the physiological model is related to the psychological model and that the form of the physiological inhibitory coefficients k_p uniquely specify the form of the psychological neural unit h_p, and vice versa. Also, by assuming a "blurring" of the stimulus spatial distribution as the excitation distribution of the receptors, a neural unit is obtained from the physiological model which is similar to the psychological neural unit suggested by the experiments of v. Békésy. Illustrative examples are given. (Contractor's abstract)

1741

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

AN ACOUSTICAL THEORY OF VOWEL PRODUCTION AND SOME OF ITS IMPLICATIONS, by K. N. Stevens and A. S. House. [1961] [18]p. incl. 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]) Unclassified

Published in Jour. Speech and Hearing Research, v. 4: 303-320, Dec. 1961.

A contemporary acoustical theory of vowel production is outlined and certain implications of the theory are discussed. The theory considers a vowel sound to be the result of excitation of a linear acoustic system by a quasi-periodic volume velocity source. The transfer function of the acoustic system is completely described by a number of poles whose frequency locations depend on the vocal-tract configuration. It is shown that the theory is compatible with data relevant to the over-all intensity of vowels, amplitude relations within syllables, and questions of balance in the vowel spectrum. Finally it is proposed that the traditional term formant be restricted to mean a normal mode of vibration of the vocal system. (Contractor's abstract)

1742

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ITERATIVE ARRAYS OF LOGICAL CIRCUITS, by F. C. Hennie, III. [1960] 242p. incl. diagrs. refs. (Special technical rept. no. 3) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108, and General Electric Research Lab.) Unclassified

Several techniques are described for those who are interested in data processing, computer design, and switching theory and who may find usefulness in the design of iterative networks. That there can be no general procedures for the analysis and synthesis of even relatively simple types of iterative [illegible]s are demonstrated. Finally, an appreciation of the [illegible]abilities and limitation of the methods presented here may facilitate the development of other, more powerful, approaches.

1743

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

THE QUANTIFICATION OF THE ELECTRICAL ACTIVITY OF THE NERVOUS SYSTEM, by W. A. Rosenblith. [1961] [15]p. incl. refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) Unclassified

Published in Quantity and Quality, New York, Free Press of Glencoe, Inc., 1961, p. 87-101.

The problem of the quantification of scientific data is considered. In particular, appropriate methods for the collection of electrophysiological data are discussed.

1744

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

COCHLEAR RESPONSES TO CONDENSATION AND RARE-FACTION CLICKS, by W. T. Peake and N. Y.-S. Kiang. [1961] [12]p. incl. diagrs. refs. (Sponsored jointly by Air Force Cambridge Research Center under AF 19(604)4112; 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 Biophys. Jour., v. 2: 23-34, Jan. 1962.

Auditory nerve responses to condensation and rarefaction clicks (CC and RC) have been recorded over a wide intensity range with gross electrodes. At low intensities the RC responses are nearly identical to CC responses. At high intensities RC and CC response waveforms are similar, but the latency of the N_1 peak in the RC response is 0.2 msec shorter than that for the corresponding CC response. At intermediate intensities the RC and CC response waveforms are quite different. These results can be interpreted in terms of a model in which there are 2 excitatory mechanisms for the neural response, which are operative in different intensity ranges. The cochlear microphonic potential and a "slow" potential are suggested as possible excitatory mechanisms. (Contractor's abstract)

1745

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

THE RELATION BETWEEN THE TRANSPORT AND THE ORBIT MODELS FOR A PLASMA, by S. Frankenthal and W. P. Allis. [1961] [9]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108, Atomic Energy Commission, and National Science Foundation) Unclassified

Published in I.R.E. Trans. on Antennas and Propagation, v. AP-10: 15-23, Jan. 1962.

Starting with the Boltzmann equation and the dynamic equation of a charged particle, a transport (particle) model for the plasma, as well as an orbit (guiding-center) model which is valid for arbitrarily large orbits is developed. The development facilitates the interpretation of the difference between the 2 models, and sets the stage for the derivation of the conditions under which the 2 become interchangeable. These conditions include restrictions of the particle distribution and on the field gradients. The role of each model in the formulation of the self-consistent-field problem in the plasma is discussed. (Contractor's abstract)

1746

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

CONSERVATION PRINCIPLES FOR PLASMAS AND RELATIVISTIC ELECTRON BEAMS, by A. Bers and P. Penfield, Jr. [1961] [15]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) Unclassified

Published in I.R.E. Trans. on Electron Devices, v. ED-9: 12-26, Jan. 1962.

Many useful conservation theorems are derived for relativistic electron beams and anisotropic plasmas. All these theorems are valid for confined-flow and irrotational-flow devices, and cold, collisionless plasmas. All the theorems are derived in a similar way, and a generalization of this method, using linear operators, is given. Among the power theorems discussed are: Tonk's theorem, the instantaneous and sinusoidal small-signal theorems, the energy theorem, a large-disturbance theorem, the Manley-Rowe formulas, an ac power theorem, and a cross-correlation theorem. Contributions to power and energy from surface waves are included. Allowing for relativistic flow and writing all equations in the laboratory frame does not significantly complicate the theorems, and in fact clarifies them somewhat. Many simple applications are discussed, although not in detail. Among these are: small-signal energy, power, and passivity; energy velocity in electron beam and plasma wave-guides; and a conservation theorem for multiple electron beams and electron beam-plasma interactions. (Contractor's abstract)

1747

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

LOW-DENSITY PARITY-CHECK CODES, by R. G. Gallager. [1961] [8]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Published in I.R.E. Trans. on Information Theory, v. IT-8: 21-28, Jan. 1962.

The code words of a parity-check code are formed by combining a block of binary information digits with a block of check digits. Each check digit is the modulo 2 sum of a prespecified set of information digits. These formation rules for the check digits can be conveniently represented by a parity-check matrix. This matrix represents a set of linear homogeneous modulo 2

equations called parity-check equations, and the set of code words is the set of solutions of these equations. This paper describes a class of coding and decoding schemes that can utilize the long block lengths necessary for low error probability without requiring excessive equipment or computation.

1748

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ON THE WIDTH OF CRITICAL BANDS, by J. A. Swets, D. M. Green, and W. P. Tanner, Jr. [1961] [5]p. incl. diagrs. table, refs. (In cooperation with Michigan U., Ann Arbor) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) Unclassified

Published in Jour. Acoust. Soc. Amer., v. 34: 108-113, Jan. 1962.

A different technique of analysis is applied to the experiment suggested by Harvey Fletcher for measuring the width of the critical band. This experiment determines the ability of noise bands of different widths to mask a pure tone centered in the band. The analysis considers 2 filters in series, 1 outside and 1 inside the observer. The width of the second filter (the critical band) can be estimated from measurements of the reduction on the noise power at the detector which is effected by the pair of filters. The width of the critical band is estimated under 4 different assumptions about the shape of the band. The results provide a context for discussing the reasons that may underlie the widely varying estimates of the critical bandwidth which have been obtained in previous studies. (Contractor's abstract)

1749

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

AVERAGE RESPONSES TO CLICKS RECORDED FROM THE HUMAN SCALP, by C. D. Geisler and W. A. Rosenblith. [1961] [3]p. incl diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) Unclassified

Published in Jour. Acoust. Soc. Amer., v. 34: 125-127, Jan. 1962.

The use of a method of electronic averaging in the detection of electrical responses from human subjects is briefly described. The correlation of such data with psychophysical data from the same subject is discussed. (Contractor's abstract)

1750

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

SCATTERING LOSS FROM MAGNETIC MIRROR SYSTEMS. I, by D. J. BenDaniel and W. P. Allis. [1961] [21]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], Atomic Energy Commission, and National Science Foundation) Unclassified

Published in Plasma Phys., Accelerators, Thermonuclear Research, v. 4: 31-51, Jan. 1962.

The problem of scattering loss of a plasma of singly-charged ions and electrons from magnetic mirror confinement is considered. Using the adiabatic approximation for the behavior of a charged particle in the absence of collisions, a method is developed in which collisions are treated as a perturbation. The time behavior of the distribution function of the ions everywhere in the system is found from the 'reference distribution' at the mid-plane. The 'square well' approximation is treated in detail. An approximation to the Rosenbluth equation is developed which permits the problem to be treated in terms of angular modes and transport coefficients. The transport coefficients involve integrals over the speed distribution of the ions; this speed distribution is the solution of a highly non-linear equation and numerical solutions are given for several mirror ratios. The asymptotic form of the distribution function in both angle and speed is discussed. (Contractor's abstract)

1751

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

THE EFFECT OF COLOR CENTERS ON THE NUCLEAR SPIN-LATTICE RELAXATION TIME IN LITHIUM FLUORIDE, by B. Josephson, Jr. and M. W. P. Strandberg. [1961] [7]p. incl. diagrs. refs. (Technical rept. no. 386) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) Unclassified

Published in Jour. Phys. and Chem. Solids, v. 23: 67-73, Jan.-Feb. 1962.

The dependence of the spin-lattice relaxation time of fluorine nuclei in lithium fluoride on the concentration of radiation-induced color centers has been investigated under rigidly controlled conditions. F-center concentrations have been determined from ultraviolet absorption spectra. The data agree with the theoretical predictions for diffusion-limited relaxation, with respect to the dependence on both the concentration of color centers and the diffusion constant for nuclear-spin diffusion. Some linewidth measurements were made for the fluorine resonance; data were obtained with the [110] crystalline axis parallel to the dc magnetic field.

1752

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

PROTON SPIN-LATTICE RELAXATION IN FERROELECTRIC COLEMANITE, by R. Blinc, M. Brenman and others. [1961] [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 Jour. Phys. and Chem. Solids, v. 23: 156-157, Jan.-Feb. 1962.

In order to throw further light on the role of hydrogen atoms in the ferroelectric behavior of Colemanite, measurements of the proton spin-lattice relaxation time T_1 have been performed over the range 150°-300° K, using a pulse technique. Experimental results are illustrated in graph form in which the presence of a strong relaxation mechanism connected with dipolar motion is evident. An Arrhenius plot of the temperature dependence of the correlation time is consistent with a single thermally activated motion, and leads to an activation energy of 4.9 kcal/mol.

1753

[Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge]

KINESTHETIC-TACTILE COMMUNICATIONS, by J. C. Bliss. [1961] [8]p. incl. illus. diagrs. table, refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Published in I.R.E. Trans. on Information Theory, v. IT-8: 92-99, Feb. 1962.

Machine aids to kinesthetic-tactile communication aim at maximizing the information-transfer rate from an external source to the human user. The display is the central problem. Source messages might be recoded into equal information units presented ons at a time to the user, or a temporal or spatial display of the message may permit the user to recode the message perceptually into manageable units. The performance of these alternatives has been examined using a kinesthetic-tactile display for English text. This device consists of 8 finger rests, each of which can move in 26 directions in 3-dimensional space. Two methods of programming this device to present information were investigated. In the "traveling-wave" presentation, a 3-dimensional traveling wave of finger movements moves across the display representing a sequence of symbols. This presentation is an example of the case in which the user recodes the source messages perceptually. In the "typewriter" presentation, the subject's fingers are moved corresponding to the way he would actively move them if he were typing. The latter proved to be the more effective, yielding a transmission rate of 4.5 bits/sec. (Contractor's abstract)

1754

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

TEMPORAL CODING OF NEURAL RESPONSES TO ACOUSTIC STIMULI, by N. S.-Y. Kiang, M. H. Goldstein, Jr., and W. T. Peake. [1961] [7]p. incl. illus. diagrs. refs. (Sponsored jointly by Air Force Electronics 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

Published in I.R.E. Trans. on Information Theory, v. IT-8: 113-119, Feb. 1962.

Electric responses to acoustic stimuli have been recorded from the auditory nervous system of cats. Responses of single nerve cells in the cochlear nucleus recorded with microelectrodes, and auditory nerve responses recorded with gross electrodes (which record activity of many cells) are presented as examples of the kinds of data which can be obtained. The behavior of these responses for various changes in stimulus paramsters is illustrated together with several methods of data analysis. The data presented are from studies in auditory physiology in which one aim is a description of the neural coding of the temporal pattern of acousti stimuli. (Contractor's abstract)

1755

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

NEURAL MECHANISMS WHICH DISCRIMINATE EVENTS ON THE SKIN, by P. D. Wall and R. Malzack. [1961] [6]p. incl. refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Rsssarch, and Signal Corps under [DA 36-039-sc-78108], Bell Telephone Labs., Inc., National Institutes of Hsalth, and Teagle Foundation) Unclassified

Published in I.R.E. Trans. on Information Theory, v. IT-8: 120-125, Feb. 1962.

This review examines the historical devslopment of concepts of nervous system organization with special referencs to ths skin ssnsory system. The commonly held view that the modalitiss of sensation are produced solely by the initial filtsring action of the receptor organs is shown not to fit the observed physiology of ths first and second cells in the sensory pathway. Instsad, it is proposed that every discriminably different cutaneous perssption is producsd by a unique space-tims pattern

of nerve impulses. The mechanisms employed by the nervous system for generating and analyzing space-time patterns of impulses are discussed. (Contractor's abstract)

1756

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

PICTURE CODING USING PSEUDO-RANDOM NOISE, by L. G. Roberts. [1961] [10]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 I.R.E. Trans. on Information Theory, v. IT-8: 145-154, Feb. 1962.

In order to transmit television pictures over a digital channel, it is necessary to send a binary code which represents the intensity level at each point in the picture. For good picture quality using standard PCM (Pulse Code Modulated) transmission, at least 6 bits are required at each sample point, since the eye is very sensitive to the small intensity steps introduced by quantization. However, by simply adding some noise to the signal before it is quantized and subtracting the same noise at the receiver, the quantization steps can be broken up and the source rate reduced to three bits per sample. Pseudo-random number generators can be synchronized at the transmitter and receiver to provide the identical "noise" which makes the process possible. Thus, with the addition of only a small amount of equipment, the efficiency of a PCM channel can be doubled. (Contractor's abstract)

1757

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

SPEECH RECOGNITION: A MODEL AND A PROGRAM FOR RESEARCH, by M. Halle and K. [N.] Stevens. [1961] [5]p. incl. diagrs. refs. (Sponsored jointly by Air Force Electronics Systems Division; 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 I.R.E. Trans. on Information Theory, v. IT-8: 155-159, Feb. 1962.

A speech recognition model is proposed in which the transformation from an input speech signal into a sequence of phonemes is carried out largely through an active or feedback process. In this process, patterns are generated internally in the analyzer according to an adaptable sequence of instructions until a best match with the input signal is obtained. Details of the process are given, and the areas where further research is needed are indicated. (Contractor's abstract)

1758

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

HANDWRITING AND PATTERN RECOGNITION, by M. Eden. [1961] [7]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 M.I.T. Computation Center, National Institutes of Health, and National Science Foundation) Unclassified

Published in I.R.E. Trans. on Information Theory, v. IT-8: 160-166, Feb. 1962.

Handwriting can be characterized as a sequence of basic strokes connected according to rule. Handwriting so generated approximates that of humans very closely. Such a matching process can be used as the fundamental principle in a handwriting recognizer. (Contractor's abstract)

1759

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

STUDIES OF NASAL CONSONANTS WITH AN ARTICULATORY SPEECH SYNTHESIZER, by M. H. L. Hecker. [1961] [10]p. incl. illus. diagrs. refs. (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: 179-188, Feb. 1962.

An electrical analog of the nasal cavities has been designed for use in conjunction with a dynamically controllable analog of the vocal tract (Jour. Acoust. Soc. Amer., v. 30: 201, 1958). The acoustical coupling between vocal tract and nasal cavities is electronically variable. Listening tests are conducted to determine the most suitable vocal-tract configurations for producing nasal consonants in consonant-vowel and vowel-consonant syllables. Other listening tests determine the most suitable patterns of temporal variables for these syllables. In general, it is found that more natural-sounding syllables are obtained when the velopharyngeal coupling varies slowly with time compared to changes in vocal-tract configuration. The results compare favorably with recent cineradiological data, and are interpreted to support the view that studies with articulatory synthesizers reveal important details about the production and perception of natural speech. The experiments demonstrate that speech can be synthesized from articulatory information in a straightforward and natural manner. (Contractor's abstract)

1760

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

LOW-TEMPERATURE ELASTIC CONSTANTS OF GALLIUM ARSENIDE, by C. W. Garland and K. C. Park. [1961] [2]p. incl. tables. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) Unclassified

Published in Jour. Appl. Phys., v. 33: 759-760, Feb. 1962.

The adiabatic elastic constants of a single crystal of gallium arsenide were obtained over the temperature range 77.4° to 300°K by measuring the velocities of longitudinal and transverse acoustic waves propagated in the $[1\bar{1}0]$ and [111] directions. For a cubic crystal, the elastic constants are related to the wave velocities (U) in the $[1\bar{1}0]$ direction by:

(1) $\rho U_{l_0}^2 = (c_{11} + c_{12} + 2c_{44})/2$

(2) $\rho U_{t||}^2 = c_{44}$ (polarized $\parallel$ to [001])

(3) $\rho U_{t\perp}^2 = C' = (c_{11} - c_{12})/2$ (polarized $\perp$ to [001]),

where ρ is the density. In the [111] direction,

(4) $\rho U_{l_1}^2 = (c_{11} + 2c_{12} + 4c_{44})/3$

(5) $\rho U_{t_1}^2 = (c_{11} - c_{12} + c_{44})/3$ (any polarization).

A 10-mc ultrasonic pulse-echo technique was used to measure all 5 of the above velocities. At 20°C the distance between a pair of parallel [111] faces was 3.666 cm and the distance between a pair of parallel $[1\bar{1}0]$ faces was 1.285 cm. The elastic constants of c_{11}, c_{12}, and c_{44} were obtained from the values of $\rho U_{t||}^2$, $\rho U_{t\perp}^2$, and $\rho U_{l_1}^2$ since this procedure minimized the uncertainties in the calculated c_{ij} values. Results are presented in tabulated form.

1761

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

HEAT CAPACITY OF CRYSTALLINE POLYETHYLENE FROM 1.8° TO 5.3°K, by L. L. Isaacs and C. W. Garland. [1961] [5]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108, and the Alfred P. Sloan Foundation) Unclassified

Published in Jour. Chem. and Phys. Solids, v. 23: 311-315, Mar. 1962.

The heat capacity of Marlex, a highly crystalline linear polyethylene, has been measured between 1.8° and 5.3°K. The data over this entire range can be represented by $C_p = 1.13 \times 10^{-2} T^3$ mJ deg^{-1}gm^{-1}. This result is discussed qualitatively in terms of a simplified model that treats the solid polymer as a set of weakly coupled 1-dimensional chains. (Contractor's abstract)

1762

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ANOMALOUS DIFFUSION OF A PLASMA ACROSS A MAGNETIC FIELD, by S. Yoshikawa and D. J. Rose. [1961] [7]p. incl. diagrs. table, refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108, and National Science Foundation) Unclassified

Published in Phys. Fluids, v. 5: 334-340, Mar. 1962.

The fluctuation of the density can cause an anomalous diffusion that is inversely proportional to the magnetic field B. The mobility of electrons perpendicular to the magnetic field was measured and supports 1/B diffusion. There is good agreement between the observed mobility and the theoretical one derived from the density fluctuation. The potential fluctuation was found to be an increasing function of the external potential and independent of the magnetic field intensity. This fact also indicates that fluctuation or turbulence plays an important role in the anomalous diffusion.

1763

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

NUCLEAR SPIN-LATTICE RELAXATION IN SOME FERROELECTRIC AMMONIUM SALTS, by S. R. Miller, R. Blinc and others. [1961] [5]p. incl. diagrs. table, refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Published in Phys. Rev., v. 126: 528-532, Apr. 15, 1962.

The temperature dependence of H^1 and F^{19} spin-lattice relaxation times in polycrystalline $(NH_4)_2SO_4$, $(NH_4)_2BeF_4$, NH_4HSO_4, and $(NH_4)_2H_3IO_6$ have been measured in both the ferroelectric and nonferroelectric phases, using a pulse technique at 30 mc/sec. The spin-lattice relaxation processes were found to be determined by molecular reorientation. Definite changes in the proton relaxation behavior in the neighborhood of the Curie points indicate a change in the state of internal motion at the transition. The same was found to be true for 2 solid solutions of $(NH_4)_2BeF_4$, in $(NH_4)_2SO_4$. The

results suggest that the ferroelectric phase changes in these solids are in general accompanied by a change in lattice structure which alters the potential in which the nuclei move, but do not involve an important change in the degree to which nuclei must cooperate in order to surmount the potential barriers. (Contractor's abstract)

1764

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ON MULTILINK AND MULTIDIMENSIONAL CHANNELS, by T. Kailath. [1961] [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 I.R.E. Trans. on Information Theory, v. IT-8: 260-262, Apr. 1962.

A different approach to the problem of optimal reception in general diversity and optical channels is presented based directly on the result for a single-link, single-dimensional channel. It can be verified that in the special case of diversity reception the solution gives the well-known results of Brennan, Pierce and others. It also leads to some interesting new results including an analogue for fading channels of Brennan's result for nonfading channels.

1765

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

SCATTERING LOSS FROM MAGNETIC MIRROR SYSTEMS. II, by D. J. BenDaniel and W. P. Allis. [1961] [10]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], and Atomic Energy Commission and National Science Foundation) Unclassified

Published in Plasma Phys., Accelerators, Thermonuclear Research, v. 4: 79-88, Apr. 1962.

Results are presented of a study in which the square well treatment was generalized by the reference distribution method to a class of more realistic mirror machine shapes. It is shown that the rate of change of density and energy in those systems may be considered in terms of equations similar in form to those derived from the 'square well'. Graphs are presented of the results of numerical calculations in which the independent parameter was the 'shape' of the system. (Contractor's abstract)

1766

Massachusetts Inst of Tech. [Research Lab. of Electronics] Cambridge.

SYMMETRY AND FREE ELECTRON PROPERTIES OF THE GALLIUM ENERGY BANDS, by J. C. Slater, G. F. Koster, and J. H. Wood. [1961] [11]p. incl. diagrs. tables. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], and National Science Foundation) Unclassified

Published in Phys. Rev., v. 126: 1307-1317, May 15, 1962.

Atomic arrangement, unit cell, and Brillouin zone of metallic gallium are described, including notations for the various symmetry directions. The point and space groups are discussed, including character tables and basic functions in the form of symmetrized plane waves for electronic wave functions of each symmetry type. The free-electron approximation is used as a first step toward finding the energy bands and Fermi surfaces. This work is preparatory toward a study of energy bands which is under way using the augmented-plane-wave method. (Contractor's abstract)

1767

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

MODE CONTROL IN RUBY OPTICAL MASERS BY MEANS OF ELASTIC DEFORMATION, by M. S. Lipsett and M. W. P. Strandberg. [1961] [15]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) Unclassified

Published in Appl. Opt., v. 1: 343-357, May 1962.

A new technique has been applied in experimental work on ruby optical masers with dramatic results. The techniques involved elastically deforming the medium and thereby invoking the stress-optic effect. Strikingly, it permitted optimizing the elastic deformation of any particular ruby specimen to reduce significantly its pumping-energy requirements for the onset of maser oscillations. At the same time, the divergence of the emergent beam could be reduced by a sizable fraction to that characteristic of low-order radiation modes. (Contractor's abstract)

1768

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

RATE FUNCTIONS FOR AUDITORY NERVE RESPONSES TO BURSTS OF NOISE: EFFECT OF CHANGES IN STIMULUS PARAMETERS, by W. T. Peake, N. Y.-S.

Kiang, and M. H. Goldstein, Jr. [1961] [5]p. incl. diagrs. (Sponsored jointly by Air Force Cambridge Research Labs. under AF 19(604)4112; 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. Acoust. Soc. Amer., v. 34: 571-575, May 1962.

Rate functions for the amplitude of neural responses are presented as a function of stimulus parameters, such as burst length, intensity, and stimulus power level. The data show that the rate functions depend on all of these parameters in a manner that does not allow for a simple description. Rate functions are also reported for noise bursts in the presence of various levels of steady masking noise. Near visual detection level these rate functions exhibit characteristics that are well accounted for by a model that deals with the overlapping of successive neural responses. (Contractor's abstract)

1769

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

HYPERFINE STRUCTURE AND ISOTOPE SHIFT IN THE $7\,^2S_{\frac{1}{2}} - 6\,^2P_{\frac{1}{2}}$ TRANSITION OF NATURAL THALLIUM BY ATOMIC BEAM ABSORPTION, by C. J. Schuler, M. Ciftan and others. [1961] [3]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Published in Jour. Opt. Soc. Amer., v. 52: 501-503, May 1962.

The isotope shift in the $7\,^2S_{\frac{1}{2}} - 6\,^2P_{\frac{1}{2}}$ transition (3776A) and the hyperfine-structure separations of Tl^{203} and Tl^{205} in the $7\,^2S_{\frac{1}{2}}$ state have been determined spectroscopically by atomic beam absorption with the use of a Fabry-Pérot interferometer crossed with a 10-in. diffraction grating. The results are 0.0554 ± 0.0012 cm^{-1} for the isotope shift in the 3776A line; -0.0405 ± 0.0013 cm^{-1} in the $6\,^2P_{\frac{1}{2}}$ level; and $\Delta\nu\,(7\,^2S_{\frac{1}{2}}) = 0.4078 \pm 0.0014$ cm^{-1} and 0.4109 ± 0.0012 cm^{-1} for the hyperfine structure separation in Tl^{203} and Tl^{205}, respectively. (Contractor's abstract)

1770

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

GROWTH OF THE ANTENNAS AND PROPAGATION FIELD BETWEEN WORLD WAR I AND WORLD WAR II. PART I. ANTENNAS, by L. J. Chu. [1961] [3]p. incl. refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) Unclassified

Published in Proc. Inst. Radio Engineers, v. 50: 685-687, May 1962.

The advances in antenna theory concepts and designs between World War I and World War II are summarized. Rapid growth of world-wide and regional broadcasting and point-to-point radio communication stimulated in the design of high-power low-frequency transmitting antennas of reasonable efficiency, directive-wave antennas for signal-to-noise improvement in low-frequency reception, rhombic and V-shape wave antennas and arrays of various types for directive short-wave transmission and reception. (Contractor's abstract)

1771

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

NUCLEAR MAGNETIC RESONANCE STUDY OF COLLAGEN HYDRATION, by H. J. C. Berendsen. [1961] [9]p. incl. diagrs. refs. [Technical rept. no. 398] (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. Chem. Phys., v. 36: 3297-3305, June 15, 1962.

The proton resonance signal of water in partially dried tendon shows 3 peaks for samples equilibrated in an atmosphere of 30%-80% relative humidity (R.H.). The outer-peak splitting (between 0.5 and 1 gauss) has the character of a proton-pair splitting with effective interactions in, or close to, the fiber direction, as concluded from the dependence of the absorption on the angle between the fiber direction and the magnetic field. Chain-like water structures, exhibiting certain proton-reorientation processes, are postualted. At 10% R.H. a narrow peak is observed, which is not angular dependent; this indicates rapid reorientation of water molecules. Above 80%-90% R.H., a single peak is observed, the width of which has a strong angular dependence. A structural relationship between collagen and water exists, by virtue of which the existence of water chains and, possibly, of 3-dimensional water structures, could be stabilized. (Contractor's abstract)

1772

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ALTERNATING-CURRENT GENERATION WITH MOVING CONDUCTING FLUIDS, by H. A. Haus. [1961] [12]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 Jour. Appl. Phys., v. 33: 2161-2172, July 1962.

A 1-dimensional, small-amplitude analysis is presented of alternating-current generation by a stationary electromagnetic circuit coupling to waves in a moving, perfectly conducting fluid. In a uniform applied dc magnetic field the waves in the fluid are either compressional waves if the time average velocity v_0 is transverse to the dc magnetic field, or Alfvén waves if it is along the dc magnetic field. It is shown that, for velocities v_0 greater than the velocity of propagation c of the compressional or Alfvén waves, self-excited oscillations may be produced in a resistively loaded coil coupling to the fluid. The results of 2- and 3-dimensional analyses are summarized in order to show that the phenomena predicted by the simplified 1-dimensional analysis occur in less idealized geometries. Possible applications are briefly discussed with reference to ac power generation by using combustion gases or a flow of a high-temperature plasma. (Contractor's abstract, modified)

1773

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

THE GENERATION OF MICROWAVE PHONONS FOR STUDYING THE SPIN-LATTICE INTERACTION, by P. H. Carr and M. W. P. Strandberg. [1961] [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-78108) Unclassified

Published in Jour. Phys. and Chem. Solids, v. 23: 923-937, July 1962.

Microwave phonons have been produced and their interaction with paramagnetic impurity centers in quartz has been studied. Phonon packets were produced by the piezoelectric effect at the end surface of a quartz rod placed in the electric field of a re-entrant cavity. They propagated down the rod, were reflected from the opposite end, and were detected at the generating surface by the inverse effect. The amplitude envelope of the echoes consisted of a series of maxima and minima, or beats superimposed on an exponential decay. From the decay, the average lifetime of the coherent phonons was found to be 10^{-5} sec. The t = 0 intercept of the envelope measured the square of the fraction of the microwave power converted into acoustic power, which was found to be smaller than the computed value of 0.7×10^{-6}. The absorption of phonons by spins produced in the natural quartz by gamma irradiation from Co^{60} source was detected as a partial saturation of the spin electron paramagnetic resonance. The partial saturation, S/S_0, was found to be 0.75 at 1.7°K, 0.75 at 4.2°K, and 0.92 at 20°K, the error in S/S_0 falling between 2 and 5%. These values for S/S_0 were independent of the difference between the microwave and phonon frequencies within 20 mc/s, and at a given temperature were independent of the microwave power. The order of magnitude of the spin-lattice relaxation time T_1 was found to be greater than 3 sec at 1.7°K, 0.3 sec at 4.2°K, and 3×10^{-4} sec at 35°K, and $3. \times 10^{-6}$ sec at 77°K. The spin-resonance absorption saturated in such a manner as to indicate partial inhomogeneous broadening, and cross relaxation took place between the closely spaced, narrow lines of the spectrum. These 2 effects prevented quantitative determination of the spin-phonon transition probability.

1774

Massachusetts Mental Health Center, Boston.

ANTISOCIAL BEHAVIOR AND HYPNOSIS: PROBLEMS OF CONTROL AND VALIDATION IN EMPIRICAL STUDIES, by M. T. Orne. [1960] [77]p. incl. refs. (AFOSR-1205) (AF 49(638)728) Unclassified

Also published in Hypnosis: Current Problems; Symposium on Theory and Research Methodology in Specific Fields, Colgate U., Hamilton, N. Y. (Apr. 1-2, 1960), New York and Evanston, Harper and Row, 1962, p. 137-192.

The question of whether a deeply hypnotized individual can be induced to perform antisocial or self-destruction acts is discussed in detail with respect to available data. Attention is given to the difficulty of testing the credibility of a statement either supporting or refuting the question posed above. There are 2 parts to the problem: (1) is there an increase in social control in hypnosis? (2) If such an increase in social control exists, do its parameters include the violation of internalized sanctions? The problem must be considered in terms of social controls if an experimental approach is to be feasible without ethical and moral difficulties. No conclusions are reached but the overall problem is presented in great detail for analysis.

1775

Massachusetts Mental Health Center, Boston.

VALIDATION AND CROSS-VALIDATION OF A SCALE OF SELF-REPORTED PERSONAL EXPERIENCES

WHICH PREDICTS HYPNOTIZABILITY, by R. E. Shor, M. T. Orne, and D. N. O'Connell. [1961] [29]p. incl. diagrs. tables, refs. (AFOSR-1205) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)728 and Human Ecology Fund) AD 438547 Unclassified

Also published in Jour. Psychol., v. 53: 55-75, Jan. 1962.

A paper and pencil self-report questionnaire was designed to measure the incidence of "hypnotic-like" experiences which have occurred naturally in the normal course of living. The questionnaire as evolved was found to predict hypnotizability, especially in the deepest region of the hypnotizability continuum. Ramifications of the data are presented in terms of theoretical formulations where both ability factors and nonability factors (such as attitudes and motives) are reviewed as components of achieved hypnotizability.

1776

Massachusetts Mental Health Center, Boston.

ON THE PHYSIOLOGICAL EFFECTS OF PAINFUL STIMULATION DURING HYPNOTIC ANALGESIA UNDER CONDITIONS DESIGNED TO MINIMIZE ANXIETY, by R. E. Shor. [1960] [37]p. incl. diagr. tables, refs. (AFOSR-2548) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)728, National Institute of Mental Health, and Society for the Investigation of Human Ecology) Unclassified

Also published in Hypnosis: Current Problems; Symposium on Theory and Research Methodology in Specific Fields, Colgate U., Hamilton, N. Y. (Apr. 1-2, 1960), New York and Evanston, Harper and Row, 1962, p. 54-75.

Five experiments dealing with the physiological effect of painful stimulation while under hypnosis are reviewed. Shortcomings of these experiments are pointed out to clarify the necessity for further research. The present state of the evidence is considered along with implications from the author's own research of 3 resulting hypotheses on pain. It is concluded that since the experience of pain is eliminated during hypnotic analgesia, physiological reactions resulting from stressful or threatening qualities (which the pain might otherwise have) do not occur; anything else that 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 hypnotic analgesia.

1777

Massachusetts Mental Health Center, Boston.

THREE DIMENSIONS OF HYPNOTIC DEPTH, by R. E. Shor. [1961] [16]p. (AFOSR-64-0828) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)728, Institute for Experimental Psychiatry, and Society for the Investigation of Human Ecology) AD 438386 Unclassified

Also published in Internat'l. Jour. Clin. Exp. Hypnosis, v. 10: 23-38, Jan. 1962.

Nine additional formal propositions are presented which extend the author's earlier presentation of a dual-factor theory of hypnosis (Amer. Jour. Psychother., v. 13: 582-602, 1959) to include a third factor, archaic involvement, a feature of hypnosis often stressed by psychoanalytically-oriented theorists. Although interactions and interrelationships usually occur among these 3 factors, the 3 are viewed as conceptually separate, i.e., the depth of each may vary independently. Many ramifications of these views are presented. The theory is most properly seen as a synthesis of the enduring insights embedded in many prior theories of hypnosis. (Contractor's abstract)

1778

Massachusetts Mental Health Center, Boston.

THE EFFECT OF EXPOSURE TO DICHOTIC NOISE ON THE DISCRIMINATION OF DICHOTIC TIME DIFFERENCES, by S. J. Freedman and D. W. Pfaff. Apr. 1961, 1v. incl. illus. tables, refs. (AFOSR-503) (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-61-26] and Wright Air Development Division under AF 33(616)7625) AD 256800 Unclassified

Subjects were exposed, under 3 conditions of motility, to a constantly changing auditory field produced by 2 separate noise-generating systems, each feeding the sound into 1 ear. After 2 hr of continuous exposure, 11 out of 12 ambulatory subjects showed increased variability in an auditory localization task, the discrimination of dichotic time differences. Performance after 2 hr under the same conditions of exposure deteriorated for only 5 out of 12 subjects when body movements were restricted. When the subjects were wheeled in a wheelchair, sitting quietly except for frequent head rotations, 9 out of 12 subjects showed increased variability. That is, self-produced motion of at least the head, while listening to dichotic noise which masked background sounds, was necessary to disrupt accurate auditory localization. (Contractor's abstract)

1779

Massachusetts Mental Health Center, Boston.

THE EFFECT OF DICHOTIC NOISE ON AUDITORY

LOCALIZATION, by S. J. Freedman and D. W. Pfaff. [1961] [5]p. incl. diagrs. (AFOSR-J347) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-26 and Wright Air Development Division under AF 33(616)7625) AD 408004 Unclassified

Also published in Jour. Auditory Research, v. 2: 305-310, Oct. 1962.

Two independent, portable noise generators were used supplying continuous stimulation to each of the subject's ears separately. After 2 hr of exposure ambulatory subjects' ability to discriminate small time differences between the two ears was significantly impaired. Performance did not deteriorate for those whose bodily movements had been restricted under the same exposure conditions. (Contractor's abstract)

1780

Massachusetts Mental Health Center, Boston.

TRADING RELATIONS BETWEEN DICHOTIC TIME AND INTENSITY DIFFERENCES IN AUDITORY LOCALIZATION, by S. J. Freedman and D. W. Pfaff. [1961] [7]p. incl. diagrs. tables. (AFOSR-J348) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-26 and Wright Air Development Division under AF 33(616)7625) AD 407119 Unclassified

Also published in Jour. Auditory Research, v. 2: 311-318, Oct. 1962.

Balancing dichotic intensity in order to center a click, after various dichotic time differences had been established, yielded an average value of 43 μsec/db for four subjects. The same four subjects gave an average of only 23 μsec/db when dichotic time differences were varied to center the sound, as a function of preset dichotic intensity differences. An implication of this disparity for the localization mechanisms employing dichotic time and dichotic intensity differences is discussed. (Contractor's abstract)

1781

Massachusetts Mental Health Center, Boston.

A RE-EXAMINATION OF THE CONCEPT OF "ALPHA BLOCKADE" IN ELECTROENCEPHALOGRAPHY, by A. D. Prince and S. J. Freedman. Dec. 1, 1961, 13p. incl. diagrs. refs. (AFOSR-2080) (AF AFOSR-62-11) AD 436182 Unclassified

This is a stimulus generalization experiment concerned with testing for response to a conditioned stimulus (CS) which varies from the standard CS in the conditioning trials. The main concern is with "alpha blockade" where "alpha" is defined as sinusoidal waves of 8-13 c/sec of 75-100 uv amplitude and "alpha blockade" is at least a 50% amplitude drop of approx 0.3 sec duration as measured by electroencephalography. "Alpha" is produced by a tone which lasts by itself for a sec then is joined by a light for 3 sec. "Alpha blockade" is produced by varying the light intensity. Results (whether or not a definite "alpha blockade" appears) are summarized for the basic experiment and numerous variations.

1782

Massachusetts U. Dept. of Chemistry, Amherst.

OXIDATION OF N-AMINODIHYDROISOINDOLLS. SYNTHESIS OF CIS- AND TRANS- 1,2-DIPHENYLBENZOCYCLOBUTENES, by L. A. Carpino. [1961] [6]p. incl. diagrs. table, refs. (Sponsored jointly by [Air Force Office of Scientific Research under AF 18(603)114] and Petroleum Research Fund) Unclassified

Published in Jour. Amer. Chem. Soc., v. 84: 2196-2201, June 5, 1962.

Oxidation of N-aminodihydroisoindole (II) by means of mercuric oxide in methylene dichloride or alkaline degradation of the corresponding p-toluenesulfonhydrazide (III) gave the dimer of o-quinodimethane, isolated as the corresponding dibromide. The related cis- and trans-1,3-diphenyl-2-aminodihydroisoindoles have been prepared from 1,3-diphenyl-1-hydroxyisoindole (XIII) by zinc-acetic acid and lithium aluminum hydride-aluminum chloride reduction, respectively. Conversion of each amine to the corresponding hydrazine through the nitroso compounds proceeded normally. Mercuric oxide oxidation of the trans isomer VIIb yielded the previously reported trans-1,2-diphenylbenzocyclobutene (XVII). Mercuric oxide oxidation of the cis-hydrazine VII a was unsatisfactory, although the use of activated manganese dioxide led to isolation of the previously unknown cis-1,2-diphenylbenzocyclobutene (XVI) in 27% yield. Nuclear magnetic resonance spectral data as well as oxidation, reduction and isomerization studies support the assigned structure. A convenient synthetic route to alkyl o-cyanobenzoates by the one-step dehydration-esterification of phthalamic acid is reported utilizing an alkane-or arenesulfonyl chloride in the presence of pyridine and an alcohol. (Contractor's abstract)

1783

Massachusetts U. Dept. of Chemistry, Amherst.

THE MEASUREMENT OF DYNAMIC BIREFRINGENCE, by S. Onogi, D. A. Keedy, and R. S. Stein. [1961] [2]p. incl. diagrs. (AFOSR-78) [AF AFOSR-61-28] AD 248744 Unclassified

Also published in Jour. Polymer Sci., v. 50: S15-S16, Mar. 1961.

The strain and birefringence of a 1.3-mil Spencer polymorphous polyethylene film was studied at room temperature as a function of frequency. The strain and

birefrigence varied with no perceptible phase difference. The variation with frequency of strain-optical coefficient, defined as the ratio of birefrigence to strain is plotted and a decrease in coefficient with increase in frequency is noted. This indicates that the response mechanism is time-dependent and is in contrast to the negligible birefrigence relaxation at longer times.

1784

Massachusetts U. Dept. of Chemistry, Amherst.

ON THE DYNAMIC LIGHT SCATTERING FROM POLYMER FILMS, by R. S. Stein. Dec. 1, 1961 [16]p. incl. diagrs. (Technical rept. no. 3) (AFOSR-2736) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-28)and Office of Naval Research) AD 427956 Unclassified

Also published in part in Jour. Polymer Sci., v. 62: S2-S4, Nov. 1962.

Based on previous experimental data, the theory for static light scattering from films is analyzed. An equation $\left(V_v = K\left\{\overline{\eta^2}\int \gamma(r)\frac{\sin hr}{hr}\, r^2\, dr + \frac{4}{45}\,\overline{\delta^2}\int f(r)\left[\frac{\overline{\eta^2}}{\alpha^2}\gamma(r)+1\right]\frac{\sin hr}{hr}\, r^2 dr\right\}\right)$ is solved giving the intensity of light scattering from a polymer film for incident and scattered light beams which are both parallel and polarized. The variation in scattering with elongation and the change in strain in the orientation direction is explained and the proper equations presented. In solving the original equation time-dependence must be considered because in a viscoelastic media birefringence is time dependent and the strain-optical coefficient must be replaced by the strain-optical spectrum which is a function of relaxation time. Attention is given to the theories of constant strain and periodic strain and actual experimental procedures are presented.

1785

Maudsley Hospital, London (Gt. Brit.).

A SENSITIVE IN VITRO TECHNIQUE FOR THE ASSAY OF THYROTROPHIC HORMONE, by P. M. Bottari and B. T. Donovan. [1957] [2]p. (AF 61(514)-953) Unclassified

Presented at meeting of the Physiological Soc., London (Gt. Brit.), Dec. 13-14, 1957.

Published in Jour. Physiol. (London), v. 140: 36P-37P, Mar. 11, 1958.

A new test for the pituitary hormone, TSH, based on the knowledge that the thyrotrophic hormone exerts a quantitative effect on the release of I^{131} labeled protein-bound iodine from the gland, is briefly explained and the results to be expected are summarized.

1786

Maudsley Hospital, London (Gt. Brit.).

THE PUTUITARY STALK AND OVULATION, by G. W. Harris. [1960] 24p. incl. illus. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 61(514)953 and National Institutes of Health) Unclassified

Published in Control of Ovulation, Proc. of Conf., Dedham, Mass. (Feb. 26-28, 1960), New York, Pergamon Press, 1961, p. 56-74.

The ripening of an ovarian follicle and its rupture, with discharge of an ovum, is dependent on the secretion of the anterior pituitary gland. Administration of purified follicle-stimulating hormone (FSH) results in follicular enlargement, but such follicles are unable to reach full size or secrete estrogen unless some luteinizing hormone (LH) is also present. Increased illumination, the feedback action of ovarian hormones and anterior hypothalamic lesions increase the discharge of FSH without its being directly administered. The blood level of LH may be increased by infusion of extracts of median eminence tissue directly into the anterior pituitary gland presumably because of some substance in the extract active in causing the discharge of LH (rather than due to damage to anterior pituitary tissue or gonadotrophic material in the extract).

1787

Maudsley Hospital, London (Gt. Brit.).

THE ESTIMATION OF THYROTROPHIC HORMONE IN BLOOD BY A SENSITIVE IN VITRO METHOD, by D. J. El Kabir. [1960] [4]p. incl. diagr. table, refs. (AF 61-(514)953) Unclassified

Published in Advances in Thyroid Research, Trans. Fourth Internat'l. Goitre Conf., London (July 1960), New York, Pergamon Press, 1961, p. 201-204.

A method for estimating the amount of thyrotrophic hormone (TSH) in the blood based on the thyrotrophin-induced release of I^{131} by incubated guinea-pig thyroid fragments is presented. The assay has been tested for reliability and blind assays carried out. The assay is accurate with doses up to 130 milliunits/100 ml when the log-dose curve loses its linearity. The assay is quite sensitive and relatively convenient. Cases using the method are presented in summary form.

1788

Maudsley Hospital, London (Gt. Brit.).

NEUROENDOCRINE RELATIONS, by G. W. Harris. [1960] [26]p. incl. illus. diagrs. refs. (AF 61(514)953) Unclassified

Also published in Ultrastructure and Metabolism of the Nervous System; Proc. Assoc. for Research in Nervous and Mental Disease, New York (Dec. 9-10, 1960), Baltimore, Williams and Wilkins, v. 40: 380-405, 1962.

Neuroendocrine relation findings of the past 20 yr are summarized. The degree of control by CNS of adrenohypophysis, anatomic pathways to anterior pituitary glands, media eminence and neurohumoral control of adrenohypophysis, hypothalamic localization of anterior pituitary secretion, hormonal regulation of CNS activities and behavior and local action of sex hormones and estrous behavior are discussed.

1789

Maudsley Hospital, London (Gt. Brit.).

HYPOTHALAMIC AND FOREBRAIN AREAS RESPONSIBLE FOR CONTROL OF SECRETION OF THYROTROPHIC AND ADRENOCORTICOTROPHIC HORMONES. Summary rept. May 1, 1956-Apr. 30, 1961, 21p. (AFOSR-1036) (AF 61(514)953) AD 261582 Unclassified

A summary report of major works done in the area of hypothalamic and forebrain areas responsible for control of secretion of thyrotrophic and adrenocorticotrophic hormones is presented. Some of the main topics discussed are: Hypothalamic control of TSH secretion: a study using remote control stimulation in conscious animals; Hypothalamic control of TSH secretion: a study using anesthetized animals with implanted electrodes and cannulation of an inferior thyroid vein and a sensitive in vitro technique for assaying TSH in body fluids.

1790

Maudsley Hospital, London (Gt. Brit.).

THE INFUSION OF BRAIN EXTRACTS INTO THE ANTERIOR PITUITARY GLAND AND THE SECRETION OF GONADOTROPHIC HORMONE, by H. J. Campbell, G. Feuer and others. [1961] [2]p. incl. table. (AF 61-(514)953) Unclassified

Presented at meeting of the Physiological Soc., University Coll., London (Gt. Brit.), Mar. 24-25, 1961.

Published in Jour. Physiol. (London), v. 157: 30P-31P, June 1961.

Experiments have been performed on the anterior pituitary gland (by means of infusions) in the rabbit to show the effect on ovulation of extracts from median eminence tissue and other parts of the brain and also of substances known to be present in the hypothalamus. Also intravenous infusions have been done with brain extracts. The results are presented in tabular form and a few conclusions drawn.

1791

Maudsley Hospital, London (Gt. Brit.).

INDUCTION OF OVULATION IN RATS BY DIRECT INTRA-PITUITARY INFUSION OF MEDIAN EMINENCE EXTRACTS, by M. B. Nikitovitch-Winer. [1961] [9]p. incl. illus. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 61(514)953 and Public Health Service) Unclassified

Also published in Endocrinology, v. 70: 350-358, Mar. 1962.

The possible existence of a hypothalamic humoral substance (s) capable of releasing the ovulating hormone from the adenohypophysis was studied. "Pentobarbital blocked" proestrous rats were used, and the effect on ovulation of various materials were determined upon direct intrapituitary infusion. Of 34 animals that received the intrapituitary infusion of borine and rat eminence extracts, 24 ovulated following the infusion. When bovine extracts were administered intravenously the effective dose had to be increased 10 to 48 times that infused into the pituitary, in order to elicit a response. Only 1 out of 28 animals infused with control substances ovulated following the infusion. Additional controls comprised 10 animals that received only pentobarbital, 6 animals in which cannulae were placed into the pituitary in addition to barbituate injections and 17 animals that received infusions of the various substances but in which the pituitary cannulae were unintentionally misplaced. None of these animals ovulated following the various procedures. These findings suggest that the median eminence of the tuber cinereum contains a substance (s) capable of releasing the ovulating hormone from the rat adenohypophysis. (Contractor's abstract, modified)

1792

Maudsley Hospital, London (Gt. Brit.).

NEW FACTORS CONNECTING METABOLIC AND ELECTRICAL EVENTS IN CEREBRAL TISSUES, by H. McIlwain. [1960] [14]p. incl. diagrs. table, refs. (AFOSR-366) (AF 61(052)404) AD 400860 Unclassified

Also published in Ultrastructure and Metabolism of the Nervous System; Proc. Assoc. for Research in Nervous and Mental Disease, New York (Dec. 9-10, 1960), Baltimore, Williams and Wilkins, v. 40: 43-56, 1962.

This contribution describes an aspect of cell structure which is of much importance to neural systems: the utilization of the energy of carbohydrate metabolism in maintaining differential ion concentrations across the nerve cell membrane. The description has 3 parts; the first states the problem of linking carbohydrate metabolism with ion movement giving new data for cerebral tissues; the second indicates how investigation has led us to implicate specific cerebral constituents in these processes; and the third offers a mechanism of active transport. (Contractor's abstract)

1793

Maudsley Hospital, London (Gt. Brit.).

BASIC PROTEINS AND THE POTASSIUM MOVEMENTS AND PHOSPHATES OF CEREBRAL TISSUES, by H. McIlwain, R. J. Woodman, and J. T. Cummins. [1961] [5]p. incl. tables, refs. (AFOSR-3445) [AF 61-(052)404] Unclassified

Also published in Biochem. Jour., v. 81: 79-83, Oct. 1961.

Guinea-pig cerebral cortex was maintained in vitro and its content of potassium salts and phosphocreatine were measured under normal conditions, immediately after applying electrical pulses and during subsequent recovery. Protamine and histone sulfates (0.1 mg/ml) did not affect the loss of potassium induced by pulses, but inhibited recovery of potassium. This inhibition was removed by gangliosides and by suramin. Higher concentrations of portamine diminished tissue potassium in the absence of pulses. Protamine (0.1-0.4 mg/ml) was without effect on phosphocreatine in the absence of pulses, but in their presence it preserved a large part of the phosphocreatine from the loss normally caused by pulses. Protamine and histone are considered to act at a mechanism which utilizes a major part of the energy-rich phosphate of the tissue in ion transport, and suggestions are made about the nature of this mechanism. (Contractor's abstract)

1794

Maudsley Hospital, London (Gt. Brit.).

FLUID CONTENT AND COMPARTMENTS IN ISOLATED CEREBRAL TISSUES, by S. Varon and H. McIlwain. [1961] [14]p. incl. diagrs. tables, refs. (AFOSR-3446) (AF 61(052)404) Unclassified

Also published in Jour. Neurochem., v. 8: 262-275, 1961.

Metabolic experiments with slices of guinea pig cerebral cortex in vitro involve association of additional fluid with the tissue by (1) adhering medium, (2) swelling during preparation of the tissue; and (3) swelling during incubation. Media containing inulin were used to characterize the fluid changes; inulin itself needed 20 min or more to equilibrate with the tissue. The fluid absorbed during preparation was in a space not accessible to inulin, while the fluid absorbed during incubation was accessible to inulin. In incubation media containing protamine, tissue swelling was less than in normal media, while in media containing ganglioside preparations, swelling was greater; both these changes were in fluid accessible to inulin. Application of electrical stimulation for 10 min had little effect on fluids but caused loss of K and gain of Na by the tissue. The chloride of the tissue did not appear to be confined to the space accessible to inulin; it and the Na were concluded to exist intracellularly to a greater extent than in the brain in vivo. (Contractor's abstract)

1795

[Maudsley Hospital] London (Gt. Brit.).

METABOLIC AND ELECTRICAL MEASUREMENTS WITH ISOLATED CEREBRAL TISSUES: THEIR CONTRIBUTION TO STUDY OF THE ACTION OF DRUGS ON CORTICAL EXCITABILITY, by H. McIlwain. [1961] [23]p. incl. diagrs. tables, refs. (AFOSR-65-1497) (Sponsored jointly by Air Force Office of Scientific Research under [AF 61(052)404] and Medical Research Council of Great Britain) AD 621404 Unclassified

Also published in Brain Function: Cortical Excitability and Steady Potentials; Relations of Basic Research to Space Biology; Proc. First Conf., Los Angeles, California U. Press, v. 1: 49-71, 1963. (AFOSR-65-1496)

Small portions of mammalian cerebral cortex were studied in isolation in order to determine what phenomena related to excitability are retained by the fragments, and the extent to which these phenomena are conditioned by the way the tissue is maintained and by the substances added to it. The electrical condition and the excitability of the tissues were of main concern. (Contractor's abstract)

1796

Max-Planck-Inst. für Aeronomie, Lindau (Germany).

A BALLOON BORNE APPARATUS FOR MEASUREMENTS OF IONIZING RADIATION IN HIGH ALTITUDES, by H. Erbe. Sept. 30, 1961 [14]p. incl. illus. diagrs. refs. (Technical note no. 1) (AFOSR-1729) (AF 61(052)372) AD 273078 Unclassified

After introductory remarks on the need for soft radiation measurements, a suitable sounding apparatus and the main features of the receiving equipment are discussed. (Contractor's abstract)

1797

Max-Planck-Inst. für Aeronomie, Lindau (Germany).

A CONTRIBUTION TO THE MORPHOLOGY OF X-RAY BURSTS IN THE AURORAL ZONE, by G. Pfotzer, A. Ehmert and others. Sept. 30, 1961, 17p. incl. diagrs. tables, refs. (Technical note no. 2) (AFOSR-1730) (AF 61(052)372) AD 273079 Unclassified

Also published in Jour. Geophys. Research, v. 67: 575-584, Feb. 1962.

Between September 16th and October 5th, 1960, 8 Skyhook-flights with combinations of thin-walled Geiger-counters and ionization chambers were performed in the auroral zone at Kiruna, Northern Sweden. X-ray bursts were recorded on September 27th, October 1st, and 2nd. The correlation between all bursts and cosmic noise absorption (CNA) was close. Clear correspondences between the onsets of the bursts and of the magnetic disturbances but only weak correlations in the later phases were observed. The events on October 1st and 2nd were probably caused by the same extraterrestrial generative source, possibly a beam of ionized solar gas, persisting during 2 rotations of the sun. (Contractor's abstract)

1798

Max-Planck-Inst. für Aeronomie, Lindau (Germany).

RESULTS OF BALLOON FLIGHTS FOR COSMIC RADIATION MEASUREMENTS AT WEISSENAU AND LINDAU (GERMANY), by H. Erbe. Dec. 31, 1961 [14]p. incl. illus. tables, refs. (Technical note no. 3) (AFOSR-2393) (AF 61(052)372) AD 273627 Unclassified

The results of 10 balloon flights with counter telescopes and of 24 flights with single counters are represented. It was found that a nearly unique correlation exists between the counting rate in a certain altitude and the counting rate of the neutron monitor on ground if only galactic radiation impinges at the top of the atmosphere. The counting rates of the single counter scatter in a more pronounced manner with respect to the average expectation values related to the neutron counting rates than those of the telescope. This is considered as due to the influence of meson decay along the very extended paths traversed by particles arriving from strongly inclined directions. These are accepted by the single counter with its larger aperture in contrast to the telescope which responds only to particles arriving in a narrower cone centered around the vertical. (Contractor's abstract)

1799

Max-Planck-Inst. für Strömungsforschung, Göttingen (Germany).

EXPERIMENTAL INVESTIGATIONS ON THE SCATTERING OF SOUND BY TURBULENCE, by D. W. Schmidt. July 1961, 60p. incl. diagrs. tables, refs. (AFOSR-1666) (AF 61(514)1143) AD 266564 Unclassified

Experimental investigations of the scattering of sound by turbulence were performed in a wind tunnel. Turbulence was produced by the grids of parallel circular rods (with diameters of 0.1 to 1.0 cm and grid meshlengths of 0.5 to 2.5 cm); the sound frequencies covered a range of 100 to 500 kc. Disturbances of the measurements due to reflections of sound waves at the tunnel walls were avoided by the application of short sound pulses. The dependence of the damping of the sound waves on the sound frequency, the Mach number of the turbulence, the length of the sound path in the turbulent flow and a predominant direction of the turbulent eddies was measured. Theoretical predictions were confirmed and partly extended. In the range of the parameters which is of interest for practical use the most important results are the proportionality of the damping to the square of the sound frequency and to the square of the turbulent Mach number. Based on the measurements and the theoretical considerations, a formula is derived which is applicable to the damping of sound by turbulent scattering in the atmosphere.

1800

Max-Planck-Inst. für Zellchemie, Munich (Germany).

THE ENZYMATIC DEGRADATION OF TERPENES, by W. Seubert and U. Remberger. Summary rept. Dec. 14, 1959-Dec. 14, 1961, 47p. incl. illus. diagrs. tables, refs. (AFOSR-2185) (AF 61(052)251) 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 to acetyl CoA and acetate of the acid formed occurs at the level of CoA activated intermediates and is associated with the carboxylation of the branched methyl groups in the molecule. The individual steps of this reaction sequence are under investigation. Pyruvate carboxylase employed in these studies has been purified 550 times from crude extracts of Ps. citronellolis. The enzyme catalyzes the ATP and Mg^{++}-dependent 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. (Contractor's abstract)

1801

Max-Planck-Inst. für Zellchemie, Munich (Germany).

[PYRUVATE CARBOXYLATE PURIFICATION AND SUBSTITUTION OUT OF PSEUDOMONAS CITRONELLOLIS] Reinigung und Wirkungsweise der Pyruvatcarboxylase aus Pseudomonas citronellolis, by W. Seubert and U. Remberger. [1961] [14]p. incl. diagrs. tables, refs. (AF 61(052)251) Unclassified

Also published in Biochem. Zeitschr., v. 334: 401-414, July 1961.

Pyruvate carboxylate catalyzes the Mg^{++}-dependent carboxylation of pyruvate to oxalacetate. The enzyme has been purified 550 times from crude extracts of Ps. citronellolis. 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 coenzyme A. The implication of this observation regarding possible different carboxylation mechanisms in bacterial and mammalian systems is discussed. (Contractor's abstract)

1802

Méditerranéen de Recherches Thermodynamiques, Nice (France).

STUDY OF THE DISTURBANCE CAUSED BY A MOVING BODY IN A PARTIALLY IONIZED GAS, by F. M. Devienne and A. Roustan. Jan. 1961, 1v. incl. illus. tables. (AFOSR-566) (AF 61(052)124) AD 258301 Unclassified

A description of the experimental device used to study the disturbance caused by a moving body in a partially ionized gas, especially, the electrical disturbance caused by the passage of the revolving arm is given. The effects on the duration and relative intensity of the disturbance produced by the speed of the moving body, the distance of the probes from the arm, the pressure, the profile of the moving body, the shape of the probe, and the nature of the gas used are examined. Also the effects of the ionization and the surface condition of the moving body are shown.

1803

Méditerranéen de Recherches Thermodynamiques, Nice (France).

SETTING UP OF A HIGH SPEED REVOLVING DISC, by F. M. Devienne and B. C. Crave. Sept. 1961 [20]p. incl. illus. diagrs. (AFOSR-2212) (AF 61(052)124) Unclassified

The construction of the discs, and various other equipment are described. The use of the high speed revolving disc is discussed.

1804

Méditerranéen de Recherches Thermodynamiques, Nice (France).

FINAL RESULTS OBTAINED IN THE SETTING UP OF THE MOLECULAR GUN, by F. M. Devienne and J. C. Roustan. Final rept. Mar. 1961, 27p. incl. illus. diagrs. table, refs. (AFOSR-652) (AF 61(052)296) AD 262973 Unclassified

This technical note is a sequel to 2 previous ones on the Molecular Gun (item nos. 1187, Vol. III and 1578, Vol. IV). It mainly presents the modifications carried out on the ion accelerator and the reasons for these modifications. A few supplementary details of its construction are given. The production of charge or momentum exchange between ions and molecules and the detection and measurement of the speeds of the high-speed molecules are described.

1805

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

MECHANICAL AND THERMODYNAMICAL ADMISSIBILITY OF STRESS-STRAIN FUNCTIONS, by B. D. Coleman. [1961] [15]p. (AFOSR-1428) (AF 49(638)541) Unclassified

Also published in Arch. Rational Mech. and Anal., v. 9: 172-186, 1962.

A general theory of mechanically admissible stress-strain functions is first considered. A theorem is then proved which characterizes mechanical admissibility in terms of an invariance principle for the rate of work resulting in a new point of view of the thermodynamic requirements on stress-strain functions. Thermodynamical admissibility is defined in terms of an integral inequality for $\hat{S}$ (the stress tensor 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 than $\hat{S}$ can be obtained from an energy function.

1806

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

KINEMATICAL CONCEPTS WITH APPLICATIONS IN THE MECHANICS AND THERMODYNAMICS OF INCOMPRESSIBLE VISCOELASTIC FLUIDS, by B. D. Coleman. Oct. 1961, 63p. incl. refs. (AFOSR-1583) (AF 49(638)541) Unclassified

Also published in Arch. Rational Mech. and Anal., v. 9: 273-300, 1962.

The first part of this paper reviews the theory of simple fluids. In the second part, viscometric flows and substantially stagnant motions are defined, and some theorems on such flows are proved. A class of viscometric flows, called generalized steady helical flows, is discussed. In the third part, the simple fluid concept is generalized to allow dependence of the stress on the internal energy history, and constitutive equations for temperature and entropy are introduced. An inequality to be satisfied by the constitutive functionals is obtained from a principle of positive entropy production. Some consequences of this inequality for isoenergetic substantially stagnant motions and viscometric flows are shown.

1807

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

INFRARED SPECTROSCOPIC STUDY OF THE PHOTOLYSIS OF CHLORINE AZIDE IN SOLID ARGON AT 4.2°K, by D. E. Milligan. Mar. 10, 1961, 4p. (AFOSR-429) (AF 49(638)542) AD 253425 Unclassified

Also published in Jour. Chem. Phys., v. 35: 372-373, July 1961.

The photolysis of chlorine azide (ClN_3) in solid argon was studied by using infrared spectroscopy; these experiments were undertaken in order to produce the chloroimino radical. Strong bands at 655, 723, 1143 and 2062 cm^{-1} were found in the ClN_3 spectrum, with a weak band at 2137 cm^{-1}. On irradiation the strong bands decreased while the 2137 cm^{-1} band remained unchanged; new bands developed at 818 ± 0.5 and 824 ± 0.5 cm^{-1}. There was evidence of a greenish-blue phosphorescence from the irradiated deposits after the UV light was extinguished.

1808

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

VIBRATIONAL EXCITONS. II. DEGENERATE VIBRATIONS, by R. M. Hexter. Mar. 17, 1961, 1v. incl. illus. diagr. refs. (AFOSR-472) (AF 49(638)542) AD 253622; PB 155465 Unclassified

Also published in Jour. Chem. Phys., v. 36: 2285-2295, May 1, 1962.

The energy of the first vibrational excited state of a molecular crystal is derived in terms of exciton theory, for the special case of an exciton state derived from a doubly degenerate molecular excited state. We also treat the case where the degeneracy is lost due to the anisotropic environment of the molecule in the crystal. From the several allowed values of such energies, the correlation field splittings in such bands are derived in terms of three-dimensional chain sums. The origin of such splittings in certain cubic crystals is traced to the intermolecular exchange of the sense of vibrational angular momentum. An expression is also derived for site splittings, observable in solid solutions of molecules in their isotopically substituted modifications. A new interpretation of such splittings is offered. Finally, the effects of isotopic substitution in such crystals are discussed and several rules of isotopic invariance are derived. An appendix is included which treats as an example the vibrational fundamentals of crystal benzene derived from the e_{1u} molecular modes. (Contractor's abstract)

1809

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

INFRARED SPECTROSCOPIC STUDY OF THE PHOTOLYSIS OF METHYL AZIDE AND METHYL-d_3 AZIDE IN SOLID ARGON AND CARBON DIOXIDE, by D. E. Milligan. Mar. 22, 1961 [29]p. incl. diagrs. tables, refs. (AFOSR-533) (AF 49(638)542) AD 254844 Unclassified

Also published in Jour. Chem. Phys., v. 35: 1491-1497, Oct. 1961.

Experiments have been carried out on the photolysis of methyl azide and methyl-d_3 azide at high dilution in solid argon (4.2°K) and carbon dioxide (~50°K). Photolysis of these species in argon and carbon dioxide matrices results in the appearance of a number of new spectral features in the 3300-600 cm^{-1} region. The spectroscopic data for the photolysis products appear to be consistent with the identification of these species as methyleneimine (CH_2:NH) and methyleneimine-d_3 (CD_2:ND). (Contractor's abstract)

1810

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

THE INFRARED SPECTRA OF THICK FILMS OF CO_2

AND CO_2 + H_2O AT LOW TEMPERATURES, by M. E. Jacox and D. E. Milligan. [1961] [7]p. incl. diagrs. table. (AFOSR-685) (AF 49(638)542) AD 256499 Unclassified

Abstract published in Symposium on Molecular Structure and Spectroscopy, Ohio State U., Columbus, June 12-16, 1961, p. 34.

Abstract also published in Spectrochim. Acta., v. 17: 1108, Oct. 1961.

Also published in Spectrochim. Acta, v. 17: 1196-1202, Nov. 1961.

High-resolution infrared-absorption studies on thick films of CO_2 and on dilute solid solutions of H_2O in CO_2 were made at 53°K and at 4°K. A spectroscopically observable complex between CO_2 and H_2O is not formed. The isolation of H_2O in the CO_2 matrix at 53°K is quite good. Monomer and dimer absorptions are assigned in the 1600-1650 cm^{-1} region. In very thick films of pure CO_2 ν_1 appears, weakly, at 53°K. In samples deposited at 4°K the ν_1 absorption is markedly intensified, probably because of an increased number of crystal imperfections, and $2\nu_2$ is also observed. Similar systems of lattice vibrations were observed in combination with both ν_2 and ν_3. (Contractor's abstract)

1811

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

SOLID-STATE VIBRATIONAL SPECTRA OF METHYL AND METHYL-d_3 CYANIDE, by D. E. Milligan and M. E. Jacox. [May 1961] [8]p. incl. diagrs. table, refs. (AFOSR-763) (AF 49(638)542) AD 259393 Unclassified

Also published in Jour. Molec. Spectros., v. 8: 126-133, Feb. 1962.

The vibrational fundamentals of thin films of CH_3CN and CD_3CN at 77°K have been observed using a high-resolution, double-beam grating spectrometer. Evidence is presented for three absorptions, assigned to ν_3, ν_6, and $(\nu_7 + \nu_8)$, in the 1300-1500 cm^{-1} region of the CH_3CN spectrum. Annealing from an initial glassy state to a crystalline form is observed for these deposits. The multiplet structure of the annealed samples indicates that CH_3CN and CD_3CN crystallize in the orthorhombic, tetragonal, or trigonal system. (Contractor's abstract)

1812

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

SOLID-STATE VIBRATIONAL SPECTRA OF ETHYLENE AND ETHYLENE-d_4, by M. E. Jacox. May 10, 1961 [20]p. incl. diagrs. tables. (AFOSR-764) (AF 49(638)-542) AD 257303 Unclassified

Also published in Jour. Chem. Phys., v. 36: 140-143, Jan. 1, 1962.

High resolution infrared spectra have been obtained for polycrystalline C_2H_4 at 4°K and 53°K and for C_2D_4 at 53°K. The observed multiplet structure of the fundamental vibrations is in good agreement with the group theoretical predictions. In C_2H_4 there is evidence for a gradual phase transition between 4°K and 53°K, involving reorientation of the planes of the H atoms of C_2H_4 molecules in the crystal. The Raman-active fundamentals have been observed, weakly, in thick deposits of C_2H_4 at 4°K. (Contractor's abstract)

1813

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

INFRARED SPECTROSCOPIC STUDY OF INTERMEDIATES IN THE PHOTOLYSIS OF SEVERAL AZIDES, by D. E. Milligan. [1961] 26p. incl. diagrs. tables, refs. (AFOSR-1524) (AF 49(638)542) AD 264478 Unclassified

Also published in Fifth Internat'l. Symposium on Free Radicals; Preprints of Papers, Uppsala U. (Sweden) (July 6-7, 1961), New York, Gordon and Breach Science Publishers, Inc., 1961, p. 45-1—45-26.

Studies of the photolysis of methyl azide in rigid inert media were undertaken with the hope of producing the methylimino radical (CH_3N) under conditions suitable for infrared spectroscopic study. It was thought that methyl azide would decompose by a free radical mechanism involving the methylimino radical and molecular nitrogen as the primary products. Ultraviolet spectra of gaseous methyl azide indicate 2 regions of absorption, a fairly weak and broad band centered at 2850A which shows evidence of structure and a considerably stronger structureless band beginning near 2400A and extending beyond 1900A. Irradiation of the gaseous material with light falling within the short wavelength band is observed to result in the formation of nitrogen, ammonia and hexamethylene tetramine. The observation of these products in the thermal and photochemical decomposition of methyl azide was interpreted to mean that the photolytic decomposition might likewise proceed through the intermediary of a short-lived methylimino radical. It was thought that the rearrangement reaction postulated in the gas phase might be partially, if not completely,

quenched in the solid state due to rapid removal of the excess energy of the free radical species through collisions with the matrix material.

1814

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

THE PROTON MAGNETIC RESONANCE SPECTRA OF 2,3-DISUBSTITUTED-N-BUTANES, by A. A. Bothner-By and C. Naar-Colin. [1961] [5]p. incl. diagrs. tables, refs. (AFOSR-1382) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)980, and National Science Foundation) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 84: 743-747, Mar. 5, 1962.

High resolution proton magnetic resonance spectra have been obtained for the meso- and dl-forms of 2,3-dibromobutane, 2,3-dichlorobutane, 2,3-diacetoxybutane and 2,3-diphenylbutane. The spectra have been analyzed in terms of chemical shifts and coupling constants. From the magnitude of the spin-spin coupling constant between the methine protons, qualitative estimates of rotamer population have been made, and the factors controlling these populations are discussed. A dependence of 1,3-proton coupling in the system $H\text{-}C\text{-}C\text{-}CH_3$ on dihedral angle is demonstrated. (Contractor's abstract)

1815

Miami U. Dept. of Chemistry, Coral Gables, Fla.

THE CALCIUM FLUORIDE – RARE EARTH OXIDE SYSTEMS IN A LABORATORY ATMOSPHERE, by K. S. Vorres. [1961] 4p. (AFOSR-4070) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-104 and Institute of Gas Technology of Chicago) Unclassified

Also published in Rare Earth Research; Proc. of Second Conf., Glenwood Springs, Colo. (Sept. 24-27, 1961), New York, Gordon and Breach, 1962, p. 9-13.

A number of materials have structures identical with or somewhat similar to that observed for calcium fluoride—the fluorite structure. Among these compounds are the heavy rare earth sesquioxides such as Gd_2O_3 through Lu_2O_3. The rare earth oxides are known to crystallize in 3 forms designated A, B and C. The A is a hexagonal type, the B is a monoclinic type, and C is a body centered cubic type. The similarity between the C form and the fluorite structure, the similarities in size between the oxide and fluoride ions on the one hand, and the calcium and trivalent rare earth ions on the other hand might lead one to expect that solid solutions or mixed crystals of these materials could be prepared. Furthermore the relative similarities in electronegatives of oxygen and fluorine as well as calcium and the rare earths should give similar bonding characteristics. This study relates the results of a series of experiments with rare earth oxides of the A as well as the C type and CaF_2.

1816

Miami U. [Dept. of Mathematics] Coral Gables, Fla.

PROBABILISTIC METHODS IN MARKOV CHAINS, by D. [G.] Austin and H. Meyer. June 1961 [15]p. (Rept. no. 27) (AFOSR-1093) (AF 49(638)184) AD 263027 Unclassified

An investigation of the analytic properties of non-negative matrices is made satisfying the probabilistically motivated functional relations which are weaker than the semi-group condition. The fundamental differentiation theorem for transition functions of a Markov process is proved in the abstract space case. (Contractor's abstract)

1817

Miami U. [Dept. of Mathematics] Coral Gables, Fla.

LIMITS AND BOUNDS FOR DIVIDED DIFFERENCES ON A JORDAN CURVE IN THE COMPLEX DOMAIN, by J. H. Curtiss. [1961] [24]p. (AFOSR-1091) (AF 49(638)-862) AD 268336 Unclassified

Also published in Pacific Jour. Math., v. 12: 1217-1233, 1962.

Let Sn + 1 be a set of n + 1 points lying on a Jordan curve C, let f be a function given on C, and let dn denote the divided difference of order n formed for f in the points Sn + 1. It is proved that if the (n-1)-th derivative of f exists and satisfies a Lipschitz condition, and C satisfies a mild smoothness restriction, then /dn/ is uniformly bounded for all choices of Sn + 1 in which the points are distinct. An extension to confluent points is given. In the case in which C is the unit circle, the structure of the bound is displayed. It is also shown for a general C that if the points of the sequence S2, S3, ... become everywhere dense on C in a certain way, then lim as n approaches infinity cn + 1dn equals integral C f dz/2pi i, where c is the transfinite diameter of C. (Contractor's abstract)

1818

Miami U. [Dept. of Mathematics] Coral Gables, Fla.

INTERPOLATION BY HARMONIC POLYNOMIALS, by J. H. Curtiss. Dec. 1, 1961, 34p. incl. refs. (AFOSR-1737) (AF 49(638)862) AD 268335 Unclassified

Also published in Jour. Soc. Indus. and Appl. Math., v. 10: 709-736, Dec. 1962.

Let Hn(u; z) denote the harmonic polynomial of degree at most n found by interpolation in 2n + 1 points to a function u given on the boundary C of a region D of the complex z-plane. It is proved that (a) for any bounded D there always exist interpolation points on C so that Hn can be uniquely determined for each n, and (b) for a wide class of Jordan regions D and for boundary data u with a smooth first derivative on C the points of interpolation on C can be chosen so that lim as n approaches infinity Hn(u; z) exists, z epsilon C + D, and gives the solution of the Dirichlet problem for u and D. Explicit formulas are derived for Hn in the case of interpolation on a circle and on an ellipse, and convergence is proved in these cases for arbitrary continuous boundary data. Various generalizations are indicated. (Contractor's abstract)

1819

Michigan State U. Dept. of Physics and Astronomy, East Lansing.

BETA DECAY OF NATURALLY RADIOACTIVE In^{115}, by G. B. Beard and W. H. Kelly. [1961] [4]p. incl. diagrs. refs. (AFOSR-408) (AF 49(638)10)
AD 260873 Unclassified

Also published in Phys. Rev., v. 122: 1576-1579, June 1, 1961.

A liquid scintillator loaded with In was used to study the 4th-forbidden β-decay of In^{115}. Specific activity measurements yield a half-life of $(6.9 \pm 1.5) \times 10^{14}$ yr. A crude β-spectrum was obtained. Linear extrapolation of the Fermi-Kurie plot gives an end-point energy of 625 ± 70 kev. (Contractor's abstract)

1820

Michigan State U. Dept. of Physics and Astronomy, East Lansing.

MAGNETIC FIELD AT THE NUCLEUS IN SPINEL-TYPE CRYSTALS, by W. H. Kelly, V. J. Folen and others. [1961] [5]p. incl. diagr. tables, refs. (AFOSR-409) (AF 49(638)10) AD 447859 Unclassified

Also published in Phys. Rev., v. 124: 80-84, Oct. 1, 1961.

Measurements of magnetic field at the Fe^{57} nucleus were obtained on powder samples at room temperature using the Mössbauer effect for the spinel-type ferrites γ-Fe_2O_3, "ordered" lithium ferrite ($Li_{0.5}Fe_{2.5}O_4$), and "disordered" lithium ferrite giving values of |496 ± 20| koe, |508 ± 20| koe, and |510 ± 20| koe. These compounds contain only trivalent and no divalent iron. The Mössbauer spectra of all of these compounds were very similar and no difference could be detected between the "ordered" and "disordered" compounds. Only 1 set of lines was observed indicating that the field at the octahedral and tetrahedral sites are about the same value. The value of the hyperfine interaction constant A obtained from electron paramagnetic resonance spectrum of the divalent Mn^{55} (isoelectronic with trivalent Fe) impurity in single crystals of the isomorphous spinel-type crystal "disordered" lithium aluminate ($Li_{0.5}Al_{2.5}O_4$) was found to be $|77.2 \pm 1.0 \times| 10^{-4}$ cm^{-1}. The angular variation of the spectrum indicated that the divalent Mn^{55} ions were located substantially on octahedral sites. The corresponding magnetic field for the Mn^{55} nucleus is around 550 koe, which is close to the value obtained elsewhere for the Mn^{55} nucleus located on a tetrahedral site in a spinel-type aluminate. This is in good agreement with the Mössbauer results. (Contractor's abstract)

1821

Michigan State U. Dept. of Physics and Astronomy, East Lansing.

PROPERTIES OF LOW-LYING NUCLEAR ENERGY LEVELS, by G. B. Beard and W. H. Kelly. Final rept. [1961] [13]p. (AFOSR-867) (AF 49(638)10)
AD 263265 Unclassified

Results obtained in experimental studies of certain properties of low-lying nuclear energy levels are summarized. Work on the decay schemes of several of the naturally radioactive isotopes is briefly described. Experiments to study magnetic fields at iron nuclei in spinel type crystals and to study temperature dependent luminescence in $CaWO_4$ and $CdWO_4$ crystals are summarized. (Contractor's abstract)

1822

Michigan State U. Dept. of Physics and Astronomy, East Lansing.

NUCLEAR RESONANCE FLUORESCENCE MEASUREMENTS OF THE 845 KEV LEVEL IN Fe^{56}, by W. H. Kelly and G. B. Beard. [1961] [10]p. incl. diagrs. tables, refs. (AFOSR-868) (AF 49(638)10) AD 263310 Unclassified

Also published in Nuclear Phys., v. 27: 188-192, Oct. 1961.

Nuclear resonance fluorescence was observed for the 845 kev level of Fe^{56}. A gaseous source of Mn^{56} as $MnCl_2$ was used in order to utilize the recoil due to previous radiations to compensate for the recoil Doppler broadening of the emission and absorption lines. Resonant self-absorption measurements gave a half-life of 6 ± 2 p sec for the state. (Contractor's abstract)

1823

Michigan State U. Dept. of Physics and Astronomy, East Lansing.

SELF-SCINTILLATION STUDY OF THE BETA DECAY OF Rb^{87}, by G. B. Beard and W. H. Kelly. [1961] [15]p. incl. diagrs. tables, refs. (AFOSR-869) (AF 49(638)-10) AD 263311 Unclassified

Also published in Nuclear Phys., v. 28: 570-577, Dec. 1961.

The β-decay of Rb^{87} was studied using the self-scintillations produced in 3 NaI(Tl) crystals doped with Rb. The β spectrum was measured down to 5-8 kev. An end point energy of 274 ± 3 kev and a specific activity equal to 780 ± 14 sec^{-1}/g of natural Rb were found. Assuming an isotopic abundance of 27.85% for Rb^{87}, a half-life of (5.53 ± 0.10) x 10^{10} yr is obtained. (Contractor's abstract)

1824

Michigan State U. Dept. of Physics and Astronomy, East Lansing.

TEMPERATURE DEPENDENT LUMINESCENCE OF $CaWO_4$ AND $CdWO_4$, by G. B. Beard, W. H. Kelly, and M. L. Mallory. [1961] [16]p. incl. diagrs. table. (AFOSR-870) (AF 49(638)10) AD 263312 Unclassified

Also published in Jour. Appl. Phys., v. 33: 144-147, Jan. 1962.

The relative efficiencies and decay times of alpha particle induced scintillations of $CaWO_4$ and $CdWO_4$ were investigated as a function of temperature in the range 10°K to 375°K. Their behavior at intermediate and high temperature is in agreement with that expected from the Mott-Seitz-Kroger configurational coordinate model. Values of eq thermal quenching energy, of 0.34 and 0.31 ev were found for $CaWO_4$ and $CdWO_4$, respectively. As the temperature was decreased below 60°K, an increase in the decay times and a decrease in the relative efficiences were found. This behavior can be explained quantitatively by assuming the existence of a trapping level. (Contractor's abstract)

1825

Michigan State U. [Dept. of Physics and Astronomy] East Lansing.

MÖSSBAUER EFFECT IN γ-Fe_2O_3 (Abstract), by W. H. Kelly, M. Hass and others. [1961] [1]p. [AF 49-(638)10] Unclassified

Presented at meeting of the Amer. Phys. Soc., Monterey, Calif., Mar. 20-23, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 135, Mar. 20, 1961.

The Mössbauer effect and hyperfine spectrum of Fe^{57} in γ-Fe_2O_3 has been observed. The spectrum is very similar to that of iron metal, giving equally spaced Zeeman levels for the first excited state of Fe^{57} in the crystal. The spectrum can be interpreted in terms of a magnetic field at the nucleus of Fe^{57} of (5.2 ± 0.3) x 10^5 oe. No difference in the field can be observed between the Fe^{+3} ions in the octahedral and tetrahedral sites. Since the Fe^{+3} ions are in S states and located in a cubic field in an insulator, the hyperfine spectrum can be attributed largely to the Fermi contact interaction with the contributions from other effects being small.

1826

Michigan State U. Dept. of Physics [and Astronomy] East Lansing.

ON THE DETERMINATION OF THE MEAN FREE PATH OF CONDUCTION ELECTRONS, by R. Kleinberg and F. J. Blatt. Nov. 1961 [5]p. incl. refs. (AFOSR-1612) (AF 49(638)70) AD 266567 Unclassified

Also published in Ann. Physik, v. 9: 62-64, Dec. 1961. (Title varies)

An earlier paper by Scheffers (Ann. Physik, v. 18: 29, 1956) is criticized. It is shown that Scheffers result for the magnetoresistance ratio of a metal is based on incorrect boundary conditions, and that the agreement with experiment in the case of the noble metals is fortuitous. (Contractor's abstract)

1827

Michigan State U. Dept. of Physics [and Astronomy] East Lansing.

ON THE POSSIBILITY OF THERMOELECTRIC REFRIGERATION AT VERY LOW TEMPERATURES, by F. J. Blatt. [1961] [9]p. incl. diagrs. refs. (AFOSR-1703) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)70 and Army Research Office (Durham)) AD 267633 Unclassified

Also published in Philos. Mag., v. 7: 715-718, Apr. 1962.

A class of materials which holds great promise for thermoelectric cooling is considered. Relevant data on one member of the class, bismuth, is presented. The work on bismuth shows that under suitable conditions very high thermoelectric powers, in excess of 4 mv/°K (4000 uv/°K) are readily attained even at 4.2°K.

1828

Michigan State U. Dept. of Physics [and Astronomy] East Lansing.

DETERMINATION OF THE MEAN FREE PATH OF CONDUCTION ELECTRONS, by R. Kleinberg and F. J. Blatt. [1961] [3]p. incl. refs. (AFOSR-437) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)70] and Army Research Office (Durham)) AD 295970 Unclassified

Also published in Ann. Physik, v. 9: 62-64, Dec. 1961.

For abstract see item no. 1826, Vol. V.

1829

Michigan State U. Dept. of Physics [and Astronomy] East Lansing.

PELTIER COOLING BELOW 4°K, by F. J. Blatt. [1961] [5]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49-(638)70] and Office of Ordnance Research) Unclassified

Published in Proc. Internat'l. Conf. on High Magnetic Fields, Cambridge, Mass. (Nov. 1-4, 1961), Cambridge, M.I.T. Press and New York, Wiley and Sons, 1962, p. 398-402. (AFOSR-2299)

Peltier cooling at very low temperatures where efficiency of operation is irrelevant depends on the proper selection of thermoelectric materials. The ratio of $\Delta T/T_0$ is the critical parameter, where ΔT is the temperature difference between the hot and cold junction of the Peltier couple and T_0 is the temperature of the cold junction. $\Delta T/T_0$ must be large to be practical and since by a series of approximations $\Delta T/T_0 = S^2/2L$ a semiconductor with a large value of S and relatively small value of L must be found.

1830

Michigan State U. Dept. of Physics and Astronomy, East Lansing.

NUCLEAR RESONANCE STUDIES OF ANTIFERROMAGNETIC $LiCuCl_3 \cdot 2H_2O$, by R. D. Spence and C. R. K. Murty. [1961] [17]p. incl. illus. diagrs. tables. (AFOSR-560) (AF 49(638)613) AD 611507 Unclassified

Also published in Physica, v. 27: 850-856, 1961.

The Li^7 and proton nuclear magnetic resonance in $LiCuCl_3 \cdot 2H_2O$ shows this compound to be antiferromagnetic with a Néel temperature of 4.46 + 0.02°K. The local fields at the Li and proton sites combined with the quadrupole splitting of the Li resonance and the dipole-dipole splitting of the proton resonance indicate that the magnetic symmetry group of this crystal must be 1 of 3 possible types. (Contractor's abstract)

1831

Michigan State U. Dept. of Physics [and Astronomy] East Lansing.

MAGNETIZATION AND PROTON RELAXATION TIME IN ANTIFERROMAGNETIC $LiCuCl_3 \cdot 2H_2O$, by R. D. Spence and C. R. K. Murty. [1961] [2]p. incl. diagrs. (AFOSR-3360) [AF 49(638)613] AD 613797 Unclassified

Also published in Jour. Chem. Phys., v. 35: 1912-1913, Nov. 1961.

$LiCuCl_3 \cdot 2H_2O$ is antiferromagnetic at low temperatures and offers an opportunity to study the temperature dependence in a crystal with the same magnetic ion, essentially the same Néel temperature but quite different crystal structure. The temperature dependence is examined and found to be extremely structure sensitive in regard to sublattice magnetization and proton relaxation time. From the experiments it is concluded the temperature range in which the conventional spin-wave theory of antiferromagnetism can be expected to be valid is less than 1/4 of the Néel temperature.

1832

Michigan State U. Dept. of Physics [and Astronomy] East Lansing.

NUCLEAR MAGNETIC RESONANCE IN SODIUM THIOSULFATE PENTAHYDRATE, by C. R. K. Murty and Z. M. El Saffar. [1961] [10]p. incl. diagrs. table. (AFOSR-3580) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)613 and Office of Naval Research) Unclassified

Also published in Acta Cryst., v. 15: 536-538, June 1962.

The proton resonance spectrum of sodium thiosulfate pentahydrate has been studied with a view to establishing orientation of the water molecules. The orientation of the experimentally determined proton-proton vectors is in excellent agreement with those implied by the hydrogen bonding scheme suggested by Taylor and Beevers. One of the proton-proton vectors appears to be much shorter than those reported in other crystalline hydrates. (Contractor's abstract)

1833

Michigan State U. Dept. of Physics [and Astronomy] East Lansing.

NUCLEAR RESONANCE AND HEAT CAPACITY STUDIES

OF ANTIFERROMAGNETIC $LiCuCl_3 \cdot 2H_2O$, by R. D. Spence, H. Forstat and others. [1961] 5p. incl. diagr. (AFOSR-3581) [AF 49(638)613] Unclassified

Presented at Internat'l. Conf. on Magnetism and Crystallography, Kyoto (Japan), Sept. 25-30, 1961.

Also published in Jour. Phys. Soc. Japan, v. 17, Suppl. B-I: 510-512, Mar. 1962.

The Li^7 and proton nuclear magnetic resonance in $LiCuCl_3 \cdot 2H_2O$ shows this compound to be antiferromagnetic below 4.46 ± 0.02°K. The local fields at the Li and H sites indicate that the magnetic symmetry group must be 1 of 3 possible types. The sublattice magnetization and spin lattice relaxation time vary more rapidly with temperature than indicated by spin wave theory. Measurements have also been made on the heat capacity of $LiCuCl_3 \cdot 2H_2O$, yielding a Néel temperature of 4.40 ± .02°K. The entropy change associated with the magnetic ordering process has been calculated. This change agrees within 2% of the theoretical value R ln (2S + 1) if the ground state spin of the magnetic ion is taken as ½. (Contractor's abstract)

1834

Michigan State U. Dept. of Physics [and Astronomy] East Lansing.

NUCLEAR MAGNETIC RESONANCE IN HEXAMETHYLBENZENE AT LOW TEMPERATURES, by Z. M. El Saffar. [1961] [2]p. incl. diagr. (AFOSR-3583) [AF 49-(638)613] Unclassified

Also published in Jour. Chem. Phys., v. 36: 1093-1094, Feb. 15, 1962.

Polycrystalline hexamethylbenzene has been previously investigated by nuclear magnetic resonance at temperatures above 95°K. The mean-square width S of the resonance absorption spectrum at 96°K was found small (13 gauss) compared with that calculated for a rigid lattice configuration (32.7 gauss). It was concluded that the molecular motion responsible for the spectral narrowing was the reorientation of the methyl groups about their threefold axis. The present work was undertaken to find out whether this motion continues at lower temperatures. In the temperature range from 38° to 80°K, the value of S decreases gradually from 13.5 to 12 gauss. In the temperature range from 1° to 38°K the signal intensity diminshed appreciably with rising temperature. Measured values of S are seen to remain essentially constant at 19 gauss. Here the indication is that the reorientation of the CH_3 groups continues down to 1°K. Measurements of T_1 between 1° and 10°K yielded a constant value of about 1 sec. This behavior departs markedly from that described by a simple activation law, and it seems necessary to take account of the reorientation of the methyl groups by tunneling. The sharp increase in signal strength observed at 38°K could possibly be explained by solid-solid phase transition. The structure is triclinic at higher temperatures, and it presumably remains triclinic below 38°K but with different lattice constants. Such a transformation may result in an increase in the height of the potential barrier and a corresponding decrease in the rate of tunneling of the CH_3 groups.

1835

Michigan State U. Dept. of Physics [and Astronomy] East Lansing.

PROTON MAGNETIC RESONANCE IN IRON (II) CHLORIDE TETRAHYDRATE, by Z. M. El Saffar and C. R. K. Murty. [1961] [4]p. incl. diagr. table. (AFOSR-3584) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)613 and Office of Naval Research) Unclassified

Also published in Acta Cryst., v. 15: 285, Mar. 1962.

In the hydrogen bonding scheme suggested by Penfold and Grigor (Acta Cryst., v. 12: 850, 1959), x-ray studies were used to determine the p-p (proton-proton) directions of $FeCl_2 \cdot 4H_2O$. In the present investigation, resonance diagrams obtained by rotating the crystal about 4 different axes of rotation were used to determine the magnitude and orientation of the p-p vectors. The vectors thereby observed are compared to those of Penfold-Grigor by means of a table and explanation.

1836

Michigan State U. Dept. of Physics and Astronomy, East Lansing.

INTERACTION OF ELECTROMAGNETIC RADIATION WITH CRYSTAL LATTICES, by D. J. Montgomery. Final rept. May 1, 1959-Oct. 31, 1961. Nov. 30, 1961, 10p. (AFOSR-1906) (AF 49(638)622) AD 270482 Unclassified

The interaction between electromagnetic radiation and crystal lattices is studied, to see how far-infrared radiation is absorbed, transmitted, and reflected by various kinds of crystalline materials. The use of isotopically enriched constituents of crystals for the purpose of identifying effects due to lattice vibrations is described. The studies show that the position of the wavelength for max absorption can be understood on the basis of the simple theory, but that the shape and the depth of the absorption curves cannot be predicted in detail by any current theory. The results of the study may eventually be of value in the development of sources and detectors for scientific and technological application, and in the design of optics and detectors for infrared guidance systems. (Contractor's abstract, in part)

1837

Michigan State U. [Dept. of Physics and Astronomy] East Lansing.

EFFECT OF TEMPERATURE ON INFRARED ABSORPTION OF SOLID LiH AND LiD (Abstract), by R. H. Misho and D. J. Montgomery. [1961] [1]p. (AFOSR-3555) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)622 and Atomic Energy Commission) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Also published in Bull. Amer. Phys. Soc., Series II, v. 6: 284 Apr. 24, 1961.

Infrared absorption spectra of thin films of LiH (~97% Li^7, 100% H^1) and LiD (~97% Li^7, ~96% H^2) evaporated on KBr plates were obtained in the range 12.5μ-25μ from 100°K to 400°K in a specially constructed cryostat-oven. The chamber containing the specimen was maintained under vacuum continuously during preparation and observation of the films. At room temperature, the primary feature of the spectrum for each material is a broad peak at 17.0μ for LiH and at 22.5μ for LiD, in agreement with results reported earlier (item no. 1600, Vol. IV). At high temperatures, the peaks flatten to such an extent that it is difficult to establish definitely the existence of a shift. At low temperatures, the peaks become deeper and narrower, and the position of the minimum transmission shifts by only a few tenths of a micron, an amount much smaller than expected by analogy with results on alkali halides. In view of the unexpected nature of the shifts, the experiment is being repeated with different substrates.

1838

Michigan State U. [Dept. of Physics and Astronomy] East Lansing.

EFFECT OF ISOTOPIC COMPOSITION ON INFRARED ABSORPTION SPECTRA OF LITHIUM HYDRIDE AND LITHIUM FLUORIDE (Abstract), by R. H. Misho and D. J. Montgomery. [1961] [1]p. (AFOSR-3556) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)622] and Atomic Energy Commission) Unclassified

Presented at meeting of the Amer. Phys. Soc., Chicago, Ill., Nov. 24-25, 1961.

Also published in Bull. Amer. Phys. Soc., Series II, v. 6: 450, Nov. 24, 1961.

Infrared absorption spectra of thin films of LiH containing varying proportions of Li^6, Li^7 and H^1, H^2 evaporated onto a KBr substrate were obtained in the region 10-28μ with a CsBr-prism spectrophotometer. Similar experiments were made in the region 15-36μ on films of LiF containing varying proportions of Li^6, Li^7 and evaporated onto CsBr and polyethylene substrates. For certain compositions spectra were obtained at 300°, 220°, and 120°K. For isotopically-pure materials, the dispersion wavelength at a given temperature varies as the square root of the reduced mass. The introduction of isotopic impurity in LiH changes the shape of the spectrum substantially, and displaces the dispersion wavelength in a complicated manner. In LiF, isotopic impurity changes the shape of the spectrum to a minor degree, and displaces the dispersion wavelength in proportion to the square root of the average reduced mass. At low temperatures, the absorption bands become deeper and narrower, the dispersion wavelength shifting to an extent dependent on the film composition and the substrate. A change in substrate alone produces a measurable shift in dispersion wavelength.

1839

Michigan State U. Dept. of Physics [and Astronomy] East Lansing.

METHOD FOR THE DETERMINATION OF ELASTIC CONSTANTS FOR SOME CRYSTALLOGRAPHIC GROUPS, by P. M. Parker and W. G. Mayer. [1961] [3]p. (AFOSR-544) (AF 49(638)894) AD 289170 Unclassified

Also published in Acta Cryst., v. 15: 334-336, Apr. 1962.

Expressions are given relating the velocities with which mechanical vibrations are propagated in single crystals of various symmetries to the appropriate elastic constants. Symmetries considered are: trigonal (7 elastic constants), trigonal (6 elastic constants), hexagonal, tetragonal (7 elastic constants), tetragonal (6 elastic constants), and cubic. The expressions given derive from the Christoffel equations without introduction of approximations. (Contractor's abstract)

1840

Michigan U. Dept. of Aeronautical and Astronautical Engineering, Ann Arbor.

SHROUD DESIGN FOR SIMULATING HYPERSONIC FLOW OVER THE NOSE OF A HEMISPHERE, by R. Dunlap. [1961] [2]p. incl. diagrs. (AFOSR-2839) (AF 49-(638)336) Unclassified

Also published in Jour. Aerospace Sci., v. 29: 757-758, June 1962.

An analytical method for designing a shroud which would generate the hypersonic pressure distribution on a hemisphere is presented. Two steps were involved in the design of the shroud contour: (1) an approximate solution for the incompressible, irrotational flow field in the region $0 \leq n \leq 45°$ was found and (2) the resulting contour was corrected for compressibility near the sonic region, assuming 1-dimensional flow.

1841

Michigan U. [Dept. of Aeronautical and Astronautical Engineering] Ann Arbor.

TURBULENCE FIELD NEAR THE STAGNATION POINT ON BLUNT BODIES OF REVOLUTION, by A. M. Kuethe, W. W. Willmarth, and G. H. Crocker. [1961] [13]p. incl. diagrs. tables, refs. (AFOSR-3647) (In cooperation with U.S. Air Force Academy, Colorado Springs, Colo.) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)336, and Aeronautical Research Labs.) Unclassified

Also published in Proc. 1961 Heat Transfer and Fluid Mech. Inst., Los Angeles, Calif. (June 19-21, 1961), Stanford, Stanford U. Press, 1961, p. 10-22.

The turbulent fields outside of the boundary layer near the noses of axially symmetric bodies with hemispherical noses have been studied by means of the hot-wire anemometer. Measurements in a low turbulence wind tunnel over a range of Reynolds numbers show that the rms streamwise fluctuations in the nose region are larger than in the free stream. Large negative spatial correlation factors between streamwise fluctuations at ± 7° from the axis at low speeds and in a supersonic tunnel at Mach 2.45 indicate that the fluctuations in the nose region are coupled with a random motion of the stagnation point. The normalized energy spectra of the fluctuations at 7° are found to scale with the wave number n/U_∞, where n is the frequency of the fluctuations, over a 10-fold range in model diameter and a 40-fold range in Reynolds number. These normalized spectra also show a shift toward lower wave numbers compared with free stream turbulence. Possible connection between these phenomena and heat transfer measurements from bodies as affected by turbulence are pointed out. (Contractor's abstract)

1842

Michigan U. Dept. of Aeronautical and Astronautical Engineering, Ann Arbor.

AN EXPERIMENTAL AND THEORETICAL STUDY OF STATIONARY GASEOUS DETONATION WAVES, by J. A. Nicholls, E. K. Dabora and others. Oct. 1961 [78]p. incl. illus. diagrs. tables, refs. (Rept. no. 0287-9-F) (AFOSR-1764) (AF 49(638)562) AD 268927 Unclassified

Emphasis was given to the study of the standing detonation wave in a hydrogen-air mixture. The experimental arrangement and procedures employed are described and the experimental results presented. A revised analysis of the ignition delay zone behind the shock is presented which handles the equations. The prediction of the time rate of growth of concentrations of the radicals behind the shock is slightly different than the earlier analysis (item no. 1606, Vol. IV) but the prediction of ignition time delay is unchanged. Vibrational relaxation is considered as it affects the ignition time delay. Preliminary measurements aimed at probing the combustion region of the detonation wave by means of the sodium D-line reversal technique are described. A consideration of some probable 2 dimensional effects behind the shock reveal a possible explanation of uncertain anomalous ignition delay measurements. Consideration is given to the theoretical prediction of magnetogasdynamic effects on plane gaseous detonation waves and to an attempted experimental check on the linearized theory of heat addition in a supersonic stream. (Contractor's abstract)

1843

Michigan U. Dept. of Chemical and Metallurgical Engineering, Ann Arbor.

KINETICS OF WHISKER GROWTH ON VANADIUM PENTOXIDE, by V. J. Lee and G. Parravano. [1961] [23]p. incl. illus. diagrs. refs. (AFOSR-828) (AF 49(638)-493) AD 613308 Unclassified

The interplay of 3 growth mechanisms responsible for the formation of filaments on solid surfaces is analyzed. These are: short circuit diffusion within the filament body, evaporation from and condensation on the tip of the filament. Kinetic [illegible] for the simultaneous occurrence of the former with the latter processes are developed and typical growth behaviors are characterized. A dislocation core is used as a suitable short circuit path for diffusion. Kinetic evidence is presented to show that whiskers grown on V_2O_5 crystals follow the derived growth patterns. Detailed rate data are reported for temperatures 500 to 650°C in air, steam and vacuum. A value for the preexponential factor for diffusion, $D_0 \cong 10^6$ cm^2/sec, and activation energy of 35-40 kcal/mol can be computed from the kinetic results. Assuming that the diffusing species are cations, the order of magnitude of these values is consistent with values for similar parameters obtained by independent methods on transition metal oxides. Observations on growth morphology of V_2O_5 whiskers are reviewed. Whenever a growing whisker collided with an adjacent crystal, rapid radial growth of the filament resulted. Thus, it is suggested that whisker growth within fine particles or pores of loose aggregates characterizes the first stage of sintering of solid particulate systems. Mathematical expressions for each step of the kinetic sequence from whisker formation to neck growth between sintering particles of vanadium pentoxide are presented. (Contractor's abstract)

1844

Michigan U. [Dept. of Electrical Engineering] Ann Arbor.

PHYSIOLOGICAL IMPLICATIONS OF PSYCHOPHYSICAL DATA, by W. P. Tanner, Jr. [1961] [14]p. incl. diagrs. table. (AF 49(638)369) AD 253050 Unclassified

Also published in Ann. New York Acad. Sci., v. 89: 752-765, Jan. 28, 1961.

An approach to the study of psychophysics that includes the use of mathematical models is presented. While the individual experiments can each be interpreted as a contribution to an area in psychophysics, the program can be interpreted as an experiment testing the feasibility of a profitable use of a particular scientific philosophy in the study of an area of psychology. This philosophy involves the use of mathematical models in manner similar to that of the physicist. It employs, first, the use of simple models describing the relations of only a few observable variables. The measures describing the relations among these variables may be measures of variables that exist only as force and gravity in physics and that can be measured only by observing their consequences. As measurement techniques become more nearly precise or, as the conditions of the experiment are extended to include a wider range, it will likely become apparent that the model had been adequate only because it was tested with coarse measurement over a restricted range of conditions. At this point it will be necessary to expand or modify the model to include the new data. The expanded or modified model should still include the original model as applied to the limited conditions. (Contractor's abstract)

1845

Michigan U. Dept. of Electrical Engineering, Ann Arbor.

AN ABSTRACT MODEL FOR THE PATTERN RECOGNITION PROCESS, by D. L. Richards. Apr. 1961, 13p. incl. diagr. (Technical rept. no. 121; rept. no. 3642-1-T) (AFOSR-488) (AF 49(638)884) Unclassified

A general recognition model which can apply to any group of patterns and to any amount of initial knowledge about them is constructed. In the preliminary model which has been developed, the initial knowledge is presented to the recognizer as a list of conditional probabilities; then, given certain characteristics of the sequence of items which has been seen, the most probable correct answer can be selected. Where these conditional probabilities are not known exactly, they are estimated by a primitive earning process. Decisions are based on a posteriori probabilities and on other criteria studied in decision theory. The model is described in precise detail, and some possible goals of additional work are mentioned. (Contractor's abstract, modified)

1846

Michigan U. Dept. of Electrical Engineering, Ann Arbor.

STUDY PROGRAM FOR A MAGNETIC TIMER UTILIZING THE PROPAGATION OF DOMAIN WALLS, by W. W. Raymond and D. M. Grimes. July 1961, 49p. incl. diagrs. tables, refs. (Rept. no. 04316-2-T) (AFOSR-949) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)986 and [Diamond Ordnance Fuze Lab.]) AD 259998 Unclassified

Investigations were made of the possible use of controlled domain wall propagation in a magnetic material as a continuously variable time delay device. The equation of domain wall propagation is developed in terms of the fundamental parameters of the magnetic material. Conditions required for precisely controlled wall motion are discussed in terms of the shape and physical characteristics of the media. Those external parameters which influence propagation are elaborated on in view of how they may be controlled to optimize the shape and velocity of the propagating magnetic discontinuity. Available data from the literature on the range in domain wall velocity in various materials are discussed and are compiled in tabulated form. Included are some results of experimental data. Several geometries are suggested for a suitable time delay system. In view of the high domain wall velocities, none of these systems are of use for time delays greater than several seconds. (Contractor's abstract)

1847

Michigan U. Dept. of Electrical Engineering, Ann Arbor.

A QUASI-CASCADED PARAMETRIC AMPLIFIER, by W. B. Ribbens. Nov. 1961, 7p. incl. diagr. (Technical note no. 2) (AFOSR-2007) (AF 49(638)986) AD 414052 Unclassified

Also published in Jour. Appl. Phys., v. 33: 757-758, Feb. 1962.

A quasi-cascaded parametric amplifier which uses resonant modes of a single sample is reported. If a sample is parallel pumped above the corresponding thresholds at both Wp and 2Wp, and if modes exist in the sample whose frequencies add properly and which satisfy the orthogonality lations of Denton, it is oossible to increase the amplification over the straight Suhl amplifier. In addition to the usual signal and idler mode which in the present case use the second harmonic of Wp as a reactive coupling, there must be a subsidiary idler mode which will be used to amplify the idler. For this latter pair of modes, Wp will be the pump.

1848

Michigan U. Dept. of Mathematics, Ann Arbor.

NILPOTENT LIE ALGEBRAS, by C.-Y. Chao. Mar. 1961, 69p. incl. refs. (Rept. no. 03000-3-T) (AFOSR-292) (AF 49(638)104) AD 254969 Unclassified

Some contributions to the classification of nilpotent Lie algebras of length 2 and of low dimensions are made. By improving a result of Malcev the existence of uncountably many nonisomorphic nilpotent Lie algebras of any given dimension > 10 is indicated. All nilpotent Lie

algebras of dimensions < 5 are constructed. Some relationship is established among the length, index, and dimension of nilpotent Lie algebras. Derivations, imbedding problems, and properties of nilpotent Lie algebras are also studied. (Contractor's abstract, modified)

1849

Michigan U. [Dept. of Mathematics] Ann Arbor.

ACTIONS OF THE ROTATION GROUP ON THE 5-SPHERE, by R. W. Richardson, Jr. [1961] [10]p. incl. refs. (AF 49(638)104) Unclassified

Published in Ann. Math., v. 74: 414-423, Sept. 1961.

This paper discusses continuous actions of the 3-dimensional rotational group SO(3) on S^5 which have a 3-dimensional orbit. Up to topological equivalence, there are at least 2, and at most 3 possibilities: (a) One orbit is homeomorphic to S^2, the action is induced by the direct sum of two 3-dimensional irreducible representations. (b) One orbit is homeomorphic to the projective plane, the action is the suspension of the action induced on S^4 by the 5-dimensional irreducible representation of SO(3). (c) If the double suspension of SO(3)/H, where H is the icosahedral group, is S^5, there is a third class in which the orbits either are homeomorphic to SO(3)/H, or are fixed points. (Math. Rev. abstract)

1850

Michigan U. [Dept. of Mathematics] Ann Arbor.

THE BOUNDARY BEHAVIOR OF MEROMORPHIC FUNCTIONS, by W. B. Woolf. [1961] [9]p. incl. refs. (AF 49(638)104) Unclassified

Published in Ann. Acad. Scient. Fenn., Series A. I., No. 305: 3-11, 1961.

Let f be defined in $|z| < 1$, and let P be a point on $|z| = 1$. Then $C(f,P)$, $C_R(f,P)$, and $C_{R-E}(f,P)$ will denote the cluster set of f at P, the radial boundary cluster set of f at P, and the radial boundary cluster set of f at P in the formation of which the radii ending at points of $E \subset \{|z| = 1\}$ are not considered respectively. The author proves 2 theorems which extend extensions of the Gross-Iverson theorem due to Lohwater and Noshire. Theorem 4: If f(z) is meromorphic in $|z| < 1$, and P is a point of $|z| = 1$, then, in each neighborhood of P, f(z) assumes every value of $C(f,P)-C_R(f,P)$ with the possible exception of at most 2 points. Any such exceptional value is an asymptotic value of f(z) at P. Theorem 5: Let f(z) be meromorphic in $|z| < 1$, E a subset of $|z| = 1$ of capacity zero, and P a point of $|z| = 1$. Then f(z) assumes in each neighborhood of P all except possibly 2 values of each component of $C(f,P)-C_{R-E}(f,P)$. Any such exceptional value is an asymptotic value of f(z), either at P or at a sequence of points of E which have P as a limit point. The methods of proof are closely related to techniques of Lohwater and Noshiro. (Math. Rev. abstract)

1851

[Michigan U. Dept. of Mathematics, Ann Arbor]

UNCOUNTABLY MANY NONISOMORPHIC NILPOTENT LIE ALGEBRAS, by C.-Y. Chao. [1961] [4]p. (AF 49-(638)104) Unclassified

Published in Proc. Amer. Math. Soc., v. 13: 903-906, Dec. 1962.

Suppose that L is an algebra over a field F, and that E is a subfield of F. Call L an E-algebra if it has a basis whose multiplication table has coefficients in E. With the stipulation that L be a real Lie algebra with $[[LL]L] = 0$ and sufficiently high dimension, it is possible to construct an uncountable assortment of algebras L which are not rational algebras. The construction also yields, for each dimension ≥ 10, an uncountable number of these algebras which are not isomorphic. A suitable one-dimensional extension of each of these then gives a similar result for a class of solvable algebras.

1852

[Michigan U. Dept. of Mathematics, Ann Arbor]

A RUNGE-KUTTA PROCEDURE FOR THE GOURSAT PROBLEM IN HYPERBOLIC PARTIAL DIFFERENTIAL EQUATIONS, by R. H. Moore. [1960] [27]p. incl. diagr. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)192 and Naval Ordnance Lab.) Unclassified

Published in Arch. Rational Mech. and Anal., v. 7: 37-63, 1961.

A numerical procedure analogous to the Runge-Kutta method is developed for the problem $u_{xy} = f(x,y,u,u_x,u_y)$, $u(x,0) = \sigma(x)$, $u(0,y) = \tau(y)$, $\sigma(0) = \tau(0)$, $0 \leq a$, $0 \leq y \leq b$. The calculation proceeds stepwise in a regular grid with mesh sides $\Delta x = h$, $\Delta y = \varphi h$. Formulas are given for the approximate determination of u, u_x, u_y at $(x_0 + h, y_0 + \varphi h)$. The calculation involves intermediate values in such a way that 18 possible different increments of the coordinates have to be considered simultaneously. With these increments a set of formulas is proposed, which, when written in matrix form, resembles structurally the ordinary Runge-Kutta formulas. The weight factors in these formulas together with the 18 increments are then determined. The resulting conditions are undetermined and permit the imposition of some symmetry and positivity requirements. A particular set of values

for all parameters is proposed which produces a comparatively simple numerical scheme. The discretization error inherent in this method is $0(h^5)$ for sufficiently smooth data. (Math. Rev. abstract)

1853

Michigan U. [Dept. of Mathematics] Ann Arbor.

BOUNDARY FUNCTIONS FOR FUNCTIONS DEFINED IN A DISK, by F. Bagemihl and G. Piranian. [1961] [7]p. (AFOSR-594) (AF 49(638)633) AD 611472 Unclassified

Also published in Michigan Math. Jour., v. 8: 201-207, 1961.

Let C denote the unit circle $|\zeta| = 1$, D the unit disk $|z| < 1$, and let $\varphi(\zeta)$ and f(z) be real-or complex-valued functions defined on C and D, respectively. Then φ is said to be a boundary function for f if for each $\zeta \in C$ there exists an arc $A(\zeta)$, which has ζ as an endpoint and lies except for this endpoint in D, such that $\lim_{z \to \zeta, z \in A(\zeta)} f(z) = \varphi(\zeta)$. The authors first consider the problem of how many different boundary functions a particular function f can have. In particular, they show that an arbitrary function f has at most $2^{\aleph_0}$ boundary functions. They then exhibit a holomorphic function f which belongs to every Hardy class H^p and actually has $2^{\aleph_0}$ boundary functions. The authors next consider the relation between boundary functions and the Baire classification. For example, they show that if 1 of the boundary functions for f is of Baire class $\alpha \geq 3$, then every boundary function for f is of Baire class α. They also construct a bounded continuous function f and then a harmonic function f, each of which has boundary functions of Baire classes 0, 1, and 2. The authors next prove that φ is the boundary function for a continuous f if φ is of Baire class 2 and differs on at most a countable set from a function of Baire class 1. A φ of Baire class 2 is exhibited which is not the boundary function for a continuous f. Finally, the authors prove that the characteristic function of a set $E \subset C$ is the boundary function for a continuous f if and only if both E and $C \setminus E$ are the union of a countable set and a set of type G_δ. The paper is concluded with a number of open questions. (Math. Rev. abstract)

1854

Michigan U. [Dept. of Mathematics] Ann Arbor.

JORDAN DOMAINS AND ABSOLUTE CONVERGENCE OF POWER SERIES, by G. Piranian. [1961] [6]p. incl. diagr. (AFOSR-3246) (AF 49(638)633) AD 428340 Unclassified

Also published in Michigan Math. Jour., v. 9: 125-128, 1962.

Let J be a closed curve that encloses the origin, and let J^{-1} be its reflection with respect to the unit circle. Let $f(z) = \Sigma 1^{\infty} a_n z^n$ and $h(z) = \Sigma 1^{\infty} c_n z^n$ be the functions that map the unit disk onto the interiors of J and J^{-1}. A curve J is constructed such that $\Sigma |a_n| < \infty$ but $\Sigma |c_n| = \infty$. Hence there cannot exist any simple geometric condition on J that is necessary and sufficient for $\Sigma |a_n| < \infty$. (Math. Rev. abstract)

1855

Michigan U. [Dept. of Mathematics] Ann Arbor.

GEOMETRIC ABA-GROUPS, by D. G. Higman and J. E. McLaughlin. [1960] [16]p. incl. refs. [AF 49(638)714] Unclassified

Published in Illinois Jour. Math., v. 5: 382-397, Sept. 1961.

It is proved that only Desarguesian projective planes admitting acutely regular groups of collineations are the planes of orders 2 and 8, and an acutely transitive group on a Desarguesian projective plane, which is not acutely regular, contains the little projective group thus determining all acutely transitive collineation groups of Desarguesian projective planes. This proof follows the following general outline. The concept of geometric ABA-groups, characterized as the finite groups admitting acutely transitive representations on 2-designs as the groups G containing subgroups A and B such that: (1) G = ABA, (2) $AB \cap BA = A + B$, and (3) $A \neq B$ and $B \neq A$. Any doubly transitive group is a geometric ABA-group with $B:A \cap B = 2$, which means that in a geometric ABA-group, A is a maximal subgroup. A projective ABA-group satisfies the condition $A:A \cap B = B:A \cap B \geq 3$. By using the Ostrom-Wagner theorem the additional condition $G = A + A \times A$ is necessary and sufficient for π to be Desarguesian and $\sigma(G)$ to contain the little projective group. If the additional condition $A \cap B = 1$ is satisfied then G is an independent ABA-group and using Singer's theorem the original statement is proved.

1856

Michigan U. Dept. of Mathematics, Ann Arbor.

REGULAR CONVERGENCE IN A PARACOMPACT SPACE, by J. H. Stoddard. May 1961, 34p. incl. refs. (Rept. no. 03597-3-T) (AFOSR-798) (AF 49(638)774) AD 259135 Unclassified

The main results are systemized concerning n-regular convergence by using a uniform method and placing them in the framework of a general, possible non-metrizable, paracompact topological space. (Contractor's abstract)

1857

Michigan U. [Dept. of Mathematics] Ann Arbor.

PARTIALLY FREE SUBSETS OF EUCLIDEAN N-SPACE, by R. L. Wilder. [1961] [11]p. (AFOSR-J777) (AF 49(638)774) AD 408265 Unclassified

Also published in Michigan Math. Jour., v. 9: 97-107, June 1962.

Let C be a continuum in E^n and T be a closed subset of C. Define C to be T-free if for every $\epsilon > 0$ there exists an ϵ-mapping f: $C \to E^n$ such that $f(C) \cap C \subset T$. When T is empty C is said to be free. The author proved earlier that free continua which separate E^n are (n-1)-generalized manifolds. The present paper continues and generalizes his results by obtaining the same conclusion. C is an (n-1)-gcm, when T is, for example, zero-dimensional. The importance of such generalizations is pointed out by Bing's result that a 2-sphere in E^3 is always T-free, with T being a Cantor set. The main results are stated in Theorems 1-7, each concluding that C is an (n-1)-gcm, but with considerable variations of hypotheses. For example, the hypotheses of Theorem 3 are: (1) C is $1C^k$ with $2k \geq n-1$; (2) C cuts E^n; (3) T is closed and totally disconnected; (4) T is not an r-separating set of C for $r \leq k$; (5) for each $\epsilon > 0$, there is an ϵ transformation f: $C \to (E^n - C) \cup T$ such that $f(C-T) \subset E^n - C$; (6) f is (k-1)-monotone on C-T; (7) $E^n - C$ is semi-(n-r-2)-connected relative to E^n for all $r \leq k$. The hypotheses of Theorem 7 are: (1) C is $1C^{n-2}$; (2) C cuts E^n; (3) for given $\epsilon > 0$ there exist both a totally disconnected subset T of C and an ϵ-transformation f such that (4) T is not a local r-separating set of C for $r \leq n-2$; (5) f(C)-C lies in one component of $E^n - C$. For all of these theorems the hypotheses are shown to imply some degree of uniform local connectedness of $E^n - C$ so that the theorems of Chapter X of the author's book, Topology of Manifolds, may be used to conclude that C is an (n-1)-gcm. (Math. Rev. abstract)

1858

Michigan U. [Dept. of Mathematics] Ann Arbor.

SOME CHARACTERIZATION OF HOMOLOGICAL DIMENSION, by Y. Kodama. [1961] [6]p. incl. refs. (AF 49(638)774) Unclassified

Published in Michigan Math. Jour., v. 9: 167-172, June 19[illegible]

Continuing his investigation of test spaces the author proves (Theorems A, B) that for some groups there is a system (T system) of test spaces, though no single test nor finite system. His corollaries are (1) a Bockstein type result (which follows immediately from Bockstein's Theorem), (2) a theorem of Cohen and (3) a result relating the dimension of X, Y and $f^{-1}(y)$ for certain mappings f: $X \to Y$. (Math. Rev. abstract)

1859

Michigan U. Dept. of Mathematics, Ann Arbor.

FLAG-TRANSITIVE COLLINEATION GROUPS OF FINITE PROJECTIVE SPACES, by D. G. Higman. [1961] [13]p. incl. refs. [AF 49(638)774] Unclassified

Also published in Illinois Jour. Math., v. 6: 434-446, Sept. 1962.

In a projective space P, a "flag" is the figure consisting of a point, a line, a plane, ..., a hyperplane, in which each element contains all those of lower dimensions; a "flag-transitive collineation group" is one such that some one of its operations transforms any flag into any other flag; and the "little projective group" is the group generated by "elations," i.e., by products of matrices of the form $1 + ak^T$, where a and k are arbitrary vectors. The order of P is n if there are n + 1 points on a line. The theorem proved is the following: A flag-transitive collineation group G of a Desarguesian projective space P of dimension $d \geq 2$ and finite order n must contain the little projective group of P unless (a) d = 2, n = 2 and $|G| = 3.7$, or (b) d = 2, n = 8 and $|G| = 9.73$, or (c) d = 3, n = 2, and G is isomorphic with the alternating group A_7 of degree 7. (Math. Rev. abstract)

1860

Michigan U. [Dept. of Mathematics] Ann Arbor.

FACTORS OF N-SPACE, by K. W. Kwun. [1961] [5]p. incl. refs. (AF 49(638)774) Unclassified

Published in Michigan Math. Jour., v. 9: 207-211, Sept. 1962.

In 1959 Bing showed that 4-space has a factorization $X \times R$ in which X is not a manifold, but it was later found that X is a homotopy manifold. So the question remained as to how "bad" such an X can be. By a result due to Raymond it must be a homology generalized manifold. In this paper the author shows that such an X may fail to have the (local) homotopy-manifold property at any point. Precisely, it is proved that for each $n \geq 3$ there exists an n-dimensional homology such that $X \times R = R^{n+1}$, whereas no open set of X is a homotopy manifold. (Math. Rev. abstract)

1861

Michigan U. Dept. of Physics, Ann Arbor.

THE USE OF THE SHOCK TUBE AS A SPECTROSCOPIC SOURCE WITH AN APPLICATION TO THE MEASUREMENT OF gf-VALUES FOR LINES OF NEUTRAL AND SINGLY IONIZED CHROMIUM, by T. [D.] Wilkerson. June 1961 [281]p. incl. illus. diagrs. tables, refs. (Rept. no. 02822-3-T) (AFOSR-1151) (AF 49-(638)439) AD 262100 Unclassified

With chromium carbonyl as the additive, the gas behind the reflected shock emitted intense lines of neutral and singly ionized chromium (Cr I and Cr II). Line intensities were measured by heterochromatic photometry, using the anode crater of a carbon arc as the primary radiation standard. The state of the gas was computed from shock tube theory, taking account of dissociation, ionization, and excitation. Computed atomic populations were used, in conjunction with the theory of radiative transfer, to derive absolute gf-values of the lines from their observed intensities. The measurements covered 20 lines of Cr I and 8 lines of Cr II in the wavelength region 4500-5000A. The relative magnitudes of the Cr I gf-values were quite different from the relative values previously found in a furnace experiment. The new values rectify the anomalies attributed to Cr I in arcs and the sun on the basis of the previous work. The results of other experiments are compared to a few of the new absolute gf-values of Cr I. The new values are 3 to 5 times greater. The gf-values for Cr II are apparently the first to be measured for this ion. Observations were made of the ionization relaxation of Cr I immediately behind the reflected shock. (Contractor's abstract)

1862

Michigan U. Dept. of Physics, Ann Arbor.

STRONG LUMINOUS SHOCKS PRODUCED IN SHOCK TUBES, by C. W. Mautz and O. Laporte. Final rept. Nov. 1961, 2p. (AFOSR-1803) (AF 49(638)439) AD 611134 Unclassified

The work reported here has proved the value of the shock tube as a source for spectroscopic measurements. In addition to establishment of the techniques for shock-tube measurement of gf-values, a significant set of values has been determined which will be of importance in astrophysics and in the measurement of excitation temperatures.

1863

Michigan U. [Dept. of Physics] Ann Arbor.

IONIZATION OF SHOCK-HEATED Cr I (Abstract), by T. D. Wilkerson. [1961] [1]p. [AF 49(638)439] Unclassified

Presented at meeting of the Amer. Phys. Soc., Colorado Springs, Colo., Nov. 15-18, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 150, Feb. 23, 1962.

The ionization-relaxation of Cr I has been observed in shock-tube experiments on Cr I and Cr II emission behind reflected shock waves. The shock-tube test gas is neon plus small amounts of Cr $(CO)_6$ vapor ($< 0.3\%$).

Transient, high-intensity Cr I emission is seen for a well-defined period $t < 10\ \mu$sec. The subsequent steady emission (lasting $\sim 100\ \mu$sec) is used for line-intensity measurements under conditions of thermal equilibrium. The ionization-relaxation time t behind the reflected shock depends inversely on the electron pressure p_{el} computed for the gas behind the primary shock. Within experimental error, this inverse dependence also applies to the electron density n_{el}, on account of the narrow range of primary flow temperature T_1 (3650 – 4850°K). A typical experiment shows $t \sim 5$ microseconds for $p_{el} \sim 10$ dynes/cm^2, $n_{el} \sim 1.8 \times 10^{13}$ cm^{-3}, $T_1 \sim 4000$°K. From a highly simplified picture of the relaxation process, one estimates an ionization cross section of 10^{-16} to 10^{-15} cm^2 for low-energy electrons on Cr I.

1864

Michigan U. [Dept. of Physics] Ann Arbor.

ABSOLUTE LINE STRENGTHS FOR Cr I AND Cr II (Abstract), by T. D. Wilkerson. [1961] [1]p. [AF 49(638)-439] Unclassified

Presented at meeting of the Amer. Phys. Soc., Berkeley, Calif., Nov. 20-22, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 374, Apr. 23, 1962.

Shock-tube experiments have yielded absolute gf values for 20 lines of Cr I and 8 lines of Cr II between 4500-5000A. The test gas is neon with 0.03% Cr $(CO)_6$, and the emission spectra are observed behind reflected shock waves at temperature T_2 = 7500°-10,000°K. The Cr I results supersede a previous report (item no. 1621, Vol. IV) of an apparent anomaly in T_2, which was based on an earlier determination of Cr I relative gf values. The new Cr I values also explain similar discrepancies reported for arcs and the solar atmosphere. The Cr II gf values are apparently the first to be measured for this ion. By means of the shock tube, it should be possible to generate and study the spectra of at least 50 elements under well-defined conditions of abundance and temperature. Such experiments will hopefully provide useful data for various studies of high-temperature gases.

1865

Michigan U. [Dept. of Psychology] Ann Arbor.

COGNITIVE ASPECTS OF INFORMATION PROCESSING. I. THE FAMILIARITY OF S-R SETS AND SUBSETS, by P. M. Fitts and G. Switzer. [1961] [9]p. incl. diagrs. tables, refs. (AFOSR-279) (AF 49(638)449) Unclassified

Also published in Jour. Exper. Psychol., v. 63: 321-329, Apr. 1962.

The investigation concerned S's ability to reduce his reaction time (RT) on the basis of knowledge that only a small subset of a larger, familiar alphabet would occur as stimuli in a particular experiment. It was predicted that S's could make effective use of this knowledge only when the small subset itself constituted a highly familiar group. The results of 3 experiments were in agreement with the predictions. These results support the view that information-handling rate is in part a function of cognitive sets which reflect the preparation which S makes, in advance, for responding to any 1 of a group of stimuli. Some characteristics of these cognitive sets are discussed, and the notion of related to recent theories of choice behavior.

1866

Michigan U. Dept. of Psychology, Ann Arbor.

THE EFFECTS OF LOAD AND ACCESSIBILITY OF INFORMATION UPON PERFORMANCE OF SMALL TEAMS, by H. G. Moore. Oct. 1961 [125]p. incl. diagrs. tables, refs. (Rept. no. 02914-8-T) (AFOSR-1636) (AF 49(638)449) AD 268462 Unclassified

Abstract published in Dissertation Abstracts, v. 23: 301, 1962.

The aim of this research is to relate objective measures of team performance to task: organizational, and information-coding variables in dynamic tasks which must be accomplished under time pressure. The task employed in the present study is a generalized version of the familiar transportation, assignment, or scheduling problem which requires the use of heuristic methods of problem solving. The task also involves a variety of related data processing and record keeping activities. The study is a distinct contribution to the methodology of system research. In addition the study indicates that a considerable amount of work sharing or load balancing can take place between the members of a team that is working under time stress, when visually displayed information is available to both members of a 2-man team and there are minimum restrictions on voice communications. (Contractor's abstract)

1867

Michigan U. Research Center for Group Dynamics, Ann Arbor.

STUDIES ON DRIVE AND INCENTIVE IN PERCEPTION. III. SOME EFFECTS OF DRIVE ON STIMULUS GENERALIZATION OBTAINED WITH A REVISED TRAINING PROCEDURE, by R. B. Zajonc and S. E. Karp. Apr. 1961, 30p. incl. tables, refs. (Technical rept. no. 8) (AFOSR-753) (AF 49(638)367) AD 257895 Unclassified

A procedural modification was developed in order to clarify the results of testing the hypothesis that within certain intensity ranges, the perceived stimulus intensity is a monotonically increasing function of drive and the actual stimulus intensity. This change in procedure prevented the formation of negative gradients which eliminated a possible effect due to variation in the response threshold and the distances between the training stimuli. It was found that there were significant curve shifts under the 2 drive conditions, thus supporting the experimental hypothesis. However, the effects found were generally weaker than those observed under the previously used procedure. (Contractor's abstract)

1868

Michigan U. Research Center for Group Dynamics, Ann Arbor.

STUDIES ON DRIVE AND INCENTIVE IN PERCEPTION. IV. SOME EFFECTS OF SOUND AND BACKGROUND BRIGHTNESS ON THE PERCEIVED SIZE OF COINS AND DISCS, by D. D. Dorfman and R. B. Zajonc. Nov. 1961, 14p. incl. diagrs. tables, refs. (Technical rept. no. 12) (AFOSR-1735) (AF 49(638)367) AD 267847 Unclassified

Also published in Jour. Abnorm. and Social Psychol., v. 66: 87-90, Jan. 1963.

The research was designed to test implications of the hypothesis that the Bruner-Goodman phenomenon is an instance of sensory interaction. Rich and poor children estimated the size of coins and discs under sound vs no sound and two levels of background brightness. Contrary to prediction, no relation was found to exist between sound level and size estimation, although such a relation did exist for background brightness. The findings failed to replicate the data of Bruner and Goodman, whereas they were in substantial agreement with those of Carter and Schooler. These results were as follows. (1) Large coins tended to be judged larger, and small coins judged smaller than neutral discs of comparable size; and (2) No differential affect was observed on the estimations of coins and discs as a function of economic status. There was, however, a reliable tendency for the children of lower economic status to overestimate both coins and discs when compared with those of higher status. (Contractor's abstract)

1869

Michigan U. Research Center for Group Dynamics, Ann Arbor.

STUDIES ON DRIVE AND INCENTIVE IN PERCEPTION. V. RESPONSE SUPPRESSION IN PERCEPTUAL DEFENSE, by R. [B.] Zajonc. Oct. 1961, 24p. incl. diagrs. tables, refs. (Technical rept. no. 14) (AFOSR-1736) (AF 49(638)367) AD 267848 Unclassified

Also published in Jour. Exper. Psychol., v. 64: 206-214, Sept. 1962.

To examine the relative effects of the stimulus and the response in perceptual defense experiments, recognition thresholds and autonomic reactions were first obtained to 6 neutral and 6 taboo words. Subsequently, Ss learned a list of paired-associates to a criterion of 3 perfect trials, where the original words served as stimulus terms and a new set of 6 neutral and 6 taboo words served as response terms. Half of the neutral stimuli were paired with neutral, and half with taboo responses. The same was true of the 6 taboo stimuli. Following, the paired-associates training recognition thresholds and GSR were again measured. One group of subjects, however, was required to give evidence of recognition by means of the response terms acquired in the paired-associates training and another by means of the original stimulus presented. The results show that stimuli have no effect on either recognition threshold or GSR unless they produce response conflict. Irrespective of the emotionality of the stimulus, recognition threshold and GSR were found to be elevated when subjects were required to give a taboo response. Also, no differences between taboo and neutral stimuli were found when the responses required of the subjects were neutral. The strongest response effects were observed for rapid learners. (Contractor's abstract)

1870

Michigan U. [Speech Research Lab.] Ann Arbor.

THE THEORY OF PHONEMIC ANALYSIS, by G. E. Peterson and C. J. Fillmore. [1961] [14]p. incl. diagrs. (AFOSR-2091) (AF 49(638)492) Unclassified

Also published in Proc. Fourth Internat'l. Cong. on Phonetic Sciences, Helsinki (Finland) (Sept. 4-9, 1961), The Hague, Mouton and Co., 1962, p. 476-489.

In this paper, the general nature of a theory of phonemic analysis is considered. A linguistic theory is viewed as a scientific theory, and as such must have the essential properties of any scientific theory. An attempt has been made to delimit phonology within linguistics and to identify those elements essential to a phonological system. Phonetic theory is considered basic to phonemic theory and to the phonological description of specific languages. A general phonemic theory specifies the individual units and the basic relationships among these units in a manner that is equally applicable to various languages. The general properties of phonological descriptions of dialects of specific languages are considered, and formats are discussed in which the phonological description of specific dialects may be presented. Thus a general phonemic theory plus a format for expressing the phonemicization of specific dialects provide the essential components of the theory of phonemic analysis. (Contractor's abstract)

1871

Michigan U. [Speech Research Lab.] Ann Arbor.

PHONEME SELECTION FOR STUDIES IN AUTOMATIC SPEECH RECOGNITION, by J. E. Shoup. [1961] [8]p. incl. diagrs. tables. (AFOSR-2094) (AF 49(638)492) Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 34: 397-403, Apr. 1962.

Two alternate methods for the selection of speech material to be used in studies in automatic speech recognition are suggested. Preference is given to the selection of a restricted set of phonemes from which words and sentences may be constructed for analysis. The selection can be based on the high frequency of occurrence of the individual phonemes, on the high yield of words by the phonemes, or on some combination of these 2 criteria. A combination of the 2 criteria appears to be most satisfactory. The phoneme selection was derived from the 500 most frequently occurring words, as given by Thorndike and Lorge. Some consideration was also given to the frequencies of occurrence of the phonemes. The phonemes are presented in cumulative order according to the number of words by which the list is increased as each successive phoneme is added. (Contractor's abstract)

1872

Michigan U. [Speech Research Lab.] Ann Arbor.

THE MEASUREMENT OF SPEECH POWER, by G. E. Peterson and N. P. McKinney. [1961] [20]p. incl. illus. diagrs. refs. (AFOSR-2095) (AF 49(638)492) Unclassified

Also published in Phonetica, v. 7: 65-84, 1961.

The measurement of speech power is basic to research on the acoustic correlates of linguistic stress. Two units essential to speech measurement are a rectifier and a filter. An amplitude compressor is also desirable. Theoretically a square-law rectifier is ideally suited for speech power measurements, but there are considerable practical difficulties in implementing such a circuit. The common "linear rectifier" has been found experimentally to be suitable for this application. A simple filter design may be achieved which is adequate for most applications and which avoids the theoretical and practical difficulties of several other filter designs discussed. Logarithmic amplitude compression of the filter output

is desirable and is easily accomplished with a diode. In making speech power measurements with the circuit developed, an effect previously discussed by House has been observed. (Contractor's abstract)

1873

Michigan U. Speech Research Lab., Ann Arbor.

INTRINSIC CUES AND CONSONANT PERCEPTION, by W. S.-Y. Wang and C. J. Fillmore. [1961] [7]p. incl. tables. (AFOSR-3283) (AF 49(638)492) Unclassified

Also published in Jour. Speech and Hearing Research, v. 4: 130-136, June 1961.

A distinction has been made between secondary cues which are extrinsic and those which are intrinsic. The purpose was to investigate the contribution of some intrinsic cues in consonant perception. Subjects were 10 phonetically trained listeners. Test items were 405 consonant-vowel-consonant syllables consisting of 9 consonants and 5 vowels in all combinations. Results of correct identification of initial consonants suggest that vowel amplitude, degree of formant bend, and vowel nasalization are significant parameters in the vowel for identifying the consonant which precedes it. (Contractor's abstract)

1874

Michigan U. [Willow Run Labs.] Ann Arbor.

PARAMAGNETIC RESONANCE OF ZnTe:Mn (Abstract), by G. H. Azarbayejani, C. Kikuchi, and D. Mason. [1961] [1]p. [AF 49(638)987] Unclassified

Presented at meeting of the Amer. Phys. Soc,, Monterey, Calif., Mar. 20-23, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 117, Mar. 20, 1961.

Spin resonance measurements of ZnTe containing about 0.01% Mn^{++} were carried out to augment the information on Mn^{++} ions in the cubic $A_{II}B_{VI}$ compounds, ZnS and CdTe, reported earlier. The g-value at 77°K is about 2.005. The cubic field parameter 3a is about 0.00348 cm^{-1} at 4.2°K. This is to be compared with 0.00233 cm^{-1} and 0.0084 cm^{-1} for ZnS and CdTe, respectively. Measurements indicate that the hfs coupling constant A is temperature dependent, having the values 62.2, 61.0, and 60.5 gauss at 300°, 77°, and 4.2°K, respectively. This temperature dependence is in contrast to that of CdTe, for which preliminary measurements give 60.6, 61.7, and 61.6 gauss at 300°, 77°, and 4.2°K, respectively.

1875

Michigan U. [Willow Run Labs.] Ann Arbor.

HYPERFINE STRUCTURE OF CHROMIUM 53 IN Al_2O_3, by R. W. Terhune, C. Kikuchi and others. [1961] [4]p. incl. diagrs. table, refs. [AF 49(638)987] Unclassified

Published in Phys. Rev., v. 123: 1265-1268, Aug. 15, 1961.

Electron nuclear double-resonance techniques were used to observe the hyperfine spectrum of Cr^{53} in Al_2O_3. Through analysis of the spectrum at zero degrees a positive value of 48.5 ± 0.1 mc/sec was obtained for the hyperfine coupling constant and -0.85 ± 0.04 mc/sec for the quadrupole coupling constant. From this a value of -0.03 barn was deduced for the quadrupole moment of Cr^{53}. (Contractor's abstract)

1876

Michigan U. [Willow Run Labs.] Ann Arbor.

SPIN RESONANCE PROPERTIES OF ZnTe:Mn AND OF OTHER $A_{II}B_{VI}$ COMPOUNDS, by C. Kikuchi and G. H. Azarbayejani. [1961] [3]p. incl. tables, refs. [AF 49-(638)987] Unclassified

Presented at Internat'l. Conf. on Magnetism and Crystallography, Kyoto (Japan), Sept. 25-30, 1961.

Published in Jour. Phys. Soc. Japan, v. 17, Suppl. B-I: 453-455, Mar. 1962.

The cubic field splittings 3a for ZnTe:Mn and CdSe:Mn are reported. The ground state splittings in ZnTe and CdTe, whose lattice parameters are 6.10 and 6.48A, are 88.9 and 83.1 x $10^{-4}cm^{-1}$, respectively. On the other hand, for CdSe, for which the lattice parameter is 6.05A, the cubic field splitting is 46.3 x $10^{-4}cm^{-1}$. It is suggested that the impurity Mn^{++} ions produce local dilatations such as to be under compression in the zinc $A_{II}B_{VI}$ compounds and under tension in the corresponding cadmium compounds. (Contractor's abstract)

1877

Midwest Research Inst., Kansas City, Mo.

EXPANSION OF HYPERGEOMETRIC FUNCTIONS IN SERIES OF OTHER HYPERGEOMETRIC FUNCTIONS, by Y. L. Luke and R. L. Coleman. [1960] [5]p. incl. refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)389] and David Taylor Model Basin, Applied Math. Lab.) Unclassified

Published in Math. Comput., v. 15: 233-237, July 1961.

In a previous paper (item no. 1248, Vol. III) an expansion has been developed for the confluent hypergeometric function in series of Bessel functions. A different expansion of the same kind given by Buchholz was also studied. Rice has also developed an expansion of this type, and a fourth expansion of this kind can be deduced from some recent work by Alavi and Wells. In this paper, a multiplication formula is deduced for the Gaussian hypergeometric functions due to Erdélyi. The principal result is specialized to give an expansion of the confluent hypergeometric function in series of Bessel functions which includes the 4 above as special cases. With the aid of the Laplace transform, the latter result is used to derive an expansion of the Gaussian hypergeometric function in series of functions of the same kind with changed argument. This is advantageous since, throughout most of the unit disc, the change in argument leads to more rapidly converging series. For special values of the parameters, the expansion degenerates into known quadratic transformations. (Contractor's abstract)

1878

Milan U. (Italy).

STUDIES ON RHENIUM COORDINATION COMPOUNDS: HEXAISOCYANIDERHENIUM(I) SALTS, PART I. STUDIES ON IRIDIUM COMPOUNDS: ISOCYANIDE DERIVATIVES OF IRIDIUM. CARBONYL DERIVATIVES OF IRIDIUM IODIDES, PART II, by L. Malatesta. Final technical rept. Mar. 31, 1961 [33]p. incl. tables, refs. (AFOSR-1204) (AF 61(052)83) AD 262065 Unclassified

The reaction of ReI_3 with p-tolylisocyanide at 150° and with ethyl-isocyanide at room temperature gives the triiodide of the hexaisocyaniderhenium(I) cations $[Re(RNC)_6]^+$. Both the aliphatic and aromatic derivatives are stable, diamagnetic substances, from which other salts such as the iodide, the perchlorate, etc., have been prepared. From the reaction of $Ir(CO)_2$(p-toluidine)(Cl) with p-tolylisocyanide (RNC) the cations $[Ir(CO)(RNC)_3]^+$ and $[Ir(RNC)_4]^+$ were obtained in solution and isolated as salts with bromide, perchlorate and iodide anions. These salts are a stable crystalline, diamagnetic substance, of intense blue color, and soluble in polar solvents. (Contractor's abstract)

1879

Milan U. (Italy).

CATHODIC REDUCTION OF OXYGEN AND HYDROGEN PEROXIDE ON PLATINUM, PALLADIUM AND IRIDIUM SMOOTH ELECTRODES, by G. Bianchi, F. Mazza, and T. Mussini. Dec. 1961 [34]p. incl. diagrs. tables, refs. (Technical scientific note no. 6) (AFOSR-2050) (AF 61(052)260) AD 277394 Unclassified

Polarization curves in acid, neutral and alkaline solutions were drawn by potentiostatic method, for O and H_2O_2 reduction processes and for H_2O_2 oxidation process, on Pt, Ir and Pd electrodes. These curves could be classified as follows: those whose slopes are 0.030 to 0.12, and those with slopes higher than 0.12. The former can be explained through already proposed mechanisms (addition of 1 electron or 1 atom of H to an adsorbed O molecule; or addition of 1 electron to an HO_2 adsorbed radical). The slopes higher than 0.12 involve a slow O or HO_2 radical adsorption which becomes kinetically determining first of all for Ir in both acid and neutral solutions. For Pd in H_2SO_4 solution and for Pt in HCl solution the O adsorption process is very slow, essentially due to the complexing action of the solution with resulting formation of surface complexes which engage the metal atoms, thus preventing or reducing the formation of adsorbed oxide. (Contractor's abstract)

1880

Milan U. (Italy).

OXYGEN AND HYDROGEN PEROXIDE ELECTROCHEMICAL BEHAVIOUR ON GOLD ELECTRODES, by G. Bianchi, F. Mazza and T. Mussini. Dec. 1961, 31p. incl. diagrs. refs. (Technical scientific note no. 5) (AFOSR-2054) (AF 61(052)260) AD 276134 Unclassified

Polarization curves in acid, neutral and alkaline solution were drawn by potentiostatic method, for oxygen and hydrogen peroxide reduction processes and for hydrogen peroxide oxidation process. In the case of acid solutions current yields were also determined for cathodic reduction of oxygen to hydrogen peroxide and of hydrogen peroxide to water. It was found that a stationary concentration of hydrogen peroxide (about .0025 M) is formed in acid solutions, and preferably either oxygen or hydrogen peroxide reduction process occurs according to the higher or lower concentration of hydrogen peroxide in the solution, in respect to the above value. (Contractor's abstract)

1881

Milan U. (Italy).

CATHODIC REDUCTION OF OXYGEN AND HYDROGEN PEROXIDE ON TITANIUM, by G. Bianchi and S. Malaguzzi. [1961] [6]p. (AFOSR-2893) (AF 61(052)260) Unclassified

Also published in Proc. First Internat'l. Cong. on Metallic Corrosion, London (Gt. Brit.) (Apr. 1961) [London] Butterworth, 1962, p. 78-83.

In a study of the behavior of oxygen and hydrogen peroxide on titanium by polarization curves, the metal functions effectively for the cathodic reduction of these 2 materials. The potential for the oxygen reaction is relatively insensitive to pH; at the lowest c. d. in acid solution this potential is ~0.2 - 0.3 v, 0.1 - 0.3 v in neutral solution, and -0.3 - 0 v in alkaline solution. The polarization curves have the same slope in acid, neutral, and alkaline solution (2RT/F). Ti may play a cathodic role to a number of metals and may produce galvanic corrosion, especially in neutral solution in which positivity is stable. In acid solution Ti is similar to Ag, Au, etc., but in alkaline solution the reduction and oxidation reactions occur at -300 mv and on the other metals at 100-200 mv; this may be due to the absorption of OH^- in place of O.

1882

Milan U. (Italy).

[ABOUT THE ELECTROCHEMICAL BEHAVIOR OF OXYGEN AND HYDROGEN PEROXIDE ON MAGNETITE ELECTRODES] Über das elektrochemische Verhalten von Sauersstoff und Wasserstoffsuperoxyd auf Magnetit-Elektroden, by G. Bianchi, G. Caprioglio and others. [1961] [7]p. incl. diagrs. tables, refs. (AFOSR-4237) (AF 61(052)260) Unclassified

Also published in Werkstoffe Korrosion, v. 13: 413-419, July 1962.

The electrochemical behavior of oxygen and hydrogen peroxide on magnetite electrodes was examined in neutral (0.5 M H_3BO_3 + 0.5 M Na_2SO_4) and alkaline (0.1 M NaOH + 0.5 M Na_2SO_4) solutions. In alkaline solution, the reaction is best described by $H_2O_2 = O_2 + 2H^+ + 2e^-$. In neutral solution, several processes occur including the reaction cited and the reaction $Fe(OH)_3 + 3H^+ + 2e^- = Fe^{+++} + 3H_2O$.

1883

Milan U. [Lab. of Physiology] (Italy).

ACTION OF CURARE-LIKE DRUGS ON SHORT AND LONG NEURONAL CIRCUITS, by D. Spinelli, T. Gualtierotti and others. [1958] 1p. (AFOSR-TN-59-1008) (AF 61(052)23) AD 617794 Unclassified

A curare-like non-hyperpolarizing drug, such as succinylcholine, seems to produce an overall facilitation on the nervous centers, involving especially long neuron 1 circuits (polysynaptic spinal reflex activity, rotary afterdischarges of the cerebellar cortex). On the oligosynaptic arc the facilitatory effect was limited to the very beginning of the administration of the drug, being followed later by inhibition. A hyperpolarizing curare drug, on the contrary, seems to induce a suppressory action on long interneuronal circuits such as those involved in the response of the cerebellar activity to a gravitational stimulation of the labyrinth. The increase of spinal reflex responses induced in a first time by this drug, seems to contradict the preceding statement; such an effect, however, may be due to a more marked blocking effect on the Renshaw inhibitory cells; the Renshaw antidromic inhibition is in fact substantially decreased under the action of this drug. (Contractor's abstract)

1884

Milan U. [Lab. of Physiology] (Italy).

ROLE OF RENSHAW ANTIDROMIC INHIBITION ON THE EFFERENT ACTIVITY OF THE SPINAL CORD IN MAN, by R. Margaria, T. Gualtierotti, and D. Spinelli. [1957] 1p. (AFOSR-TN-59-1009) (AF 61(052)23) AD 617795 Unclassified

The function of Renshaw antidromic inhibition in the activity of the spinal centers was investigated. It is suggested that there is a link between the rhythm of discharge of the single motoneurons of the spinal cord, the silent period in the muscle, and the Renshaw antidromic inhibition. This last is presumably the main controlling mechanism for the efferent activity of the spinal centers, and it seems responsible for their low frequency of discharge.

1885

Milan U. Lab. of Physiology (Italy).

[SPINAL REFLEX RESPONSES DURING STRESS AND FATIGUE] by R. Margaria. Final rept. [1961] 13p. incl. refs. (AFOSR-605) (AF 61(052)23) AD 259051 Unclassified

Oligo- and multisynaptic reflexes in the sciatic-gastronemius territory have been studied in men during rest and after exhaustive physical exercise. The general characteristics of the reflex responses have been investigated statistically; motor and sensory conduction speed, total and spinal reflex time, endplate delay and the inhibitory curve have been determined or calculated. During exhaustive physical exercise the only significant change consisted in a decrease of the spinal reflex time. The rhythm of discharge of the single motoneuron in man has been studied by recording the action potentials of the single muscle fiber in ten muscular groups from head to leg muscles. It was concluded that the frequency of discharge is controlled by antidromic inhibition of the motoneurons. The responses of single units of the flocculonodular lobe to rotatory accelerations has been studied and differential discharges have been found. The working of the cerebellar analyzers for accelerations is described.

1886

Milan U. [Lab. of Physiology] (Italy).

BODY SUSCEPTIBILITY TO HIGH ACCELERATIONS AND TO ZERO GRAVITY CONDITION, by R. Margaria and T. Gualtierotti. [1961] [23]p. incl. illus. diagrs. table, refs. (AFOSR-2014) (AF 61(052)23) Unclassified

Also published in Advances in Aeronaut. Sci., v. 3-4: 1081-1103, 1961.

Experiments concerning body susceptibility to high accelerations and to zero gravity condition indicate the following results: (1) gravity is but one factor and not the most important acting on the static organs of the labyrinth; (2) the energizer effect on the other nervous structures of labyrinth and cerebellum is largely independent from external stimulation; (3) most of the sensory inflow to the vestibulo-cerebellar system will be maintained through tactile, visual and deep receptor connections; and (4) whatever impairment the absence of the gravitational factor may induce on the static organs, it might easily be overcome after a short training.

1887

Milan U. Lab. of Physiology (Italy).

RESPONSES OF THE FLOCCULO-NODULAR LOBE OF THE CEREBELLUM TO MINUTE STATIC AND DYNAMIC EXCITATION OF THE LABYRINTH IN THE CURARIZED CAT, by T. Gualtierotti, R. Margaria, and R. Mossa. [1959] [7]p. incl. illus. diagrs. (AFOSR-64-1700) (AF 61(052)23) AD 448272 Unclassified

Also published in Atti Cong. Internaz. Med. Aeronaut. e Spaziale, v. 2: 564-570, Oct. 1959.

In curarized cats the response to acceleration forces of the medial and lateral parts of the left flocculo-nodular lobe of the cerebellum has been recorded. The stimulation was given either (a) by centrifuging the animal at a very low speed, the centrifugal force being maintained at a very low fraction of g, or (b) by changing the position of the animal, the body being tilted from the horizontal to a maximum of 10°, while the head was kept rigidly in the same position in respect to the body; (c) in a third group of experiments the plan of rotation of the centrifuge was inclined 1.5° to 10° to the horizontal, thus combining the 2 kinds of stimulation as described in (a) and (b). Static and dynamic responses are different. Static excitation induces an increase of amplitude of the cerebellar potentials without changes of frequency while dynamic stimulation, observed during rotation, mainly results in a synchronization of the cerebellar potentials with a decrease of frequency from 150-300/sec to 50-80/sec: the slower potentials are much ampler. (Contractor's abstract)

1888

Minneapolis-Honeywell Regulator Co., Hopkins, Minn.

SURFACE STATES ON CLEAVED SILICON, by D. R. Palmer, S. R. Morrison, and C. E. Dauenbaugh. [1960] [2]p. [AF 49(638)597] Unclassified

Published in Phys. Rev. Ltrs., v. 6: 170-171, Feb. 15, 1961.

Measurements were made of surface band structure on cleaved silicon using the channel methods of Statz. Samples were made by diffusing phosphorus into 80-ohm-cm p-type silicon to form npn units and by diffusing boron into 20-ohm-cm n-type silicon to form pnp units. The base width was 0.04 in. By cleaving, so as to leave the junction intersecting a cleaved surface, it was possible to make measurements of the channel conductance, if any, caused by the cleaved surface. In neither the npn nor the pnp case was the conductivity of the cleaved surface greater than 10^{-2} μmho/sq at 1.5 v bias, indicating there was no channel (inversion layer) present. It is concluded that the dominant surface states are near the center of the gap with a freshly cleaved silicon surface, if it is assumed that the surface state structure is independent of the bulk type.

1889

[Minneapolis-Honeywell Regulator Co., Hopkins, Minn.]

RESEARCH ON PROPERTIES OF CLEAN SURFACES, by S. R. Morrison, D. R. Palmer, and C. E. Dauenbaugh. Final rept. May 1961, 25p. incl. diagrs. refs. (AFOSR-755) (AF 49(638)597) AD 256262 Unclassified

Experiments to determine the surface band structure of clean surfaces produced by cleavage in ultra-high vacuum have been performed on germanium, silicon, and indium antimonide. A clean Ge surface is highly p-type with the Fermi level at the surface near the valence band. This is brought about by acceptor-like surface states in the valence band with a density of 2-3 x $10^{12}/cm^2$. The density of these low-lying surface states decreases when the surface is exposed to oxygen. A clean Si surface is nearly intrinsic, possibly slightly n-type, indicating that the dominant surface states are near the center of the forbidden gap at the surface. Preliminary results on InSb are reported. (Contractor's abstract)

1890

[Minneapolis-Honeywell Regulator Co., Hopkins, Minn.]

GROUP THEORY AND THE ENERGY BAND STRUCTURE OF SEMICONDUCTORS, by A. Nussbaum. [1961] [20]p. incl. diagrs. tables, refs. (AFOSR-4250) (AF 49(638)597) Unclassified

Also published in Proc. Inst. Radio Engineers, v. 50: 1763-1781, Aug. 1962.

The purpose of this paper is to present the principles involved in calculating the energy band structures of semiconductors. These calculations can be simplified by the use of group theory, which is a branch of analysis that permits expressing the symmetry properties of crystals in a quantitative manner. Some of the simpler concepts of group theory are explained and then applied to band structure determinations. (Contractor's abstract)

1891

[Minneapolis-Honeywell Regulator Co., Hopkins, Minn.]

STUDIES OF CLEAVED GERMANIUM SURFACES (Abstract), by S. R. Morrison, D. R. Palmer, and C. E. Dauenbaugh. [1961] [2]p. [AF 49(638)597] Unclassified

Presented at meeting of the Amer. Phys. Soc., Monterey, Calif., Mar. 20-23, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 106-107, Mar. 20, 1961.

The method of Statz and his co-workers has been found particularly adaptable to electrical studies of clean (by cleavage) Ge surfaces. Earlier work (item no. 1662, Vol. IV) has shown that a strongly p-type surface layer is found on clean Ge. Our approach then has been to prepare by diffusion a pnp transistor-like structure, and cleave in such a way as to cleave through the junctions. Then biasing both junctions in the reverse direction, the "channel" resistance across the p-type surface layer is measured. The resistivity upon cleavage has turned out to be the order of 100 μmho/sq with an 0.1-v bias on the junctions. The resistivity variations with oxygen admission are similar to earlier work on argon-bombarded and particularly cleaved Ge surfaces.

1892

[Minneapolis-Honeywell Regulator Co.] Hopkins, Minn.

TELLURIUM, by J. S. Blakemore, D. Long and others. [1961] [45]p. incl. illus. diagrs. tables, refs. (AFOSR-734) (AF 49(638)908) Unclassified

Also published in Prog. in Semiconductors, v. 6: 39-84, 1962.

Physical and chemical properties of tellurium are reviewed to include the following: lattice characteristics, optical properties, transport phenomena, properties of excess carriers, and energy band structure.

1893

Minneapolis-Honeywell Regulator Co., Hopkins, Minn.

THE OPTICAL AND ELECTRICAL PROPERTIES OF SINGLE CRYSTAL TELLURIUM. Fourth quarterly rept. (Interim final rept.) May 31, 1961, 30p. incl. diagrs. tables, refs. (AFOSR-1469) (AF 49(638)908) AD 267318 Unclassified

The results of measurements of 12 galvanomagnetic coefficients of tellurium as a function of temperature are presented. Based on these results, as well as the optical absorption measurements of the previous quarterly report, an energy band structure is postulated as the culmination of our first year's work on tellurium. This band structure differs from those previously proposed by Callen and Reitz, which are not in accord with the experimental data for our high-perfection crystals. (Contractor's abstract)

1894

Minneapolis-Honeywell Regulator Co., Hopkins, Minn.

THE OPTICAL AND ELECTRICAL PROPERTIES OF SINGLE CRYSTAL TELLURIUM. Fifth quarterly rept. Aug. 31, 1961, 68p. incl. diagrs. tables, refs. (AFOSR-1470) (AF 49(638)908) AD 267319 Unclassified

In excess carrier studies, work is continuing on the measurement of drift mobility. Lifetime measurements are being extended to antimony doped crystals. The previously reported optical absorption edge data is being fitted to an indirect absorption model. A report has been prepared on the application of group theory to band structure calculations, with special reference to tellurium. (Contractor's abstract)

1895

[Minneapolis-Honeywell Regulator Co.] Hopkins, Minn.

GALVANOMAGNETIC COEFFICIENTS OF SINGLE-CRYSTAL TELLURIUM, by A. Nussbaum and R. J. Hager. [1961] [7]p. incl. diagrs. tables, refs. (AFOSR-3387) [AF 49(638)908] AD 613801 Unclassified

Also published in Phys. Rev., v. 123: 1958-1964, Sept. 15, 1961.

The 12 galvanomagnetic coefficients of tellurium crystals grown by the Czochralski method were measured over the temperature range 77°-300°K. The results of these measurements plus previous measurements at 4.2°K and a determination of the effect of pressure on 1 of the Hall coefficients are combined with symmetry characteristics to postulate an energy band structure. This structure differs from those previously proposed on the basis of tight-binding methods or by simple applications of group theory. (Contractor's abstract)

1896

[Minneapolis-Honeywell Regulator Co., Hopkins, Minn.]

GALVANOMAGNETIC TENSOR FOR PURE TELLURIUM FROM 77° TO 300°K (Abstract), by A. Nussbaum and R. J. Hager. [1961] [1]p. [AF 49(638)908]
Unclassified

Presented at meeting of the Amer. Phys. Soc., Monterey, Calif., Mar. 20-23, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 130, Mar. 20, 1961.

The elements of the galvanomagnetic tensor of pure, single crystal tellurium were measured from 77° to 300°K. This extends the work of Roth and of Nussbaum and Long by giving the temperature dependence of the following 12 elements: ρ_1, ρ_3, R_1, R_3, ρ_{1111}, ρ_{1133}, ρ_{1122}, ρ_{3333}, ρ_{3311}, ρ_{1313}, ρ_{1123}, and ρ_{2311}. The general behavior of our material, which is purer than Roth's, is about the same for the elements he measured. However, we find that ρ_{1123} and ρ_{2311} over the entire temperature range are essentially zero, and this value is consistent with the hypothesis of ellipsoidal energy surfaces. This result does not agree with that obtained for large crystals grown by the Bridgman method.

1897

Minnesota U., Minneapolis.

ON THE WEAK CONVERGENCE OF STOCHASTIC PROCESSES, by M. D. Donsker. [1960] [12]p. (AF 18-(603)30) Unclassified

Published in Math. Scand., v. 9: 43-54, 1961.

A theorem of Helly-Bray type in function space is proven using characteristic functionals of processes and an explicit inversion formula for characteristic functionals. If for each $\lambda \neq 0$, $\lim_{k\to\infty} \Phi^k(\lambda p) = \Phi(\lambda p)$ for almost all p(t) and if for any $\epsilon > 0$ there exists an H, independent of k, such that for all k $P\{S_{H,K}\} \geq 1 - \epsilon$, then, for any functional G[x] defined on C[0,1] which is bounded and almost everywhere continuous in the uniform topology on the sample functions of $\{x_t, 0 \leq t \leq 1\}$ as well as on the sample functions of $\{x^k_t, 0 \leq t \leq 1, k = 1, 2, \ldots$, we have $\lim_{k\to 0} E_{x^k}\{G[x^k]\} = E_k\{G[x]\}$.

1898

Minnesota U., Minneapolis.

ON THE REGULARITY OF MARKOV PROCESSES, by F. Knight. Mar. 1, 1961, 32p. (Technical rept. no. 13) (AFOSR-529) (AF 18(603)30) AD 256497
Unclassified

Also published in Illinois Jour. Math., v. 5: 591-613, Dec. 1961.

Starting with a continuous parameter Markov process having an arbitrary state space, a related process is defined which possesses certain regularity properties, chief among them being the strong Markov property. The connection of this process with t original process is considered. They are shown to differ with probability zero at each t except for those in a countable set. (Contractor's abstract)

1899

Minnesota U., Minneapolis.

FRECHET-VOLTERRA VARIATIONAL EQUATIONS, BOUNDARY VALUE PROBLEMS, AND FUNCTIONAL SPACE INTEGRALS, by M. D. Donsker and J. L. Lions. [1961] [82]p. incl. refs. (AFOSR-667) (AF 18(603)30)
Unclassified

Also published in Acta Math., v. 108: 147-228, 1962.

In this paper some connections among (a) boundary value problems arising in partial differential equations, (b) function space integrals (stochastic process operations), and (c) Fréchet-Volterra variational equations - equations where an unknown functional appears under operations involving Vréchet-Volterra derivatives - are studied.

1900

Minnesota U., Minneapolis.

FERRIMAGNETIC RESONANCE OF IRON-OXIDE MICROPOWDERS, by A. H. Morrish and E. P. Valstyn. [1961] [4]p. incl. diagrs. table. (AFOSR-1410) [AF 49-(638)803] Unclassified

Presented at Internat'l. Conf. on Magnetism and Crystallography, Kyoto (Japan), Sept. 25-30, 1961.

Also published in Jour. Phys. Soc. Japan, v. 17, Suppl. B-I: 392-395, Mar. 1962.

Ferrimagnetic resonance phenomena of single-domain γ-Fe_2O_3 powders with different particle shape distributions were studied at two frequencies: 24,116 mc and 9,480 mc. One of the powders had particles with close to spherical shape, which made it possible to estimate

the g-factor, the first-order anisotropy constant, and the spin-spin relaxation time of γ-Fe_2O_3. The values obtained are: $g = 1.97 \pm 0.02$, $K_1 = -3.0 \times 10^5$ ergs/cm^3, $\tau_2 = 1.2 \times 10^{-10}$ sec. The resonance field of the acicular powders was lower than that of the spherical powder. The experimental data are in contradiction with theoretical results based on the Stoner-Wohlfarth model. The origin of this discrepancy is discussed.

1901

Minnesota U., Minneapolis.

FERROMAGNETIC RESONANCES IN THIN FILMS, by D. Chen and A. H. Morrish. Nov. 1961 [2]p. incl. diagrs. (AFOSR-1685) (AF 49(638)803) AD 613780 Unclassified

Presented at Seventh Conf. on Magnetism and Magnetic Materials, Phoenix, Ariz., Nov. 13-16, 1961.

Also published in Jour. Appl. Phys., Suppl., v. v. 33: 1146-1147, Mar. 1962.

The ferromagnetic resonance spectra of thin films of Permalloy and other materials have been investigated. Frequently more than 1 maximum in the resonance line is observed. The evidence from various experiments indicates that films with more than 1 resonance peak are stratified. A simple model in which 2 layers of film are coupled via the dipole-dipole interaction is considered. (Contractor's abstract)

1902

Minnesota U., Minneapolis.

PRODUCTION OF SMALL SPHERES FROM SUSPENSIONS OF MICROPOWDERS, by E. P. Valstyn, A. H. Morrish, and C. W. Searle. [1961] [1]p. incl. illus. diagr. (AFOSR-1766) [AF 49(638)803] Unclassified

Also published in Rev. Scient. Instr., v. 33: 377-378, Mar. 1962.

A study of the ferrimagnetic resonance phenomena of γ-Fe_2O_3 powders with particle sizes in the micron or submicron range has been carried out in this laboratory. For this investigation it was necessary to produce spherical samples of suspensions of these powders in Lucite or paraffin wax. This required the development of grinding techniques other than the familiar air-blast method. In order to suspend the iron-oxide powders in Lucite, Lucite powder and iron-oxide powders were mixed in the desired proportion. Then acetone, which dissolves the Lucite, was added. The mixture was stirred for several hr until enough of the acetone had evaporated to leave a very viscous suspension, which was then left to dry in the air. If the stirring is carried out in only 1 direction, the acicular particles will become about 80% aligned on account of the shear forces on them. Hence, if a randomized suspension is desired, the stirring has to be done so as to cause a large amount of turbulence. A sphere press was designed with which spheres of 1/16 in. in diam could be produced in a bath of boiling water. The sphere press consisted essentially of 2 parts with hemispherical indentations which were made to fit exactly on top of each other. Thus, due to the joint between the 2 halves, the resulting spheres had a narrow equatorial ridge, which, however, disappeared quickly in the sphere grinder. The samples were then left in the grinder until they had the desired size, which was between 0.05 and 0.1 cm. For spheres from wax suspensions, the small pieces of the suspension were put into the mechanical sphere grinder which was now used without abrasive paper. The blows imparted to the wax particles by the walls of the grinder mold them into spheres.

1903

Minnesota U., Minneapolis.

ON A GENERALIZATION OF THE FINITE ARCSINE LAW, by G. Baxter. [1961] 7p. (AFOSR-J486) (AF AFOSR-62-252) AD 407878 Unclassified

Also published in Ann. Math. Stat., v. 33: 909-915, Sept. 1962.

Let S_k be the sum of k mutually independent random variables having a continuous, symmetric distribution. The author proves that the joint probability that the number of positive S_k, $k = 1, 2, \ldots, n$, is m, and that S_n is not less than S_k for $k < n$ is

$$(1/2n)\binom{2n - 2m}{n - m}2^{-2n+2m}, \quad 1 \le m \le n.$$

The main result is a similar distribution free formula for the joint distribution of the number of negative S_k and the number of S_k which exceeds S_n, and its limiting form, $n \to \infty$. (Math. Rev. abstract)

1904

Minnesota U. Dept. of Aeronautical Engineering, Minneapolis.

TRANSIENT AND PERIODIC RESPONSE OF A LOADED SANDWICH PANEL, by C.-C. Chang and B. T. Fang. [1960] [47]p. incl. diagrs. refs. (AFOSR-761) (AF 18(603)112) Unclassified

Presented at Twenty-eighth annual meeting of the Inst. Aeronaut. Sci., Aeroelasticity Session, New York, Jan. 25-27, 1960. (Title varies)

Also published in Jour. Aerospace Sci., v. 28: 382-396, May 1961.

For abstract see item no. 1678, Vol. IV.

1905

Minnesota U. Dept. of Electrical Engineering, Minneapolis.

THE STUDY OF PROCESSES IN GASEOUS PLASMAS WITH THE AID OF A DRIFT-VELOCITY SPECTROMETER, by J. M. Madson and H. J. Oskam. July 1961 [59]p. incl. diagrs. refs. (AFOSR-1395) (AF 49(638)-378) AD 265228 Unclassified

The construction of a drift-velocity spectrometer developed for the measurement of the mobility of positive ions produced in steady state and pulsed gaseous discharges is described. The ions are extracted from the gaseous plasma via a gating system and the time needed to traverse the drift region under the influence of a known electric field is measured. A short survey of the various methods used for the calculation of the ion mobility values is included. Preliminary measurements in helium of the value of the mobility of atomic and molecular helium ions gave the following results: (a) The value for the mobility of He^+ in helium is in excellent agreement with that obtained by other research groups. (b) The value for the mobility of He_2^+ in helium is considerably smaller at low E/P_0 (electric-field-gas pressure ratio) than found by others and seems to be close to the value derived from microwave studies of disintegrating gaseous plasmas. (Contractor's abstract)

1906

Minnesota U. Dept. of Electrical Engineering, Minneapolis.

RESEARCH IN GASEOUS ELECTRONICS, by H. J. Oskam. Interim final rept. Oct. 1961, 6p. (AFOSR-1462) (AF 49(638)378) AD 264897 Unclassified

The purpose of the investigation is a detailed study of various basic processes occurring in gaseous discharge plasmas. The primary emphasis has been directed towards the study of processes determining the properties of decaying plasmas. The report summarizes the main results obtained using the microwave and drift velocity measuring techniques. The research is being continued under a grant supplied by the same agency. The report includes a list of publications resulting from these investigations; included in these are detailed reports describing the techniques and results. (Contractor's abstract)

1907

Minnesota U. Dept. of Electrical Engineering, Minneapolis.

APPLICATION OF THE CATAPHORESIS EFFECT IN THE PREPARATION OF GAS FILLED TUBES, by V. R. Mittelstadt and H. J. Oskam. Nov. 6, 1961 [4]p. incl. diagr. [AF 49(638)378] Unclassified

Published in Rev. Scient. Instr., v. 32: 1408, Dec. 1961.

This note describes briefly a method for preparing gas-filled tubes which contain gas of at least the same purity as that for tubes connected permanently to an ultra-high vacuum system. The glass tubing contains restrictions in 2 places (C_1 and C_2). After the conventional bake-off process and heat treatment of the electrodes the tube is filled with gas at the desired pressure and sealed off at C_1, while a dc discharge is maintained with electrode 1 as cathode and electrode 2 as anode. Impurities evolving from the hot glass at C_1 and diffusing in the direction of the measuring tube are ionized and moved toward electrode 1 instead. The discharge between the 2 electrodes is maintained for about 20 hr at a current of at least 20 ma, so that, for instance, the neon contamination in helium is segregated from the helium in the measuring tube by the cataphoresis effect and driven toward the cathode region around electrode 1. As soon as the discharge has been initiated, again using helium as an example, the cathode region of the discharge shows strong neon spectral lines, which indicate that neon in helium is moved preferentially toward the cathode region. After about 20 hr the tube is sealed at C_2 while maintaining the discharge as long as possible. The method has been found to be very useful when it is necessary to carry out measurements on sealed-off gas-filled tubes.

1908

Minnesota U. Dept. of Electrical Engineering, Minneapolis.

MICROWAVE FREE CARRIER FARADAY EFFECT IN SEMICONDUCTORS. PART I. FIRST ORDER PERTURBATION THEORY FOR GUIDED WAVES, by K. S. Champlin. July 20, 1961, 15p. incl. refs. (AFOSR-1181) (AF 49(638)747) Unclassified

Also published in Physica, v. 28: 1143-1149, Nov. 1962.

The theory of the Faraday effect in degenerate TE-mode waveguides containing semiconductors is formulated for the low magnetic field limit. The effects of losses and of reflections at the sample's surfaces are taken into account in an exact manner. Formulas are derived to determine the 4 terms of the anti-symmetric permittivity tensor from measurements of 4 microwave quantities: attenuation, phase shift, Faraday angle, and Faraday ellipticity. At frequencies much less than the collision frequency these yield the permittivity, conductivity, Hall

angle, and a fourth relationship between the 4 experimental quantities. The last relationship can be used to eliminate 1 of the measurements or to check experimental data to determine the validity of the low field approximation. (Contractor's abstract)

1909

Minnesota U. Dept. of Electrical Engineering, Minneapolis.

EXPLICIT FORMS FOR THE CONDUCTIVITY AND PERMITTIVITY OF BULK SEMICONDUCTORS IN WAVEGUIDES, by K. S. Champlin and G. B. Armstrong. [1961] [1]p. (AFOSR-3401) (AF 49(638)747) AD 612334 Unclassified

Also published in Proc. Inst. Radio Engineers, v. 50: 232, Feb. 1962.

One application in the analysis of waveguides containing bulk semiconductors is the microwave measurement of electron transport phenomena. In this application, it is desired to find the conductivity and/or permittivity (or changes in these quantities caused by carrier injection, dc electric and magnetic fields, etc.) from measurement of the transmission or reflection coefficient of a waveguide containing the semiconductor. This paper considers TE waves propagating in a waveguide that is perturbed by a semiconductor of arbitrary but uniform cross section between Z = 0 and Z = d.

1910

Minnesota U. Dept. of Electrical Engineering, Minneapolis.

WAVEGUIDE PERTURBATION TECHNIQUES IN MICROWAVE SEMICONDUCTOR DIAGNOSTICS, by K. S. Champlin. Dec. 28, 1961 [14]p. incl. illus. diagrs. (AFOSR-3733) (AF 49(638)747) Unclassified

Scattering processes in semiconductors are often studied by observing scattering averages with measurements of various dc transport phenomena. With microwaves, the observation frequency can be of the order of the scattering frequency so that the corresponding microwave transport property may be complex. Thus in studying detailed scattering mechanisms, a microwave transport experiment contains potentially more information than the analogous dc experiment. This paper discusses perturbation techniques which are useful in determining the microwave transport properties of a bulk semiconductor contained in a waveguide from measurement of the properties of the transmitted wave. (Contractor's abstract)

1911

Minnesota U. [Dept. of Mathematics] Minneapolis.

ASYMPTOTIC BEHAVIOR OF SUCCESSIVE COEFFICIENTS OF SOME POWER SERIES, by A. M. Garsia, S. Orey, and E. Rodemich. [1961] [10]p. (AFOSR-J516) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)617] and National Science Foundation) AD 411475 Unclassified

Also published in Illinois Jour. Math., v. 6: 620-629, Dec. 1962.

Let $f_n \geq 0$, $\sum_{n-1}^{\infty} f_n = 1$ and assume that the greatest common division of the indices n for which $f_n > 0$ is 1. Put $u_0 = 1$, $u_{n+1} = \sum_{i=1}^{n+1} f_i u_{n+1-i}$, $r_{n+1} = u_{n+1}/u_n$. Interest is centered in obtaining conditions which insure (1) $\lim_{n\to\infty} r_n = 1$. Among others, it is proved that $\limsup f_{n+1}/f_n \leq 1$ implies (1), but considerably more general, though more complicated conditions are also obtained. Two involved problems are mentioned: (I) Does $\limsup f_{n+1}/f_n < \infty$ imply (1)? (II) Let $u_1, \ldots, u_{N-1}, \lambda$ be real numbers, $u_{N-1} \neq 0$, $\lambda > 0$. Assume that

$$\limsup_{n\to\infty} \frac{f_{n+1} + u_1 f_{n+2} + \cdots + u_{N-1} f_{n+N}}{f_n + u_1 f_{n+1} + \cdots + u_{N-1} f_{n+N-1}} \leq \lambda.$$

Does it then follow that $\limsup_{n\to\infty} u_{n+1}/u_n \leq \max(\lambda, 1)$? (Math. Rev. abstract)

1912

Minnesota U. [Dept. of Mathematics] Minneapolis.

A RENEWAL THEOREM, by W. Feller and S. Orey. [1961] [6]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)617] and Office of Ordnance Research) Unclassified

Published in Jour. Math. and Mech., v. 10: 619-624, July 1961.

Let $\{X_n: n = 1,2,\cdots\}$ be a sequence of independent identically (non-lattice) distributed random variables, with $X_0 = 0$, and let $S_n = \sum_0^n X_k$. For any interval I, let U(I) be the expected number of times S_n visits I. Then either $U(I) = \infty$ for every nondegenerate I (the case of interval-recurrence), or $U(I) < \infty$ for every bounded interval. In the non-recurrent case either (*) $U(I + t) \to \alpha |I|$ and $U(I - t) \to 0$ $(t \to +\infty)$, or (**) $U(I + t) \to 0$ and $U(I - t) \to \alpha |I|$ $(t \to +\infty)$; here $|I|$ denotes the length of I, and α is a non-negative real number. The non-negative real number α is non-zero if and only if $E(|X|) < \infty$ and $E(X) \neq 0$; we will then be in case (*) when $E(X) > 0$, and in case (**) when $E(X) < 0$, and $\alpha = |E(x)|^{-1}$. In the course of the proof (which is a mixture of Fourier analysis and measure theory) the authors obtain an interesting Fourier representation for the symmetrized measure $\frac{1}{2}\{U(dx) + U(-dx)\}$ in terms of the characteristic function $E(e^{itX})$. (Math. Rev. abstract)

1913

Minnesota U. [Dept. of Mathematics] Minneapolis.

STRONG RATIO LIMIT PROPERTY, by S. Orey. [1961] [4]p. (AF 49(638)617) Unclassified

Published in Bull. Amer. Math. Soc., v. 67: 571-574, Nov. 1961.

Let $p_{ij}^{(n)}$ be the n-step transition probabilities of a recurrent, irreducible, aperiodic Markov chain. If for a certain index 0 we have $p_{00}^{(n+1)}/p_{00}^{(n)} \to 1$, then for any i, j, k, h, $p_{ij}^{(n)}/p_{kh}^{(n)}$ tends to a limit as $n \to \infty$. The condition can be relaxed by requiring only that the lim sup not exceed 1, and the sequence {n} be replaced by {mn} for any positive integer m. The continuous analogue and the reversible case are also discussed. (Math. Rev. abstract)

1914

Minnesota U. Dept. of Mathematics, Minneapolis.

CLUSTER SETS OF PSEUDO-MEROMORPHIC FUNCTIONS, by D. A. Storvick. June 1961, 15p. incl. refs. (Technical note no. 1) (AFOSR-935) (AF 49-(638)836) AD 621217 Unclassified

Also published in Nagoya Math. Jour., v. 18: 43-51, Apr. 1961.

The author treats a class of functions which are also called K-quasiconformal, and shows first that if f(z) is a bounded K-quasiconformal function in $|z| < 1$, then the cluster set of f(z) at $e^{i\theta}0$ is contained in the closure of the convex hull of the radial limit values (wherever such exist) on any arc $A = \{e^{i\theta}: \theta_1 < \theta < \theta_2\}$ containing $e^{i\theta_0}$. Denoting the cluster set of f(z) at $e^{i\theta_0}$ by $C(f, e^{i\theta_0})$ and the boundary cluster set of f(z) at $e^{i\theta_0}$ modulo a set E on $|z| = 1$ by $C_{R-E}(f, e^{i\theta_0})$, the author proves that if f(z) is pseudo-meromorphic in $|z| < 1$, and if E is an arbitrary set of capactty zero on $|z| = 1$, then every value of $C(f, e^{i\theta_0}) - C_{R-E}(f, e^{i\theta_0})$ is assumed by f(z) in any neighborhood of $e^{i\theta_0}$ except possibily for a set of capacity zero. A theorem is proved concerning asymptotic values of such functions.

1915

Minnesota U. [Dept. of Mathematics] Minneapolis.

ARITHMETIC PROPERTIES OF BERNOULLI CONVOLUTIONS, by A. M. Garsia. May 1, 1961 [40]p. incl. refs. (Technical note no. 3) (AFOSR-548) (AF 49-(638)857) AD 256761 Unclassified

Distribution functions of the type $F(x,r) = \overset{\infty}{\underset{n=1}{\bigstar}} A(\frac{x}{r_n})$ are discussed, where $\Sigma r_n^2 < \infty$ and the star indicates this convolution operation. The main results obtained are 2 sets of criteria to decide when F(x, r) is singular and when it is absolutely continuous. These criteria are not necessary but they are fruitful in some cases. The results are illustrated by examples. (Contractor's abstract)

1916

Minnesota U. [Dept. of Mathematics] Minneapolis.

A NOTE ON THE MEAN VALUE PROPERTY, by A. [M.] Garsia. May 15, 1961, 9p. (Technical note no. 4) (AFOSR-672) (AF 49(638)857) Unclassified

Also published in Trans. Amer. Math. Soc., v. 102: 181-186, 1962.

An exact bound for the dimension of the space of functions is found satisfying the mean value property with respect to a mass distribution with finite support. The following theorem is proven: If μ concentrates all its mass on a finite set of points $S = P_1 U P_2 U \ldots U P_N$ whose convex hull is not flat and if in addition, setting $\mu_i = \int_{(P_i)} d\mu$ then $\mu_{i_1} + \mu_{i_2} + \ldots \neq 0$ for all $1 \leq i_1 < i_2 < \ldots < i_k \leq N$ then the functions satisfying the mean value property with respect to μ fill only a space of polynomials of degree less than or equal to $\frac{N(N-1)}{2}$.

1917

Minnesota U. [Dept. of Mathematics] Minneapolis.

UNBOUNDED CONVERING OF RIEMANN SURFACE AND EXTENSIONS OF RINGS OF MEROMORPHIC FUNCTIONS, by H. Röhrl. [1961] [27]p. incl. refs. (AFOSR-J1270) [AF 49(638)885] Unclassified

Published in Trans. Amer. Math. Soc., v. 107: 320-346, May 1963.

Using properties of permutation groups, the author extends in the first part some results of Hurwitz about the number of unbounded coverings of a compact Riemann surface which have a prescribed ramification type. Upper and lower bounds for that number are obtained in terms of the degree of the covering, the genus of the base surface, and the local ramification types. The second part deals with extensions of algebraic function fields of one variable whose local splitting is prescribed. It is shown, in particular, that the bounds obtained in the first part of the paper may serve in general as bounds for the number of isomorphy classes of such field extensions. The third part is devoted to a study of the algebraic structure of those extensions of the ring of holomorphic functions

on an open Riemann surface which are defined by an unbounded covering of finite degree. It is shown that they are integrally closed, have no zero divisions, and are free modules of finite rank over the given ring. (Math. Rev. abstract)

1918

Minnesota U. [Dept. of Mathematics] Minneapolis.

A CONVERGENCE EQUIVALENCE RELATED TO POLYNOMIALS ORTHOGONAL ON THE UNIT CIRCLE, by G. Baxter. [1961] [17]p. (AFOSR-231) (AF AFOSR-61-4) Unclassified

Also published in Trans. Amer. Math. Soc., v. 99: 471-487, June 1961.

Here $f(\theta)$ is a complex function, integrable on the interval $[-\pi,\pi]$, with Fourier coefficients c_k. $D_n(f)$ is the Toeplitz determinant $\det(c_{i-j})$, $0 \le i, j \le n$, and if $D_n(f) \neq 0$ for $n \ge 1$, $\alpha_n = (-1)^n D_{n-1}(e^{-i\theta}f)[D_{n-1}(f)]^{-1}$. Finally, if $\log f(\theta)$ has a determination, integrable on $[-\pi,\pi]$, then $G(f) = \exp\{(2\pi)^{-1}\int_{-\pi}^{\pi} \log f(\theta)d\theta\}$. If $\|f\|_\nu = \Sigma_{-\infty}^{\infty} \nu(n)|c_n|$, $\|\alpha\|_\nu = \Sigma_{-\infty}^{\infty}\nu(n)|\alpha_n|$ (here $\nu(n) = \nu(-n)$, $\nu(n) \le \nu(m)\nu(n-m)$ for every n, m, and $\nu(n)n^{-\lambda}\to 0$ as $n \to \infty$ for some $\lambda > 0$) the main result is Theorem 1.1: Let $f(\theta)$ be a real bounded measurable function on $[-\pi,\pi]$ and let $D_n(f) \neq 0$ for $n \ge 0$. Then $\log f(\theta)$ is integrable and $\|\log f\|_\nu < \infty$ if and only if $\|\alpha\|_\nu < \infty$. A related result is Theorem 2.1: Let $f(\theta) > 0$ be continuous on $[-\pi,\pi]$ and let $\Sigma_{-\infty}^{\infty}|k|^{1/2}|c_k| < \infty$. Then $\lim_{n\to\infty} D_n(f)[G(f)]^{-n-1} = \exp\{\Sigma_{m=1}^{\infty} m|d_m|^2\} < \infty$, where $\log f(\theta) \sim \Sigma_{-\infty}^{\infty} d_m e^{im\theta}$

1919

Minnesota U. [Dept. of Mathematics] Minneapolis.

A NORM INEQUALITY FOR A "FINITE-SECTION" WIENER-HOPF EQUATION, by G. Baxter. Aug. 1, 1961, 14p. (Technical note no. 4) (AFOSR-J487) (AF AFOSR-61-4) AD 407877 Unclassified

Also published in Illinois Jour. Math., v. 7: 97-103, Mar. 1963.

Let $f(\theta)$ and $\log f(\theta)$ be integrable functions on $-\pi \le \theta \le \pi$ with Fourier coefficients c_k and d_k, respectively. The equation (1)

$$\frac{1}{2\pi}\int_{-\pi}^{\pi} h(\theta)f(\theta)e^{-ik\theta}d\theta = g_k, \quad (0 \le k \le n),$$

where $h(\theta)$ is a polynomial of at most degree n in $e^{i\theta}$ and where $f(\theta)$ is such that (2) $\Sigma|d_n| < \infty$ is investigated. If we let $g(\theta) = \Sigma_{k=0}^{n} g_k e^{ik\theta}$ and let "g" and h denote the sum of the absolute values of the coefficients in $g(\theta)$ and $h(\theta)$, then the main theorem includes the following as a special case: Theorem: Let $f(\theta)$ satisfy (2). Then, there exists an integer N and a constant M, depending only on $f(\theta)$, such that for every pair $g(\theta)$ and $h(\theta)$ of degree $n \ge N$ satisfying (1), "h" $\le$ M "g". Applications of this theorem to Toeplitz determinants and Szegö polynomials are discussed. (Contractor's abstract)

1920

Minnesota U. Heat Transfer Lab., Minneapolis.

MEASUREMENT OF HEAT TRANSFER FROM A CIRCULAR CYLINDER TO AN AXIAL STREAM WITH AIR INJECTION INTO A TURBULENT BOUNDARY LAYER, by O. E. Tewfik, E. R. G. Eckert, and L. S. Jurewicz. Aug. 1961, 57p. incl. diagrs. table, refs. (Technical rept. no. 38) (AFOSR-1397) (AF 49(638)558) AD 266568 Unclassified

A 2-in. (outside diam) circular cylinder with porous walls fabricated out of a stainless steel woven wire mesh was aligned with its axis parallel to a low speed air stream. Secondary air was injected through the cylinder walls into the boundary layer at a uniform mass rate per unit area of outside cylinder surface in the range 0.00028 to .00290 of the free stream mass velocity. The boundary layer was turbulent. The heat transfer distribution along the cylinder was measured and is presented as a functional relationship between local Stanton number and Reynolds number with the injection rate as a parameter. Up to about one half reduction in heat transfer compared with zero injection resulted. A macroscopic energy balance at one injection rate was made on 3 portions of the model by appropriate boundary layer velocity and temperature surveys. Its results provided a satisfactory check on the heat transfer measurements. (Contractor's abstract)

1921

Minnesota U. Heat Transfer Lab., Minneapolis.

SENSITIVITY OF SKIN FRICTION AND DRAG TO THE DISTRIBUTION OF SUCTION OR BLOWING, by E. M. Sparrow and E. R. G. Eckert. [1961] [2]p. incl. diagr. tables. (AFOSR-2343) (AF 49(638)558) Unclassified

Also published in Jour. Aerospace Sci., v. 29: 104-105, Jan. 1962.

Similarity solutions to boundary-layer problems can be obtained by dealing with ordinary differential equations; however, a certain amount of freedom in the choice of boundary conditions may be lost. The purpose of this report is to explore procedures by which the shear-stress and drag results as furnished by the similarity solutions may be extended to apply to other blowing and suction distributions.

1922

Minnesota U. Inst. of Tech., Minneapolis.

ON THE DEFINITION AND PROPERTIES OF CERTAIN VARIATIONAL INTEGRALS, by J. Serrin. [1961] [29]p. incl. refs. (AFOSR-375) (AF 49(638)262)
Unclassified

Also published in Trans. Amer. Math. Soc., v. 101: 139-167, Oct. 1961.

The author is concerned with nonparametric integrals of the form $I[u, R] = (R) \int f(x,u,u_x)\, dx$ where R is an open set of the Euclidean space E_n, $x = (x_1, \cdots, x_n)$, $u = u(x)$, $x \in R$, is a real-valued function, and u_x is the vector of the first partial derivative of u. It is essentially known that, when f(x, u, p) is convex in p, then I[u] can be thought of as an area. The author carries on in the present paper the program of discussing I[u] as an area with the aim of extending Tonelli's theorems on area and lower-semicontinuity, together with their generalizations and modelling the process of surface area theory. The following extension of Tonelli's theorems are given: If R is a bounded open set in E_n, if f(x, u, p) is continuous in (x, u, p), is convex in p for every (x, u), and satisfies $a|p| \leq 1 + f(x, u, p) \leq A|p|$ for every $|p| \geq 1$ and some constants $a, A > 0$, then I[u] is finite if and only if u(x) is weakly differentiable. If this is the case, u is also continuous if f depends on u, then $\mathfrak{J}[u] \geq I[u]$, and the usual Lesbesque derivative $\mathfrak{J}'(x)$ of $\mathfrak{J}[u, R]$ exists everywhere in R, and $\mathfrak{J}'(x) = f(x, u, u_x)$ a.e. in R. Finally $\mathfrak{J}[u] = I[u]$ if and only if u(x) is strongly differentiable in R, or equivalently, if and only if I[u, Q] is an absolutely continuous function of open sets Q in R. Theorems for lower semicontinuity of the functional $\mathfrak{J}[u]$ are then proved.

1923

Minnesota U. [Inst. of Tech.] Minneapolis.

STRONG CONVERGENCE IN A PRODUCT SPACE, by J. Serrin. [1961] [5]p. (AFOSR-591) (AF 49(638)262) AD 259314
Unclassified

Also published in Proc. Amer. Math. Soc., v. 13: 651-655, Aug. 1962.

The purpose of this note is to present a certain necessary and sufficient condition for strong convergence in L_p over a product space. This result is formulated as Theorem 1 below. Theorem 1: Let $\{u_k\}$ be a sequence of functions of class $L_p(S)$, having joint compact support in S. Suppose that for almost all fixed y the functions $u_k(x, y)$ converge weakly in $L_p(E^n)$, and that (1) $\|u_k\|_x \leq v(y)$, $k = 1, 2, \cdots$, where v(y) is of class $L_p(E^m)$. Then the sequence $\{u_k\}$ converges strongly in $L_p(S)$ if and only if (2) $\lim_{|t|\to 0} \|u_k(x + t, y) - u_k(x, y)\| = 0$ uniformly in k. Theorem 1 includes as a special case a well-known compactness condition of M. Riesz, which is stated in slightly different form as Theorem 2. In the final part of the paper it is shown that Theorem 1 can be used to give very simple proofs of the so-called Rellich lemma of functional analysis.

1924

Minnesota U. Inst. of Tech., Minneapolis.

ON THE INTERIOR REGULARITY OF WEAK SOLUTIONS OF THE NAVIER-STOKES EQUATIONS, by J. Serrin. Aug. 1, 1961, 19p. (AFOSR-1239) (In cooperation with Stanford U., Calif.) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)262 and Office of Naval Research under Nonr-22511) AD 262798
Unclassified

Also published in Arch. Rational Mech. and Anal., v. 9: 187-195, 1962.

A vector u is called a weak solution of a Navier-Stokes equation of n (an arbitrary number) spatial dimensions in R if it is weakly divergence free and if $\int \{(u, \Phi_t) + (u, \Delta\Phi) + (u, u \text{ grad } \Phi)\}\, dt = -\int (f, \Phi) dt$ for all $\Phi \in D$ (where D denotes the test space of C^∞ vector fields which are divergence-free and have compact support in an open region of space-time. The purpose here is to prove a differentiability theorem for such weak solutions. The order of time differentiability of a weak solution is intimately tied to the amount of time regularity which is originally assumed. It is reasonable to expect, though, that modest assumptions concerning the spacial regularity of a weak solution should be enough to guarantee infinite differentiability with respect to the space variables. This is proved in the resulting main theorem. If u is a weak solution and $u \in L^{2,\infty}(R)$, $\omega \in L^{2,2}(R)$, and $u \in L^{s,s'}(R)$ where the exponents s and s' satisfy the relation $n/s + 2/s' < 1$, then u is of class C^∞ in the space variables and each derivative is bounded in compact subregions of R. The proof of the main theorem is based on 2 equations $\omega = \text{grad } K*g + B$ and $|g| \leq \text{Const.} |u| \cdot |\omega|$.

1925

Minnesota U. [Inst. of Tech.] Minneapolis.

ON THE ENTROPY CHANGE THROUGH A SHOCK LAYER, by J. Serrin and Y. C. Whang. [1961] [2]p. incl. diagrs. (AFOSR-3843) [AF 49(638)262] Unclassified

Also published in Jour. Aerospace Sci., v. 28: 990-991, Dec. 1961.

When a viscous, heat-conducting gas traverses a shock wave its temperature, density, pressure, and entropy are all increased. It might be supposed, therefore, that during the process of shock transition all of these

quantities increase monotonically from their initial to their final values. It is shown that this is true for the temperature, density, and pressure. It is not true for the entropy. This quantity first increases to a local maximum in the interior of the shock, and then undergoes a decrease to its final value. These conclusions follow from general thermodynamic assumptions, and therefore, apply to all gases of practical interest.

1926

Minnesota U. Rosemount Aeronautical Labs., Minneapolis.

EVAPORATIVE FILM COOLING AT HYPERSONIC VELOCITIES FOR RE-ENTRY VEHICLES, by R. Hermann and W. L. Melnik. Apr. 1961 [32]p. incl. illus. diagrs. refs. (Research rept. no. 178) (AFOSR-669) (AF 49(638)190) AD 286173 Unclassified

Also published in Proc. Sixth Symposium on Ballistic Missile and Aerospace Technology; Re-entry, Los Angeles, Calif. (Aug. 1961), New York, Academic Press, v. 4: 113-144, 1961.

A theoretical analysis of similarity parameters of evaporative film cooling was developed for blunt bodies indicating the effect of mass transfer on heat transfer and skin friction for Prandtl and Lewis numbers unity. Calculated interface temperatures are in good agreement with wall temperatures measured around a hemisphere in a hypersonic wind tunnel. Application of the analysis shows that evaporative film cooling is feasible for typical re-entry vehicles. At circular velocities the effective heat of evaporation of water is as high as 11,000 Btu/lb_m. The significant advantage of evaporative film cooling is that the walls of a vehicle during re-entry are maintained at relatively low temperatures.

1927

Minnesota U. School of Chemistry, Minneapolis.

POLAROGRAPHY AND VOLTAMMETRY IN DIETHYLSULFOXIDE, by I. M. Kolthoff and T. B. Reddy. June 1, 1961 [6]p. incl. diagrs. tables, refs. (AFOSR-696) (AF 49(638)519) AD 257862 Unclassified

Also published in Jour. Electrochem. Soc., v. 108: 980-985, Oct. 1961.

An exploratory voltammetric study of several acids, some representative metal ions, a few quinones, and oxygen has been made in the solvent dimethylsulfoxide (DMSO). Perchloric, sulfuric, and hydrochloric acids were found to be monoprotic strong acids in DMSO. Cobalt (II) and nickel (II) are reduced irreversibly at the dropping mercury electrode with large overpotentials indicating strong solvation. Polarograms of quinones showed 2 cathodic waves of unequal height in the absence of proton donor. The effect of proton donor on the polarograms of quinones was studied. The mechanism of the reduction of quinones in DMSO is discussed. Rotated platinum and rotated mercury pool electrodes can be used to advantage in DMSO.

1928

Minnesota U. School of Chemistry, Minneapolis.

ACID-BASE EQUILIBRIA IN ACETONITRILE. SPECTROPHOTOMETRIC AND CONDUCTOMETRIC DETERMINATION OF THE DISSOCIATION OF VARIOUS ACIDS, by I. M. Kolthoff, S. Bruckenstein, and M. K. Chantooni, Jr. [1961] [9]p. incl. diagrs. tables, refs. (AFOSR-699) (AF 49(638)519) AD 258695 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 3927-3935, Oct. 5, 1961.

The indicators o-nitroaniline, o-nitro-p-chloroaniline and o-nitrodiphenylamine are about 5×10^4 as strong in acetonitrile as in water. Perchloric acid behaves as a strong acid, other acids denoted by HA are weak. Except in extremely dilute solutions hydrobromic, sulfuric, nitric and hydrochloric acids dissociate according to $2HA \rightleftharpoons H^+ + AHA^-$. The over-all dissociation constants of these acids have been determined spectrophotometrically with the aid of indicator bases and conductometrically for sulfuric and picric acids. By other suitable methods the stability constants $K_{AHA^-} = [AHA^-]/[HA][A^-]$ have been evaluated. The value of K_{AHA^-} decreases from 1.3×10^3 for sulfuric acid to 2.5×10^2 for hydrobromic, and 2×10^2 for nitric and hydrochloric acids at 25°. From the above data the simple dissociation constants $K_{HA} = [H^+][A^-]/[HA]$ could be evaluated. These values for pK_{HA} are reported: hydrobromic, 5.5; sulfuric, 7.25; nitric and hydrochloric acids, 8.9. Picric acid at concentrations smaller than 0.1 M dissociates into H^+ and Pi^-, and $pK_{HPI} = 8.9$. At higher concentrations the data fit a dissociation $3HPi \rightleftharpoons H^+ + Pi(HPi)_2^-$, $pK_{3(HPI)}$ being 6.1. The ion pair dissociation constants of tetraethylammonium bisulfate and of lithium nitrate were found to be 1.4×10^{-3} and 4.1×10^{-4}, respectively. (Contractor's abstract)

1929

Minnesota U. School of Chemistry, Minneapolis.

POLAROGRAPHIC AND ACID PROPERTIES OF THORIUM PERCHLORATE IN ACETONITRILE, by I. M. Kolthoff and S. Ikeda. [1960] [7]p. incl. diagrs. tables, refs. (AFOSR-1861) (AF 49(638)519) Unclassified

Also published in Jour. Phys. Chem., v. 65: 1020-1026, June 1961.

For abstract see item no. 1713, Vol. IV.

1930

Minnesota U. School of Chemistry, Minneapolis.

ACID-BASE STRENGTH IN DIMETHYL SULFOXIDE, by I. M. Kolthoff and T. B. Reddy. [1961] [6]p. incl. diagr. tables, refs. (AFOSR-1877) (AF 49(638)519) Unclassified

Also published in Inorg. Chem., v. 1: 189-194, May 1962.

Dimethyl sulfoxide (DMSO) has an autoprotolysis constant of the order of 5×10^{-18}. Its basic strength is comparable to that of water; hydrochloric and sulfuric acids are completely dissociated in this solvent, whereas the acid di-n-butylammonium ion has a dissociation constant about 10 times as large as that in water. Water is an extremely weak base in DMSO. The degree of dissociation of several uncharged acids is quite abnormal. The dissociation constant of picric acid is of the order of 500 times greater than that in water, while that of 2,6-dinitro-4-chlorophenol is of the same order of magnitude in both solvents. Extremely large stabilization of the nitrophenolate ions in DMSO is indicated. On the other hand, acetic acid has a constant which is about 10^{-7} as large in DMSO as in water, while that of benzoic acid is 10^{-6} as large. Brom cresol green and brom thymol blue have constants about 1/250 as large in DMSO as in water, a value close to that predicted for a univalent negatively charged acid on the basis of the difference in dielectric constant between the 2 solvents. The univalent bisulfate ion has a constant 10^{-7} as large in DMSO as in water. (Contractor's abstract)

1931

Minnesota U. School of Chemistry, Minneapolis.

ELECTRON SPIN RESONANCE STUDIES OF IMPURITY IONS IN MAGNESIUM OXIDE, by J. W. Orton, P. Auzins and others. [1961] [15]p. incl. diagrs. table, refs. [AF 49(638)615] Unclassified

Published in Proc. Phys. Soc. (London), v. 78: 554-568, 1961.

The univalent ions Fe^{1+}, Co^{1+} and Ni^{1+} have been produced by ultra-violet or x-irradiation of impure MgO crystals. The electron spin resonance spectra of these ions are compared with those of the isoelectronic ions Co^{2+}, Ni^{2+} and Cu^{2+} which they resemble closely. The spectra of Fe^{1+}, Co^{1+} and Ni^{2+} show line-width effects which may be interpreted as being due to the presence of small distortions in the cubic crystal lattice. A detailed report of the $3d^9$ configuration in a cubic field is given. There is a transition at low temperature from an isotropic to an anisotropic spectrum, presumably due to the 'freezing in' of Jahn-Teller distortions. Observation of hyperfine structure from Ni^{61} has made it possible to estimate the nuclear moment by comparison with the observed hyperfine structure from Co^{1+}. The ease of formation and stability of these univalent ions is shown to be related to the concentration of positive ion vacancies and to the concentration of trapped hole centers.

1932

Minnesota U. [School of Chemistry] Minneapolis.

ELECTRON SPIN RESONANCE STUDIES OF RADIATION EFFECTS IN INORGANIC SOLIDS, by J. E. Wertz, J. W. Orton, and P. Auzins. [1961] [11]p. incl. diagrs. tables, refs. (AFOSR-194) [AF 49(638)683] Unclassified

Also published in Faraday Soc. Discussions, No. 31: 140-150, 1961.

It is suggested that negative-ion vacancies in 3 different environments are trapping sites for electrons, and positive-ion vacancies of 2-types are trapping sites for holes. These 2 hole centers are in addition to those types found in crystals which have not been neutron-irradiated. Some of these centers may be induced by grinding and x-irradiation of MgO or other alkaline earth oxides, sulfides or selenides which have the MgO structure. Mechanical working is believed to distribute negative-ion vacancies by dissociation from dislocations which are swept through the crystals. In the neutron-irradiated crystals there is evidence that some local regions are so disrupted that they rearrange to body-centered instead of face-centered packing. Extended heating largely anneals out the neutron-produced structural defects. It is then possible to see esr spectra of defects which are highly sensitive to distortions of cubic symmetry. (Contractor's abstract, modified)

1933

Minnesota U. [School of Chemistry] Minneapolis.

SPIN RESONANCE OF POINT DEFECTS IN MAGNESIUM OXIDE, by J. E. Wertz, J. W. Orton, and P. Auzins. [1961] [7]p. incl. refs. (AFOSR-3586) [AF 49-(638)683] AD 612336 Unclassified

Presented at Internat'l. Conf. on Chemical Physics of Nonmetallic Crystals, Evanston, Ill., Aug. 28-31, 1961. (AFOSR-2143)

Also published in Jour. Appl. Phys., Suppl., v. 33: 322-328, Jan. 1962.

Transition metal impurity ions and intrinsic defects such as trapped electron and trapped hole centers are readily detected in MgO crystals by electron spin resonance. The valence state of impurity ions may readily be changed by heat treatment or by irradiation. Both 2+ and 1+ states may be observed for Ni and Co. Additional 3+ state is observed for Fe. The extra positive charge

of trivalent ions is usually compensated by positive ion vacancies. Vacancies, either single or in clusters alter the electric field symmetry about an impurity ion or intrinsic defect. Hence they may indicate their presence by altering the symmetry from cubic to tetragonal, rhombic or lower type. The impurities are generally substitutional, but one interstitial type has been found. Isolated positive ion vacancies can trap either one or two holes, in each case producing centers of axial electric field symmetry. Other hole centers are observed after extensive atomic displacements have been produced by neutron irradiation. Negative ion vacancies are difficult to produce except by such irradiation. Electrons trapped at negative ion vacancies are largely localized upon the vacancy, as is evident from the small hyperfine splitting of adjacent Mg ions. If crystals are heated in order to lead to association of vacancies, a second type of F center is formed. With protracted neutron irradiation, yet a third type of F center is produced. Optical studies are being undertaken to learn more about these paramagnetic centers. (Contractor's abstract)

1934

Minnesota U. School of Chemistry, Minneapolis.

THE EFFECT OF SOLVENT ON RATES OF ACID-INDUCED DEOXYMERCURATION, by M. M. Kreevoy, J. W. Gilje, and R. A. Kretchmer. [1961] [3]p. incl. diagrs. tables, refs. (AFOSR-864) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)711 and National Science Foundation) AD 438884 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 4205-4207, Oct. 20, 1961.

Rates of deoxymercuration by non-halogen acid have been obtained for 4 methoxy mercurials in ethanol-water mixtures and dioxane-water mixtures. All of the rates exhibit a minimum in intermediate solvent compositions, but otherwise the rates are quite different functions of solvent composition. Previously suggested measures of solvent acidity fail to correlate the rate constants quantitatively. (Contractor's abstract)

1935

Minnesota U. School of Chemistry, Minneapolis.

THERMODYNAMIC PROPERTIES OF ACTIVATION FOR CIS AND TRANS-DEOXYMERCURATION, by M. M. Kreevoy, J. W. Gilje and others. [1961] [4]p. incl. diagr. table, refs. (AFOSR-1694) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)711 and National Science Foundation) AD 438548 Unclassified

Also published in Jour. Org. Chem., v. 27: 726-729, Mar. 1962.

Entropies (ΔS^*) and enthalpies (ΔH^*) of activation have been measured for 4 additional deoxymercuration reactions induced by nonhalogen acids. These have been compared with values previously obtained for cyclohexane derivatives and with each other. Variations in ΔH^* and ΔS^* are semiquantitatively predicted by theory if the curve of potential energy vs θ has deep minima at both 0° and 180° and maxima at 90° and 270°. The angle between the carbon-carbon-oxygen plane and the carbon-carbon-mercury plane is θ. This is a reasonable result in view of the likely mechanism for deoxymercuration. (Contractor's abstract)

1936

Minnesota U. [School] of Chemistry, Minneapolis.

THE ONE-DIMENSIONAL PLASMA, by S. Prager. [Mar. 1961] [35]p. incl. diagrs. [Technical rept. no. 2] (AFOSR-431) (AF 49(638)720) AD 254140 Unclassified

The interaction of 2 charges in 1 dimension corresponds to the 3 dimensional interaction of 2 uniformly charged parallel plates. The partition function for an electrically neutral system of such charges can be obtained rigorously, without recourse to any approximations. The resulting thermodynamic functions agree with those predicted by the 1-dimensional Debye-Hückel theory in the limit of high pressures, but considerable deviations appear as the pressure is reduced. At very low pressures the system behaves as though made up of neutral molecules. The effect of an external electrostatic field is discussed, and the treatment is also extended to plasma mixtures. (Contractor's abstract)

1937

Minnesota U. [School of Chemistry] Minneapolis.

EQUILIBRIUM STATISTICAL MECHANICS OF THE ONE-DIMENSIONAL PLASMA (Abstract), by S. Prager. [1961] [1]p. [AF 49(638)720] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 246, Apr. 24, 1961.

The interaction of 2 charges in 1-dimension corresponds to the 3 dimensional interaction of 2 uniformly charged parallel plates, that is, the potential is ∧- or ∨-shaped depending on whether the charges are of like or unlike sign. The partition function for an electrically neutral system of such charges can be obtained rigorously, without recourse to any approximations. The resulting thermodynamic functions agree with those predicted by the 1-dimensional Debye-Hückel theory in the limit of high pressures, but considerable deviations appear as the pressure is reduced. At very low pressures the system behaves as though made up of neutral molecules.

1938

Minnesota U. [School of Chemistry] Minneapolis.

ELECTROSTATIC VARIATIONAL PRINCIPLES IN THE CALCULATION OF MOLECULAR ENERGY LEVELS (Abstract), by D. M. Schrader and S. Prager. [1961] [1]p. [AF 49(638)720] Unclassified

Presented at meeting of the Amer. Phys. Soc., Chicago, Ill., Nov. 24-25, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 432, Nov. 24, 1961.

Thomson's and Dirichlet's variational principles afforded upper and lower bounds, respectively, for the various electronic interaction integrals appearing in molecular energy calculations. A proper use of the 2 principles leads to a modified minimum energy principle in which not only the wave function, but also certain trial electric fields and potentials are varied to obtain a minimum in the total energy. The main advantage of this procedure is that the sixfold electronic interaction integrals that normally appear in molecular energy calculations are replaced by integrals over at most 3 coordinates, thus greatly simplifying the calculation. The total energy of the ground state of the hydrogen molecule was calculated for the wave function $\exp[a(\xi_1 + \xi_2)]g(\eta_1)g(\eta_2)$, where ξ and η are elliptical coordinates, and $g(\eta)$ is completely open. The resulting binding energy was 3.568 ev, which compares favorably with the best SCF energy of 3.636 ev.

1939

Minnesota U. School of Chemistry, Minneapolis.

ABSORPTION OF ELECTROMAGNETIC RADIATION BY A PERFECTLY RIGID CRYSTAL, by C. A. Mead. Apr. 18, 1961, 24p. (Technical rept. no. 1) (AFOSR-495) (AF 49(638)940) AD 254717 Unclassified

The Fano-Hopfield theory of the dielectric constant predicts that a perfectly rigid crystal (i in which no nuclear vibrations are allowed) should exhibit dispersion without absorption. It is pointed out that this result is in conflict with the Kronig-Kramers relations, and hence cannot possibly be correct. If it is assumed that the Fano-Hopfield theory gives the real part of the dielectric constant correctly, the imaginary part can be calculated by means of the Kronig-Kramers relations. This is done for the long-wave, tight binding case, resulting in an absorption curve with finite width. An unobservable delta-function absorption is obtained only if the energy of an exciton is independent of its wave number, a condition which is never satisfied. Since the Fano-Hopfield procedure really depends on the assumption that no absorption takes place, it follows that the theory is inconsistent. It is suggested that the inconsistency probably arises from a too-literal interpretation of the periodic boundary conditions imposed on the radiation field. (Contractor's abstract)

1940

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-1051) (AF 49(638)754) AD 264884 Unclassified

Also published in Ann. Math. Stat., v. 33: 525-532, June 1962.

A study is presented of the statistic used to provide a test of the hypothesis that a population has a prescribed distribution function. Kuiper static (Koninkl. Nederl. Akad. Wetenschap. Proc., Indag. Math., v. 63: 38-47, 1960), modified Kolmogorov statistic (Ann. Math. Stat., v. 30: 568-576, 1959), and one studied by Sherman (Ann. Math. Stat., v. 21: 339-361, 1950) are considered as distances between hypothetical distribution function and empiric distribution function. The Kuiper statistic occupies a position intermediate between the modified Kolmogorov statistic and Sherman's. It appears to yield a test more powerful than Kolmogorov against certain alternatives (different scale parameter, for a symmetric distribution) and less powerful against others (different location parameter). The appendix treats the problem of finding the probability that all the points of the strip will lie between parallel lines of which the lower passes through or below (0,0) and through or above (1,1).

1941

Missouri U. [Dept. of Mathematics] Columbia.

ORBIT FAMILIES OF CONTINUOUS FLOWS, by N. E. Foland. [1961] [28]p. (AFOSR-2795) (AF 49(638)754) AD 428410 Unclassified

The first section of this paper shows the proof of several theorems: (1) If O(x) is the orbit of a point $x \in X$ under ρ, then O(x) is homeomorphic to R, if and only if x is neithrr positively nor negativeiy recurrent. (2) If O(x) is homeomorphic to R, then the flow mapping at any point $y \in O(x)$ is itself a homeomorphism. (3) O(x) is a simple closed curve if and only if x is a non-fixed periodic point. If x is a non-fixed periodic point with primitive period w, then the flow mapping at any point $y \in O(x)$ is a homeomorphism of the set $O < r < w$ onto O(x) when the points O and w are identified. (4) Let X be compact and suppose that, for arbitrarily small r, X contains a point which is fixed under the homeomorphism $\varphi(x,r)$. Then X contains a point which is fixed under the continuous flow φ. In the next section it is shown that under the hypothesis that X is an open or a closed 2-cell, that the only positively or negatively recurrent points of X are the periodic ones. This leads to the conclusion that a 1-1 and continuous image of R can be replaced with a homeomorphic image of R. In proving this it is shown that the orbit curves satisfy conditions of being regular and orientable in a neighborhood of each non-fixed point of X. In the

last section the structure of the orbit family of continuous flows on a 2-cell is discussed with special attention being given to the α and ω limit sets of an orbit.

1942

Missouri U. [Dept. of Mathematics] Columbia.

THE STRUCTURE OF THE ORBITS AND THEIR LIMIT SETS IN CONTINUOUS FLOWS, by N. E. Foland. [1961] [8]p. incl. refs. (AFOSR-64-0676) (AF 49(638)-754) AD 436285 Unclassified

Also published in Pacific Jour. Math., v. 13: 563-570, Summer 1963.

The problem of describing those points of an arbitrary metric space with orbits homeomorphic to R is solved. The structure of the orbit family of continuous flows on a 2-cell is discussed, with special attention being given to the α and ω limit sets of an orbit.

1943

Mount Zion Hospital, San Francisco, Calif.

STEREOTAXIC SURGERY FOR PARKINSONISM. A METHOD OF EVALUATION AND CLINICAL RESULTS, by G. Levin, B. Feinstein and others. [1960] [7]p. incl. illus. diagrs. tables. (AFOSR-1025) (Sponsored jointly by Air Force Office of Scientific Research under AF 18-(603)48, Harry Freund Memorial Foundation, Max C. Fleishmann Foundation of Nevada, Office of Vocational Training, and Oppen Memorial Fund) Unclassified

Also published in Jour. Neurosurg., v. 18: 210-216, Mar. 1961.

This report strives to overcome the difficulty of converting to useful data phenomena that are to any extent determined subjectively. The disease being treated is parkinsonism and the treatment is by stereotaxic surgery. The evaluation of the results is done by essaying a careful quantitative evaluation of certain characteristics of an abnormal state of muscles, and then by statistical means striving to test the validity of the artificial quanta and to examine the results of the study and treatment of some patients with parkinsonism. The first operation is more effective than subsequent procedures. First operations upon the right side of the brain are slightly more apt to improve the patient than those upon the left. The study has offered some encouragement in efforts to relate the effects of electrical stimulation of a large target to the rated effects of a destructive lesion in the same target.



1944

Naples U. Inst. of Aeronautics (Italy).

[NON-EQUILIBRIUM FLOW], by L. G. Napolitano. Annual summary rept. no. 1, Mar. 1961, 21p. (I. A. rept. no. 24) (AFOSR-659) (AF 61(052)327) AD 265160 Unclassified

A new thermodynamic approach to the study of non-equilibrium flow is presented. In section 1 the essential concepts of thermodynamics are briefly restated in their modern formulation which is particularly useful in the present contest. In section 2, a new series of thermodynamic potentials is introduced and their properties derived and discussed. In section 3 these potentials are applied to the analysis of non-equilibrium flow of binary gas mixtures. It is shown that their usefulness relies upon the possibilities of: (a) obtaining rather straight-forwardly, exact solutions of particular classes of non-equilibrium flows to which all known techniques are results of classical equilibrium fluid-dynamic which can be easily extended; and (b) devising a number of promising approximate methods of solutions for general non-equilibrium flow fields. (Contractor's abstract, modified)

1945

Naples U. Inst. of Aeronautics (Italy).

ON SOME MATHEMATICAL ASPECTS OF LINEARIZED NON-EQUILIBRIUM FLOW, by L. G. Napolitano. Nov. 1961 [61]p. incl. diagrs. refs. (Technical note no. 1; I. A. rept. no. 39) (AFOSR-2530) (AF 61(052)-327) AD 280129 Unclassified

A general discussion is presented of the thermodynamics and fluid-dynamics of a reacting ideal mixture: the basic equations are derived and subsequently specialized to the linearized case. An analysis of the characteristics of the complete system and of the potential equation (i.e. the third order partial differential equation for the velocity potential) is shown: the various families of characteristics is individuated, the corresponding regularity condition are derived and discussed, the propagation of the discontinuities (up to those of second order in the normal derivatives) along the characteristic lines is obtained and analyzed. A similar analysis of discontinuity surfaces which are physically allowed within the framework of a linearized theory is presented. Existence of discontinuity surfaces for the basic unknown functions is proved, the law of propagation of the jumps derived, their properties discussed and the differences between the subject case and that of inert gases pointed out. A review of the available information on the existence, uniqueness and continuous dependence on the boundary and/or initial data for problems such as Cauchy's, Goursat's and mixed boundary problems is also presented. A generalization of properly set Goursat's and mixed boundary problems for the subject case of multiple characteristics is then shown. The last section deals with the questions connected with a properly set Goursat's problem for the potential equation. These questions arise because the mathematical solutions of the potential equation yield a potential function which is always continuous with its first derivatives while physically pertinent boundary conditions may require discontinuities in the first 2 derivatives of the potential function. A discussion of the situation in which this occurs is given, together with the techniques necessary to cope with them. (Contractor's abstract, modified)

1946

Naples U. [Inst. of Theoretical Physics] (Italy).

FUNCTIONAL INTERPRETATION OF CEREBELLAR HISTOLOGY, by V. Braitenberg. [1961] [2]p. incl. diagr. (AFOSR-1296) [AF 61(052)96] AD 262252 Unclassified

Also published in Nature, v. 190: 539-540, May 6, 1961.

The nature of the transformation of patterns of excitation within the cerebellar cortex may be explained by the following argument. The cerebellar cortex is a sheet of grey substance with anisotropic structure. Entirely different histological pictures are obtained in sections cut in frontal and sagittal planes. All output fibers arise from 1 type of neurons (Purkinje cells) the dendritic fields of which are characteristically flattened in the laterolateral direction. One set of input fibers (climbing fibers) is connected 1-to-1 with the set of Purkinje cells. Another set of input fibers (mossy fibers) reaches the output (Purkinje) cells via long, very thin, unmyelinated fibers, the so-called parallel fibers, each making the same kind of histological contacts with a long row of Purkinje cells. This histology allows one to predict widely varying delays interposed between the input in 1 fiber system (mossy fibers) and the arrival of activity at different laterolateral distances from the input, while, on the contrary, the other input system (climbing fibers) should influence Purkinje cells after a fixed, short time delay. Direct physiological support for this hypothesis has been provided. By letting $Px(t)$, $Mx(t)$ and $Cx(t)$ be 3 sets of functions of time with common indices x and interpreting them as representatives of activity in Purkinje cells, mossy fibers, and climbing fibers, the hypothesis becomes $Px_0(t) = f[Mx(t - \frac{|x_0 - x|}{v}), Cx_0(t)]$, where v represents the velocity of conduction in parallel fibers which is assumed to be constant. This approach can be used for transforming distances into time intervals; in other words, as a clock. Three possible modes of operation are suggested and explained: (1) an alarm clock, (2) a stop clock, and (3) operation as coincidence and time shift detector.

1947

Naples U. Inst. of Theoretical Physics (Italy).

A SOLVABLE MODEL OF FIELD THEORY, by E. R. Caianiello and A. Campolattaro. [1961] 8p. (Technical note no. 1) (AFOSR-639) (AF 61(052)434) AD 258322 Unclassified

Also published in Nuovo Cimento, Series X, v. 20: 422-426, Apr. 16, 1961.

A Dirac spinor field coupled scalarly with a neutral boson field is considered which satisfies conditions partially presented in a previous paper (Nuovo Cimento, Series X, v. 11: 492, 1954). The present model if obtained by replacing throughout the free boson propagator with a positive constant, which without loss of generality may be assumed to be equal to one. The model describes a non-local phonon interaction among spinor particles, such that each point of a given spinor line interacts equally with all past, present and future points of the same and all other lines; the vacuum fluctuations of the spinor field are taken into account correctly. From the standard theory of parabolic equations, the only permissible formal solution which reduces to the free propagator is presented. Even though the solution of parabolic equations is a classical chapter of analysis, the author continues at this point with a discussion of 2 points by the customary heuristic methods and then with greater mathematical care.

1948

Naples U. Inst. of Theoretical Physics (Italy).

UNITARITY CONDITIONS IN TERMS OF PROPAGATION KERNELS, by E. R. Caianiello and H. Umezawa. Mar. 30, 1961, 13p. (Technical note no. 2) (AFOSR-857) (AF 61(052)434) AD 258254 Unclassified

Also published in Nuovo Cimento, Series X, v. 20: 1001-1009, June 1, 1961.

If the group property (macroscopic causality) of the U-matrix (S-matrix xomputed between finite initial and final times) is postulated, the proof of its unitarity reduces to a most simple verification on the propagation kernels of the theory. The Appendix gives an explicit proof of that property for electro- and mesodynamics by means of perturbative expansions, which may be easily generalized. (Contractor's abstract)

1949

Naples U. Inst. of Theoretical Physics (Italy).

INTERFERENCES AMONG FEYNMAN GRAPHS OF DIFFERENT TOPOLOGY, by E. R. Caianiello and K. Y. Shen. Apr. 11, 1961, 7p. incl. illus. (Technical note no. 3) (AFOSR-858) (AF 61(052)434) AD 258255 Unclassified

Also published in Nuovo Cimento, Series X, v. 20: 1038-1041, June 1, 1961.

Whenever approximations are made with a theory that describes interactions of fermion fields - that is, when the graphs of a perturbative expansion which do not belong to some summable classes are dropped or, equivalently, the integral equations which become then the substitute for the exact theory are solved - the equation arises whether the exclusion principle is being treated correctly. If all the graphs which characterize the chosen approximation procedure are duly antisymmetrized in all the intermediate states, this does not suffice in general to secure that the exclusion principle be rigorously respected (as it is in the exact solution). A given graph, or partial sum of graphs, although usually regarded for computational purposes as a compact expression, is in fact a sum of contributions arising from all the individual modes of the free fermion fields; these contributions may be partly, or totally, cancelled by others that belong, in the graphical picture, to diagrams which are disregarded by the approximation chosen. (Contractor's abstract)

1950

Naples U. Inst. of Theoretical Physics (Italy).

SOME REMARKS ON THE WICK PRODUCT OF INTERACTING FIELDS, by A. Campolattaro and M. Marinaro. [Oct. 1961] 9p. (Technical note no. 4) (AFOSR-1836) [AF 61(052)434] AD 272425 Unclassified

Also published in Nuovo Cimento, Series X, v. 22: 879-883, Nov. 16, 1961.

It is customary to write the Lagrangian or Hamiltonian of a quantized field theory by replacing the ordinary products of wave functions of the non-quantized theory with the Wick products of the corresponding field operators. As is well known, however, when there is interaction, the definition of the Wick product is somewhat artificial and not wholly unambiguous (if at least, as it is usually stated, it is attained by imposing only that it reduce to the one for free fields when the interaction vanishes). The question arises, what difference does it actually make if one changes the definition, or gives up the use of the Wick product. It is shown that if all calculations involving formally divergent integrals are made so as to satisfy some specific consistency requirements, the difference shows up simply as a phase factor. With different physical considerations, the same conclusions hold also for many-body problems (in which case the corresponding integrals are finite, but the proofs still apply).

1951

Naples U. Inst. of Theoretical Physics (Italy).

NEUTRAL SCALAR σ-MESON AND THE MASS DIFFERENCE BETWEEN MUON AND ELECTRON, by Tanaka. [1961] [8]p. (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)434 and Atomic Energy Commission) Unclassified

Published in Nuovo Cimento, Series X, v. 21: 169-176, July 1, 1961.

The self-mass arising from the interaction of a leptonic field with a scalar neutral σ-meson is calculated in perturbation theory to examine the possibility that the electron may be regarded as a light muon because the sign of the self-mass is negative.

Further, the consequences of a model in which a leptonic field interacting with the σ-meson can describe the electron and muon as eigenstates are studied. (Contractor's abstract)

1952

National Bureau of Standards, Washington, D. C.

MEMORY EFFECTS IN IRREVERSIBLE THERMODYNAMICS, by R. Zwanzig. [1961] [10]p. incl. refs. Unclassified

Published in Phys. Rev., v. 124: 983-992, Nov. 15, 1961.

A new generalization of Onsager's theory of irreversible processes is presented. The main purpose is to allow for memory effects or causal time behavior, so that the response to a thermodynamic force comes later than the application of the force. This is accomplished by a statistical mechanical derivation of an exact non-Markoffian kinetic equation for the probability distribution in the space of macroscopic state variables. The memory effect in the resulting transport equations is represented by a time convolution of the thermodynamic forces with memory functions. The latter are time-correlation functions in the rates of change of the phase functions corresponding to macroscopic quantities. The resulting transport equations are not restricted to small deviations from thermal equilibrium. Onsager's theory is shown to be the low-frequency limit of our causal theory. (Contractor's abstract)

1953

National Bureau of Standards, Washington, D. C.

THERMODYNAMIC CONSTANTS FOR ASSOCIATION OF ISOMERIC CHLOROBENZOIC AND TOLUIC ACIDS WITH 1,3-DIPHENYLGUANIDINE IN BENZENE, by M. M. Davis and H. B. Hetzer. [1961] [5]p. incl. diagr. tables, refs. (AFOSR-81) (CSO-670-55-21) Unclassified

Also published in Jour. Research Nat'l. Bur. Stand., v. 65A: 209-213, May-June 1961.

Values of ΔF_{25}, ΔH, and ΔS_{25} for the association of diphenylguanidine with the isomeric monochlorobenzoic acids and the isomeric toluic acids in benzene from spectrophotometric measurements at 25 and 30°C, using bromophthalein magenta E (3', 5', 3'', 5''-tetrabromophenolphthalein ethyl ester) as the indicator are reported. The results are compared with available data for other donor-acceptor associations in aprotic solvents which include the monomer-dimer equilibrium of benzoic acids, the association of tertiary amines with iodine, and the association of certain oxygen bases with phenols. The comparisons indicate that the value of the ratio $\Delta H/298\Delta S$ is approximately constant in the following associations in aprotic solvents: (1) association of phenolic or carboxylic acids with nitrogenous bases to form hydrogen bonded ion-pairs; (2) hydrogen bonding of weakly acidic phenols to nitrogenous bases; (3) association of tertiary amines with iodine. A somewhat smaller value for this ratio seems to apply to most associations of phenols with oxygen bases. Possible applications of these findings include estimation of other thermodynamic constants when 1 of the constants ΔF, ΔH, or ΔS is known, and clarification of the relative importance of ionic and covalent contributions in hydrogen bond formation. (Contractor's abstract)

1954

National Bureau of Standards, Washington, D. C.

MICROSIZE MAGNETIC FIELD PROBES WITH AXIAL SYMMETRY, by C. A. Shiffman. [1961] [2]p. incl. illus. diagr. [CSO-680-59-7] Unclassified

Published in Rev. Scient. Instr., v. 33: 206-207, Feb. 1962.

Magnetic field probes occupying less than 10^{-8} cc and having axially symmetric response have been developed for use at liquid nitrogen temperatures and below. The probes are made by drawing a microscopic boule of bismuth from the melt, using a wire which ultimately serves as a pair of leads at one end. A second wire is fused to the other end by ohmic heating. (Contractor's abstract)

1955

National Bureau of Standards, Washington, D. C.

THEORY OF AN ACCURATE INTERMEDIARY ORBIT FOR SATELLITE ASTRONOMY, by J. P. Vinti. May 22, 1961, 67p. (NBS rept. no. 7154) (AFOSR-690) [CSO-660-60-2] AD 259506 Unclassified

This paper derives an accurate intermediary orbit of an artificial satellite of an oblate planet. The drag-free motion takes place under the action of a gravitational potential which fits the even zonal harmonics exactly through the second and approximately through the fourth, in the case of the earth. This potential leads to separability of the Hamilton-Jacobi equation. Two alternative sets of orbital elements are set forth. The first set is related directly to initial conditions, but requires numerical factoring of a certain quartic to evaluate some of the integrals. The second set, on the other hand, permits exact factoring of both quartics that appear, but is not related directly to initial conditions, so that its members can best be obtained by a least-square fit of the solution over many orbital revolutions. The final solution is given in terms of certain uniformising variables, whose periodic terms are correct through the second order in the oblateness parameter and whose secular terms are exact, for the intermediary orbit. These exact solutions for the secular terms are expressed by means of certain rapidly converging series. (Contractor's abstract)

1956

National Bureau of Standards, Washington, D. C.

THEORY OF AN ACCURATE INTERMEDIARY ORBIT FOR SATELLITE ASTRONOMY, by J. P. Vinti. [1961] [33]p. (AFOSR-712) [CSO-680-60-2] Unclassified

Also published in Jour. Research Nat'l. Bur. Stand., v. 65B: 169-201, July-Sept. 1961.

For abstract see item no. 1955, Vol. V.

1957

National Bureau of Standards, Washington, D. C.

INTERMEDIARY EQUATORIAL ORBITS OF AN ARTIFICIAL SATELLITE, by J. P. Vinti. Oct. 1961, 19p. (NBS rept. no. 7345) (AFOSR-1480) (CSO-680-60-2) AD 264755 Unclassified

A previous paper derived the solution for the drag-free motion of an artificial satellite in the gravitational field of an oblate planet. The corresponding potential, expressed in oblate spheroidal coordinates, leads to separability and represents the even zonal harmonics exactly through the second, for any oblate planet, and approximately through the fourth, in the case of the earth. The previous paper contained a restriction on the orbital inclination I, viz., $I_c < I < 180° - I_c$, where I_c might be as large as 1° 54' for an orbit sufficiently close to the earth. The present paper removes this restriction and shows that many of the formulae for the periodic terms may be simplified, when the orbit is equatorial or almost so. The results agree with those obtained by a direct 2-dimensional solution, when the orbit is purely equatorial. (Contractor's abstract)

1958

[National Bureau of Standards, Washington, D. C.]

A MISSILE TECHNIQUE FOR THE STUDY OF DETONATION WAVES, by F. W. Ruegg and W. W. Dorsey. June 28, 1961 [36]p. incl. illus. diagrs. refs. (AFOSR-394) (ISSA-60-6) Unclassified

Also published in Jour. Research Nat'l. Bur. Stand., v. 66C: 51-58, Jan.-Mar. 1962.

Problems and effects of stabilizing combustion and detonation against hypersonic flow were investigated by observation of a 20 mm spherical missile in a stoichiometric mixture of hydrogen and air at rest. Combustion produced detectable effects on the shape and position of the shock wave at Mach numbers between 4 and 6.5, and above pressures of 0.1 atm. Delayed ignition was noted and measured. Strong combustion-driven oscillations originated in front of the sphere, with frequencies up to approx 0.1 mc/sec. These were observed when the Mach number was less than 6 at a pressure of 1/2 atm, and less than 5 at 1/4 atm. A large reduction of the drag coefficient of the missile was noted in one case of intermittent combustion. This reduction was probably caused by combustion which delayed the separation of the flow from the rear half of the sphere.

1959

National Engineering Science Co., Pasadena, Calif.

ANALYSIS OF CONDITIONS FOR SEPARABILITY OF THE VECTOR WAVE EQUATION OF ELASTICITY FOR INHOMOGENEOUS MEDIA, by J. F. Hook. Aug. 1961, 33p. (AFOSR-1207) (AF 49(638)1082) Unclassified

In a previous paper by the author, a generalization of the Helmholtz method was developed for separation of the vector wave equation of elasticity for inhomogeneous media. Waves axially symmetric about the z-axis and waves independent of y were considered. The properties of the media depend on z only. Conditions for separability consisting of a system of non-linear differential equations for the properties of the media were found. Several special solutions of this system were given, but the general solution was not obtained. The present paper gives a more complete analysis of this system. Several cases arise, for all but one of which the general solution is obtained. Some singular solutions are also obtained. An almost complete explicit definition of the class of media for which the vector wave equation is separable by this method is thus obtained. Separation leads to independent P, SV, and SH waves. The SH displacement vector is solenoidal, but in general, certain vectors obtained through multiplication of the P and SV displacement vectors by appropriate functions are irrotational and solenoidal, respectively. Gvozdev has given the vector differential behavior of the displacement at wave fronts for all inhomogeneous media. It is shown that Gvozdev's relations are satisfied everywhere for the separable cases. (Contractor's abstract)

1960

National Engineering Science Co., Pasadena, Calif.

CONTRIBUTIONS TO A THEORY OF SEPARABILITY OF THE VECTOR WAVE EQUATION OF ELASTICITY FOR INHOMOGENEOUS MEDIA, by J. F. Hook. [1961] [8]p. incl. tables, refs. (AFOSR-4379) (AF 49-(638)1082) AD 295951 Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 34: 946-953, July 1962.

In a recent paper, the author introduced a generalization of the Helmholtz theorem for representation of vectors in terms of potential functions. It was shown that use of this generalization leads to separation (in the dependent variables) of the vector wave equation of elasticity for certain inhomogeneous media whose properties are functions of the Cartesian coordinate z. The conditions for separability are a system of nonlinear differential equations for the constitutive

parameters. Only a few special solutions of this system were given. An almost complete catalog of the separable cases is developed in the present paper. The vector differential properties of the field for the separable cases are discussed. It is shown that the P and S fields are irrotational and solenoidal, respectively, provided we regard as the fundamental field vectors the quantities $f_1 u_P$, $f_2 u_{SV}$, and U_{SH} rather than the displacement vectors themselves, where f_1 and f_2 are appropriate weighting functions. The vector differential properties of the displacement vectors themselves are derived and these results compared with similar results obtained by the eikonal method of analysis. (Contractor's abstract)

1961

National Research Council. National Academy of Sciences, Washington, D. C.

REPORT OF MEETING OF IUPAC COMMISSION ON ORGANIC NOMENCLATURE, JULY 20-26, 1961 AND SYMPOSIUM ON NOMENCLATURE, JULY 27-29, 1961, HELD IN COLUMBUS, OHIO. [1961] 37p. incl. diagrs. (AFOSR-2846) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-103, Chemical Abstracts, and NAS-NRC Division of Chemistry and Chemical Technology) AD 429277 Unclassified

The twenty-first Conference of IUPAC held in Montreal in August 1961, presented a favorable opportunity for the Union's Commission on Organic Nomenclature to hold its annual meeting in the United States and thus to become more directly acquainted with the views of the very large number of organic chemists on this side of the Atlantic. To promote this exchange of views the Division of Chemistry and Chemical Technology of the NAS-NRC, in collaboration with the American Chemical Society's Committee on Organic Nomenclature, arranged for the IUPAC Commission to meet in Columbus, Ohio, at the office of Chemical Abstracts Service, during the period July 20-26, and for a Symposium on Nomenclature to follow on July 27-29. This report presents a digest of the proceedings of these 2 fruitful meetings.

1962

[National Research Council. National Academy of Sciences, Washington, D. C.]

NOMENCLATURE OF ORGANIC CHEMISTRY. TENTATIVE RULES FOR SECTION C. CHARACTERISTIC GROUPS CONTAINING CARBON, HYDROGEN, OXYGEN, NITROGEN, HALOGEN, SULFUR, SELENIUM, AND/OR TELLURIUM, July 1961. London, Butterworths, 1962, 238p. incl. diagrs. tables. (AFOSR-5243) [AF AFOSR-61-103] AD 416524 Unclassified

The Tentative Rules, Section C, were presented for consideration by chemists; they were discussed again by the Commission, later, before Definite Rules for this field were issued. As with Sections A and B, efforts were, in the main, confined to codifying sound practice which already had existed, rather than originating new nomenclature-the latter may form a later stage of the Commission's activities. The compounds discussed in Section C have atoms of, or groups containing, carbon, hydrogen, oxygen, nitrogen, halogen, sulfur, selenium, and/or tellurium as constituents. It is intended later to publish rules for compounds in which other elements are attached to carbon, for stereochemical isomers, and for certain classes of compounds such as saccharides where specialized nomenclature is required. Section C thus supercedes almost all of Sections IV, V, and VII, of the Liège rules, and also the relevant parts of the later revision of Section VI.

1963

[Naturalia et Biologia, Paris (France)]

[INHIBITION OF EVOKED CORTICAL AND SUBCORTICAL ACTIVITY BY STIMULATION OF NUCLEI AT THE BASE OF AND OF REGIONS ADJACENT TO THE INTERNAL CAPSULE] [Inhibition d'activités évoquées corticales et sous-corticales par la stimulation des noyaux de la base et des regions limitrophes de la capsule interne, by G. Krauthamer and D. Albe-Fessard. [1961] [8]p. incl. diagrs. (AFOSR-J1056) [AF 61(052)475] Unclassified

Also published in Compt Rend. Seances Soc. Biol., v. 155: 1443-1450, July 1961.

The results of this article show that the experiments described are able to explain, at least partially, the effects of stimulation of the striated structures on spontaneous movements or movements provoked by cortical stimulation. Apparently these cause a modification in the properties of the motor cortex. The actions that have been observed on the association cortex are without doubt in rapport with the effects of stimulation of striated structures on the level of awareness.

1964

Naturalia et Biologia, Paris (France).

IDENTIFICATION OF ACTIVE MEMBRANE AREAS IN THE GIANT NEURON OF APLYSIA, by L. Tauc. [1961] [17]p. incl. illus. diagrs. refs. (AFOSR-64-0166) (In cooperation with California U., Los Angeles) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)475, National Institutes of Health, and Office of Naval Research) AD 432742 Unclassified

Also published in Jour. Gen. Physiol., v. 45: 1099-1115, July 1962.

Intracellular and extracellular potentials were simultaneously recorded from the soma and different parts of the axon of the giant cell of Aplysia. Evidence was obtained that for all modes of stimulation the spike originated in the axon at some distance from the cell body. The conduction of the spike is blocked at a distance of 200 to 300 μ from the soma for the

antidromic spike, closer to the soma as a small or A spike. After some delay, a spike is initiated in the resting part of the axon and in the axon hillock; the soma is invaded only afterwards. The response of these 3 parts of the neuron is recorded in the soma as the big or S spike. (Contractor's abstract)

1965

Natura'is et Biologia, Paris (France).

SITE OF ORIGIN AND PROPAGATION OF SPIKE IN THE GIANT NEURON OF APLYSIA, by L. Tauc. [1961] [21]p. incl. illus. diagrs. refs. [AF 61(052)-475] Unclassified

Published in Jour. Gen. Physiol., v. 45: 1077-1097, July 1962.

The form and time sequence of spikes generated by orthodromic, antidromic, and direct stimulation and during spontaneous activity have been studied with intracellular electrodes simultaneously introduced in the soma and in different parts of the axon of the giant nerve cell of Aplysia. Evidence was obtained that under normal conditions of excitability, the spike originates at some distance from the soma in an axonal region with a higher excitability surpassing that of the surrounding membranes. Between the trigger zone and the soma is situated a region of transitional excitability where the conduction of the spike towards the soma may be blocked at a functionally determined and variable locus. The cell body is electrically excitable, but has the highest threshold of all parts of the neuron. The inactivation or even the removal of the cell body does not suppress synaptic transmission. (Contractor's abstract)

1966

Nebraska U., Lincoln.

THE LIOUVILLE THEOREM FOR A QUASI-LINEAR ELLIPTIC PARTIAL DIFFERENTIAL EQUATION, by E. Bohn and L. K. Jackson. [1961] [6]p. (AF 49-(638)506) Unclassified

Published in Trans. Amer. Math. Soc., v. 104: 392-397, Sept. 1962.

The following theorem is proved. Consider the equation (*) $L[z] = A(x, y, p, q)r + 2B(x, y, p, q)s + C(x, y, p, q)t = F(x, y, z, p, q)$ (where $p = z_x$, $q = z_y$, $r = z_{xx}$, $s = z_{xy}$, $t = z_{yy}$) which satisfies the following assumptions. (1) A, B, and C are continuous and have continuous first partial derivatives with respect to p and q for all (x, y, p, q). (2) $A > 0$ and $B^2 - AC < 0$ for all (x, y, p, q). There are continuous functions $a(p, q)$ and $c(p, q)$ and a constant $d > 0$ such that $AC - B^2 > d$, $A(x, y, p, q) \leq a(p, q)$ and $C(x, y, p, q) \leq c(p, q)$ for all (x, y) and all (p, q) with $p^2 + q^2 \leq 1$. (3) $F(x, y, z, p)$ is continuous and has continuous first partial derivatives with respect to z, p, and q with $F_z \geq 0$ for all (x, y, z, p, q). Given any $N > 0$ there exists an $H_N > 0$ such that $|F(x, y, z, p, q)| \leq H_N(p^2 + q^2)$ for $|z| \leq N$, $p^2 + q^2 \leq 1$, and all (x, y). A function $z(x, y)$ which is of class $C^{(2)}$ and a solution of (*) throughout the finite plane and which is bounded on one side must be a constant. (Math. Rev. abstract)

1967

New Hampshire U. Dept. of Chemistry, Durham.

ELECTROPHILIC DISPLACEMENT REACTIONS. XIII. THE KINETICS OF THE PHENYLMERCURIDE-BORONATION OF BENZENEBORONIC ACID, by H. G. Kuivila and T. C. Muller. [1961] [6]p. incl. diagrs. tables, refs. (AFOSR-1365) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)312 and Office of Naval Research) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 84: 377-382, Feb. 5, 1962.

The kinetics of the reaction between benzeneboronic acid and basic phenylmercuric perchlorate in aqueous ethanol have been studied. The rate was found to be first order in each reactant. Investigations in buffer systems showed a retardation in the rate by phosphoric acid, acetic acid and dihydrogen phosphate ion. The reaction rate is pH-independent in the range pH 4-8. Above pH 10 the rate decreases with increasing pH. The bearing of these and other observations on the mechanism of the reaction is discussed. (Contractor's abstract)

1968

New Hampshire U. Dept. of Chemistry, Durham.

ELECTROPHILIC DISPLACEMENT REACTIONS. XIV. TWO NOVEL REACTIONS INVOLVING ARENE-BORONIC ACIDS AND HALOGENS, by H. G. Kuivila, L. E. Benjamin and others. [1961] [5]p. incl. diagrs. refs. (AFOSR-1426) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)312] and Office of Naval Research) Unclassified

Also published in Jour. Org. Chem., v. 27: 825-829, Mar. 1962.

meta-Methoxybenzeneboronic acid has been found to react with 1, 2, and 3 moles of bromine to yield, respectively, 2-bromo-5-methoxybenzeneboronic acid, 2, 4-dibromo-5-methoxybenzeneboronic acid, and 2, 4, 5-tribromoanisole. Chlorination yields 2-chloro-5-methoxybenzeneboronic acid and probably, 3-methoxy-4-chlorobenzeneboronic acid. Reaction with iodine chloride yields 2-iodo-5-methoxybenzeneboronic acid along with the chloro acids. Benzeneboronic acid reacts with hypochlorite and hypobromite to give phenol, which reacts to form halophenols. (Contractor's abstract)

1969

New Hampshire U. Dept. of Physics, Durham.

CONDUCTION THEORIES IN GASEOUS PLASMAS AND SOLIDS. Final rept. Oct. 1, 1959 - Oct. 31, 1961. Dec. 1961, 5p. (AFOSR-1843) (AF 49(638)687) AD 414116 Unclassified

The theoretical studies on the transport properties of ionized media performed have been based entirely on the effective particle approach and have ignored all correlation effects as well as quantum corrections. Within this approximation several specific problems have been treated: the anomalous skin effect, the magneto-acoustic effect, magneto-galvanic resistance, and certain aspects of microwave diagnostics. The first 2 effects are of considerable interest in metals and semi-metals and were studied and extended so as to apply to plasmas. The microwave diagnostic techniques developed here were originally aimed at the interpretation of a specific problem in plasma physics but are of sufficient generality to treat a class of problems involving magneto-hydrodynamic fluids, semi-metals, as well as semi-conductors. (Contractor's abstract)

1970

New Mexico U. Dept. of Physics, Albuquerque.

EXTENSIVE AIR SHOWERS OF THE COSMIC RADIATION, by J. R. Green. Final rept. Jan. 16, 1961 [59]p. incl. diagrs. tables, refs. (AFOSR-243) (AF 49(638)34) AD 251274 Unclassified

Investigations have been carried out concerning the structure, properties, and interactions of the components of the extensive air showers of the cosmic radiation. Two scintillators having an acceptance area of 7.3 m^2 have been developed together with the circuits necessary to analyze and record the data. An automatic data reduction system with considerable flexibility of function had been designed to give the data in the form of punched cards. Three smaller scintillators with an area of 0.66 m^2 were also constructed. The size spectrum of extensive air showers in the region of 10^4 to 10^8 has been investigated and found to be represented by the power law of the form:

$$K(\geq N) = (2.26 \pm 0.14) \times 10^{-7} (N/10^6)$$

$$\text{sec}^{-1}\text{m}^{-2}\text{str}^{-1}$$

$$-(1.540 \pm 0.006)_{\cos}{}^{6.5}$$

at the elevation of Albuquerque (1575 m. s. l.). A μ-meson telescope was constructed from the three smaller scintillators with a total of 8 in. of lead absorber and was put in operation for a period of 55 days to obtain barometric and temperature coefficients for the μ-mesons and to observe variations in the flux of these particles. A vertical telescope formed from the two larger scintillators was used to find the average energy of the electronic component as a function of distance from the shower core. Results indicate that over the range from 3 m to 30 m the average energy of an electron decreases from 5×10^8 to 10^8 ev. This result indicates a change in distribution of electronic energies between mountain elevation and sea level. A new transition effect for the showers with water as an absorber has been obtained. The transition curves have made it possible to estimate that the relative number of photons to electrons is not far from unity, and that the ratio of the average electron energy varies from about 2 to 5 near the periphery of the shower to approximately unity near the core. (Contractor's abstract, modified)

1971

New Mexico U. [Dept. of Physics] Albuquerque.

ELECTRON-PHOTON ENERGIES IN EXTENSIVE AIR SHOWERS, by J. R. Green and J. R. Barcus. [1961] [16]p. incl. diagrs. tables, refs. (AFOSR-2810) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)34] and National Science Foundation) Unclassified

Presented at meeting of the Amer. Phys. Soc., Los Angeles, Calif., Dec. 27-29, 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 516, Dec. 27, 1961.

Also published in Nuovo Cimento, Series X, v. 23: 708-723, Feb. 16, 1962.

Average electron and photon energies are found at various distances from the cores of extensive air showers by comparing the multiplicities produced under different thicknesses of lead and water absorbers as measured through the use of 2 large scintillators. For distances from 2.3×10^{-2} to 1.4×10^{-1} shower units from the cores of showers of 10^5 to 10^7 particles the total energy carried by electrons and photons per electron is found to be $61(r/r_2)^{-0.74}$ mev per electron. The ratio of the average photon energy to the average electron energy is found to vary from 1.5 to 3.3 at different distances. Transition curves obtained with different thicknesses of water as absorber are used to show that for showers of 4.6×10^4 particles a total of 1.5×10^{12} ev is expended in the production of pions per nuclear interaction to give an inelasticity of 0.33. (Contractor's abstract)

1972

New Mexico U. [Dept. of Physics] Albuquerque.

LATERAL DISTRIBUTION OF THE ENERGY OF THE SOFT COMPONENT OF EXTENSIVE AIR SHOWERS (Abstract), by J. R. Barcus and J. R. Green. [1961] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)34] and National Science Foundation) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 52, Feb. 1, 1961.

The multiplicity of shower particles resulting from the traversal of various thicknesses of Pb and of H_2O has been measured using 2 large scintillators. Under certain assumptions regarding the relative number and relative energy of the electrons and photons, the cascade theory can be used to determine the corresponding energies. The observed frequency of occurrence of a given multiplicity then can be compared with the predicted response of the scintillators to showers striking at various distances from the apparatus to show that the average energy of the soft component at the periphery of the showers is of the order of 10^8 ev and increases to more than 10^9 ev within a meter of the shower axis. Measurements of the transition effect in water indicate that the ratio of photons to electrons is approximately unity but that the photons carry more energy at distances of 10 m and beyond than do the electrons. The measurements were made for showers of 10^5 to 10^8 particles; no effects due to size were observed.

1973

New Mexico U. [Dept. of Physics] Albuquerque.

SIZE SPECTRUM AND ANNUAL VARIATION OF EXTENSIVE SHOWERS (Abstract), by J. R. Green and J. R. Barcus. [1961] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)-34] and National Science Foundation) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 52, Feb. 1, 1961.

Extensive air showers have been observed with a large single scintillator for a period of about 1 yr. The accumulated data lead to an integral size-spectrum of $K(\geq N) = (2.1 \pm 0.3) \times 10^{-7} (N/10^6)^{-(1.540 \pm 0.008)} m^{-2} s^{-1} str^{-1}$ for showers containing from 10^5 to 10^8 particles at 1575 msl. Although the inherent statistical accuracy is high because of the large acceptance area of the scintillator, the calibration of the apparatus introduces errors that restrict the accuracy of comparison of rates over long time intervals. As a result of this limitation, it can be said only that any annual variation in the rate of occurrence of extensive air showers of the order of 10^7 particles must be less than 8%.

1974

New Mexico U. [Dept. of Physics] Albuquerque.

FURTHER MEASUREMENTS OF THE SIZE-SPECTRUM OF EXTENSIVE AIR SHOWERS, by J. R. Green and J. R. Barcus. [1961] [8]p. incl. diagrs. tables. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)34] and National Science Foundation) Unclassified

Published in Nuovo Cimento, Series X, v. 21: 361-368, July 16, 1961.

Measurements on the size-spectrum of extensive air showers have been made over a period of about 1 yr to include approximately 10^5 events. It is found that errors of about 5% in determining the number of particles traversing the scintillator make it impossible to observe time variations of less than 8%. For showers containing a total number of particles $10^5 < N < 10^7$, the spectrum for vertical incidence is $K_0(\geq N) = (2.26 \pm 0.14) \cdot 10^{-7} (N/10^6)^{-(1.540 \pm 0.006)} s^{-1} m^{-2} sr^{-1}$. (Contractor's abstract)

1975

New York State Psychiatric Inst., N. Y.

GLUTAMIC ACID METABOLISM IN BRAIN AND LIVER DURING INFUSION WITH AMMONIA LABELLED WITH NITROGEN-15, by G. Takagaki, S. Berl and others. [1961] [1]p. incl. table. (AFOSR-J246) (Sponsored jointly by [Air Force Office of Scientific Research under AF 49(638)725] and Public Health Service) AD 400874 Unclassified

Also published in Nature, v. 189: 326, Jan. 28, 1961.

Recent results of in vivo experiments using glutamic acid labelled with carbon-14 were consistent with the hypothesis that the amidation of the administered amino-acid to glutamine represents a metabolic event occurring in a tissue of cellular compartment. N-ammonium acetate was infused into the carotid artery of cats over a period of 8-85 min with simultaneous electroencephalographic and electrocardiographic tracings. The experiments were terminated by exsanguination of the animal, the blood was collected, brain and liver excised and frozen, and the level of glutamic acid and its metabolic derivatives determined in the tissue samples, as well as the concentration of nitrogen-15 in the amino or amide groups respectively of these compounds. The results of a typical experiment of 25-min duration are given in tables.

1976

New York State Psychiatric Inst., N. Y.

INCORPORATION OF HISTAMINE INTO LIVER PROTEIN IN VIVO, by I. Wajda, M. Ginsburg, and H. Waelsch. [1961] [2]p. incl. diagr. (AFOSR-J247) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)725], Ford Foundation, National Institute of Neurological Diseases and Blindness, and Research Foundation for Mental Hygiene) AD 400873 Unclassified

Also published in Nature, v. 191: 1204-1205, Sept. 1961.

Whereas there is no difficulty in demonstrating transglutaminase action in vitro, in early experiments attempts to show fixation of administered amines in the liver proteins of mice were unsuccessful

even after experimental liver damage (carbon tetrachloride) or after nephrectomy. The possibility was considered that proteins modified by incorporated amines may have antigenic properties and could be involved in auto-immune reactions. Since H. pertussis vaccine enhances anaphylactic sensitization its effect and that of a lipopolysaccharide from S. typhosa on liver transglutaminase and histamine incorporation into liver proteins was studied. The histamine content of the liver proteins from normal or lipopolysaccharide-treated mice with or without histamine injection was less than could be detected. The liver proteins of lipopolysaccharide-treated animals after histamine injection contain significant amounts of histamine, the quantity of which correlated with transglutaminase-level ($r = 0.9$; $P < 0.001$). In order to demonstrate increased histamine fixation in liver protein of lipopolysaccharide-treated mice, it was necessary to administer large doses of histamine. This raises the question whether histamine is the natural replacing amine and experiments are now in progress to study the conditions of in vivo incorporation of other amines.

1977

New York State U. Dept. of Chemistry, Long Island Center, Oyster Bay, N. Y.

THE INFRARED SPECTRUM AND STRUCTURE OF GERMYL CYANIDE (Abstract), by T. D. Goldfarb. [1961] [1]p. (AF AFOSR-61-11) Unclassified

Published in Symposium on Molecular Structure and Spectroscopy, Ohio State U., Columbus, June 12-16, 1961, p. 50.

Also published in Spectrochim. Acta, v. 17: 1123, Oct. 1961.

The infrared spectrum of germyl cyanide and its deuterated analogue has been studied in the 4000-850 cm^{-1} region with both prism and grating resolution. A partial vibrational analysis will be presented including frequency assignments and structural data. A comparison of the spectrum and structure of those of methyl and silyl cyanide will be discussed with reference to similar comparisons that have been made for analogous derivatives of methane, silane and germane.

1978

New York U., N. Y.

THE THERMAL DECOMPOSITION OF ALUMINUM TRIETHYL, by Y. A. Tajima, G. Salser, and C. J. Marsel. Feb. 1961, 20p. incl. diagrs. tables, refs. (AFOSR-553) (AF 49(638)173) AD 257019 Unclassified

An investigation of the pyrolysis of triethyl aluminum (TEA) was undertaken preliminary to a study of the kinetic mechanism involved in its ignition. The thermal decomposition reactions were homogeneous. The main decomposition products were H, butenes, ethylene, and Al Ethane was a minor product. Polyethylene, traces of methane and propylene sometimes appeared. The mechanism was molecular. (Contractor's abstract)

1979

New York U., N. Y.

PYROLYSIS AND COMBUSTION OF ALUMINUM ALKYLS, by C. J. Marsel, G. Salser, and Y. Tajima. [1961] [1]p. [AF 49(638)173] Unclassified

Presented at Second AFOSR Contractors' meeting on Chemical Kinetics of Propulsion, Illinois Inst. of Tech. Armour Research Foundation, Chicago, Sept. 11-12, 1961. (AFOSR-1417; AD 265513)

It has been established that aluminum triethyl (TEA) and aluminum tri-n-propyl (TPA) decompose at 210-250°C by a molecular mechanism. The principal hydrocarbon products are butenes with TEA and propylene with TPA; a marked difference in the pyrolysis of TEA and TPA is that dimers (butenes) form from TEA but dimers (hexenes) do not form from TPA. Addition of oxygen induces a free radical mechanism on the pyrolysis of TEA. Thus, ethane and n-butane appear as products. Further improvements have been incorporated into the New York U. 60° sector mass spectrometer. Machine stability has been vastly improved by use of a transistorized emission regulator, regulated magnet supply, and regulated supply voltage. Ion optical problems concomitant with electrostatic scanning have been resolved by 3-fold increase of the accelerating voltage. The use of strong focusing as a more satisfactory solution is also discussed.

1980

New York U. Coll. of Engineering, N. Y.

NUMERICAL STUDIES OF TRANSITION FROM LAMINAR TO TURBULENT FLOW OVER A FLAT PLATE, by D. F. DeSanto and H. B. Keller. Final rept. Apr. 1961, 45p. incl. diagr. refs. (AFOSR-723) (AF 18(603)25 and AF 49(638)446) AD 257587 Unclassified

Also published in Jour. Soc. Indus. and Appl. Math., v. 10: 569-595, Dec. 1962.

A finite-difference technique is developed for analyzing the time-dependent 2-dimensional flow of an incompressible viscous fluid over a semi-infinite flat plate. The complete (non-linear) equations of motion for perturbed Blasius flow are numerically integrated with respect to time, and the propagation of disturbances in the boundary layer is determined. An analysis of the theoretical convergence and stability properties of the difference scheme is carried out. The method developed has been employed in 2 test calculations, in which slightly unstable oscillatory disturbances have been introduced at some upstream

point. The numerical solutions exhibit many of the major theoretical and experimentally observed features associated with transition from laminar to turbulent boundary-layer flow. (Contractor's abstract)

1981

New York U. [Dept. of Chemistry] N. Y.

STUDY OF THE HYDRODYNAMIC EQUATIONS FOR FREE-RADICAL FLAMES (Abstract), by E. S. Campbell. [1961] [1]p. [AF 49(638)169]
Unclassified

Presented at Second AFOSR Contractors' meeting on Chemical Kinetics of Propulsion, Illinois Inst. of Tech. Armour Research Foundation, Chicago, Sept. 11-12, 1961. (AFOSR-1417; AD 265513
Unclassified

In this study of the hydrodynamic equations for the propagation of free-radical flames, methods of solutions have been developed which are appropriate to different temperature ranges and different ranges of deviation from the kinetic steady-state. Alternative hypotheses had been presented as possible explanations for the discrepancy between the calculated flame profiles and profiles which could satisfy the boundary conditions at the flame holder. These hypotheses have now been narrowed to the tentative conclusion that the ozone flame involves 2 eigenvalues. This conclusion, which contradicts the basic assumption of previous treatments of the ozone flame, is being checked. Brief comment is also made on the following topics: (1) significance of the ignition temperature approximation, (2) free-radicals as a means of energy transport, (3) diffusion, flame-velocity, and deviation from the kinetic steady state, (4) study of the heat-flux vector, (5) deviation from the kinetic steady-state and flame-speeds, and (6) flame thickness.

1982

[New York U. Dept. of Chemistry, N. Y.]

THE OPTICS OF FLAMES AND METHODS FOR THE STUDY OF REFRACTIVE INDEX FIELDS IN GASES, by F. J. Weinberg. [1961] 424p. incl. diagrs. refs. (AFOSR-1190) (In cooperation with London U. Imperial Coll. of Science and Technology (Gt. Brit.)) (AF 49(638)976 and AF 61(514)1013) AD 260996
Unclassified

In recent years, the subject of combustion has grown and ramified enormously. In this monograph, an attempt has been made to cover all the aspects of what has proved to be perhaps the most informative single group of methods in making visible, in rapidly recording and in the accurate measurement of processes associated with flame phenomena. The necessary combustion is provided in chapter IV. Elementary revision of the minimum necessary optics is also included. The purposes of this monograph are to establish the form of refractive index fields occurring in combustion, to examine the usefulness of a wide variety of optical systems in this context and supplement their theory as necessary, to provide a compact text, comprehensive yet elementary enough to assist those workers of a variety of academic backgrounds who are using or wish to use such techniques, and to draw the attention of that wider circle who have no previous experience of such methods to their scope, versatility and simplicity for visualization and quantitative measurements of combustion.

1983

New York U. Dept. of Electrical Engineering, N. Y.

TRANSIENT ANALYSIS OF INTERACTING DYNAMICAL SYSTEMS BY THE PRINCIPLE OF ENERGY TRANSFORMATION, by S. S. L. Chang. Feb. 1961 [8]p. incl. diagrs. (Technical rept. no. 400-22) (AFOSR-64) (AF 49(638)586) AD 269562
Unclassified

An energy transformer is defined as a reversible device which converts free energy of 1 form into another and vice versa. Basic transformer equations are derived for these devices which are good for both steady-state as well as transient operations. Using the transformer analogy, interacting systems can be represented by a single equivalent circuit from which transient and steady-state responses and interacting effects can be calculated. The method is applicable to nonlinear as well as linear systems. Examples are given to illustrate its applications in electromechanical and hydromechanical systems. (Contractor's abstract)

1984

New York U. [Dept. of Electrical Engineering] N. Y.

COMPUTER OPTIMIZATION OF NONLINEAR CONTROL SYSTEMS BY MEANS OF DIGITIZED MAXIMUM PRINCIPLE, by S. S. L. Chang. Mar. 1961, 9p. incl. diagr. (Technical rept. no. 400-26) (AFOSR-513) (AF 49(638)586) AD 269563
Unclassified

Presented at I. R. E. Internat'l. Convention, New York, Mar. 20-23, 1961.

Also published in I. R. E. Internat'l. Convention Record, Pt. 4: 48-55, 1961.

A digitized version of the maximum principle is derived by a simple and elementary method. In the limit of the discrete time interval approaching zero, the digitized maximum principle is reduced to Pontryagin's maximum principle. The digitized version can be readily programmed on a computer, and all 4 types of optimization problems: (1) minimum time, (2) maximum range, (3) minimum cost between terminal points, and (4) maximum gain (or minimum cost) in a given interval, are solvable by this method. The computation of the optimum process requires relatively little computer memory, and is exact for systems

describable by a set of difference equations. The use of a computer to implement the computed optimum process in various ways is discussed. A more general condition for bang-bang control is also derived. (Contractor's abstract)

1985

New York U. Dept. of Electrical Engineering, N. Y.

SYNTHESIS OF LINEAR CONTROL SYSTEMS WITH LOW SENSITIVITY TO PLANT VARIATIONS, by P. E. Fleischer. May 1961, 147p. incl. diagrs. refs. (Technical rept. no. 400-31) (AFOSR-702) (AF 49-(638)586) AD 269564 Unclassified

This thesis is a study of the design of linear control systems which are insensitive to plant variations. Linear feedback systems, characterized by no direct transmission to the output and plants which have only a single input and a single output, are considered. In such systems, the degree of insensitivity, (with respect to plant variations), that can be achieved is limited only by 3 factors. These are the noise generated by the measuring instrument, the possibility of plant saturation, and the non-minimum phase zeros of the plant. No analysis, presented thus far, has considered any of these factors; consequently, there exists no methods for the rational synthesis of a wide class of control systems. The main purpose of this paper is to derive methods for specifying a system's sensitivity function in the presence of these conflicting requirements. The results are also of value in establishing and limiting the fundamental capability of a passive-adaptive control system to minimize the effects of plant variations. This is of importance if the use of adaptive control is contemplated. Such control is often difficult to implement and is slow in adjusting to the changing environment. For these reasons it should not be used unless a clear superiority over insensitive (i. e., passive-adaptive) systems can be demonstrated. (Contractor's abstract)

1986

New York U. Dept. of Electrical Engineering, N. Y.

DYNAMIC PROGRAMMING AND PONTRYAGIN'S MAXIMUM PRINCIPLE, by S. S. L. Chang. June 1961 [18]p. incl. diagrs. (Technical rept. no. 400-32) (AFOSR-865) (AF 49(638)586) AD 269565 Unclassified

Bellman's dynamic programming and Pontryagin's maximum principle are generally regarded as 2 alternative ways of solving the problem of optimum control of a nonlinear system. A multistage decision process is described and applied to an optimum trajectory. The maximum principle is derived when tries to overcome certain practical difficulties in dynamic programming. (Contractor's abstract)

1987

New York U. Dept. of Electrical Engineering, N. Y.

OPTIMAL CONTROL IN BOUNDED PHASE SPACE, by S. S. L. Chang. Aug. 1961, 36p. (Technical rept. no. 400-37) (AFOSR-1238) (AF 49(638)586) AD 269566 Unclassified

Also published in Automatica, v. 1: 55-67, Jan.-Mar. 1963.

A bounded phase space condition is derived for a restricted class of problems. The condition is proved to be a necessary condition for optimal control in a fixed time interval with free end point. If the system is linear, and the allowed regions of phase variables and controls are convex, the condition is both necessary and sufficient, for optimal control in a fixed time interval, as well as minimum time control between two fixed points.

1988

New York U. Dept. of Electrical Engineering, N. Y.

NOISE AND RANDOM PROCESSES, by J. R. Ragazzini and S. S. L. Chang. Oct. 1961 [43]p. incl. diagrs. refs. (Technical rept. no. 400-40) (AFOSR-1533) (AF 49(638)586) AD 269567 Unclassified

Also published in Proc. Inst. Radio Engineers, v. 50: 1146-1151, May 1962.

The theory of noise and random processes in electronic devices was developed in 2 stages. The first stage spanning the 2 decades following 1918 brought about the understanding of the nature and effects of noise in vacuum tubes and circuits. The second stage, initiated by Wiener in the early 1940's, established the theoretical basis for synthesizing systems which optimized the transmission and detection of signals in the presence of noise. While the detailed discussion of the detection of weak signals in the presence of noise is contained in a separate paper on information theory, this subject is discussed briefly to demonstrate the similarity in the underlying concepts of optimum transmission and detection. The literature on the subject of noise and random processes is so extensive as to make complete coverage impractical. Only highlights and significant stepping stones in the development of the theory are described.

1989

New York U. Dept. of Electrical Engineering, N. Y.

THEORY OF OPTIMUM MULTIPLE MEASUREMENTS, by J. C. Hung. Aug. 1961, 167p. incl. diagrs. tables, refs. (Technical rept. no. 400-36) (AFOSR-1550) (AF 49(638)586) AD 269568 Unclassified

Multiple measurements with random inputs are studied. Methods of weighting and combining the measured signals are proposed. The relationships between the measured signals and the desired signal

are assumed linear and time-invariant; the random inputs are assumed stationary with rational spectral density functions; the criterion of performance used is to minimize the mean squared value of the continuous error between the estimate and the desired signal; and the weighting operations are assumed linear. Two kinds of single-rate systems are studied: Single-rate multiple measurements with known spectral density functions of signal and noise, and single-rate multiple measurements with known noise but unknown signal spectral density functions. A new method employing the frequency domain optimization theorems together with factorization theorems of rational matrices is proposed for obtaining the optimum system of the first kind. (Contractor's abstract, modified)

1990

New York U. Dept. of Electrical Engineering, N. Y.

APPROXIMATELY OPTIMUM CONTROL OF AN INERTIAL PLATFORM WITH RANDOM DISTURBANCES, by F. J. Alexandro, Jr. and S. S. L. Chang. Nov. 1961, 35p. incl. illus. (Technical rept. no. 400-43) (AFOSR-1974) (AF 49(638)586) AD 277507 Unclassified

A number of techniques are discussed which can be used to modify the bang-bang principle in order to overcome some common problems such as finite gain, random inputs, and minor time constants, namely: automatic dual mode, provision for reverse torque, and means for incorporating lag compensation. An example is given in which the methods are incorporated into an approximate bang-bang system to control an inertial platform. (Contractor's abstract)

1991

New York U. Dept. of Electrical Engineering, N. Y.

AN INTRODUCTION TO THRESHOLD DEVICES AND THEIR USE IN PATTERN RECOGNITION, by P. Kaszerman. Aug. 1961, 68p. incl. diagrs. tables. (Technical rept. no. 400-44) (AFOSR-2414) (AF 49-(638)586) AD 281760 Unclassified

Introductory concepts are presented of the switching logic which can be realized by threshold devices, and examples are given of the use of these devices in pattern recognition applications. A threshold device is a switching network which realizes a given function by: (1) forming a weighted linear sum on the binary inputs plus a threshold number; and (2) forming a binary output whose value is determined by the value of this sum. It is shown that the complement of a single variable, the AND function of any number of variables and the OR function of any number of variables can be realized by a single threshold device. A necessary condition for realizability by a single threshold device is that the function be completely monotonic; that is, for any 2 groups of values assigned to a common subset of variables, 1 of the reduced functions must imply the other. Various properties of realizable functions are derived and a synthesis procedure is presented without proof. In addition, a geometric approach to the analysis of a single threshold device is given. (Contractor's abstract, modified)

1992

New York U. Dept. of Physics, N. Y.

HYPERFINE STRUCTURE OF THE ROTATIONAL SPECTRUM OF HDO, by E. B. Treacy and Y. Beers. [1961] [8]p. incl. diagrs. tables, refs. (AFOSR-968) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)259] and Office of Naval Research) Unclassified

Also published in Jour. Chem. Phys., v. 36: 1473-1480, Mar. 15, 1962.

The hyperfine structure of the $3_2 - 3_3$ and $5_2 - 5_3$ rotational transitions of HDO, which fall at about 825 and 487 mc, respectively, have been studied using microwave cavities as spectrometers. The experiments illustrated the usefulness of large Q cavities as spectrometers for this kind of work. The $3_2 - 3_3$ transition was resolved into a symmetrical pattern consisting of a strong central line with 6 weak satellites on each side. The minimum full linewidth between half-power points that was achieved was about 10 or 12 kc. The spectrum was fitted with $C_H = -46.6 \pm 0.3$ kc, $C_D = -1.66 \pm 0.3$ kc, and $(eqQ)_{OD} = 310.3 \pm 3$ kc. The $5_2 - 5_3$ transition was resolved into a symmetrical pattern also, with a strong central line and 3 weak satellites on each side. The minimum full linewidth between half-power points was about 6 kc. The spectrum was fitted with $C_H = 47.38 \pm 0.1$ kc, $C_D = -2.42 \pm 0.1$ kc, and $(eqQ)_{OD} = 314.3 \pm 1.5$ kc. A systematic comparison of the results with those obtained elsewhere on the $2_1 - 2_2$ transition in HDO is made. The qualitative features of the spectra are consistent with what one would expect on the basis of existing theory, but the present state of the theory may be inadequate for explaining some of the quantitative details of the magnetic structure.

1993

New York U. Dept. of Physics, N. Y.

LOW FREQUENCY ABSORPTION SPECTRA, by Y. Beers. Final rept. Nov. 24, 1961 [11]p. incl. refs. (AFOSR-2057) (AF 49(638)259) AD 289175 Unclassified

This report summarizes work performed under this contract. The purpose of this project is to extend the observation of molecular spectra in gases to the frequency region between 300 and 6000 mc. One of the objectives is to obtain information which can provide a valuable supplement to that obtainable in the conventional microwave region and the infra-red concerning rotational constants and hyperfine splittings.

As the work progressed, it was gradually realized that observation of spectral lines in this region provides a means of observing hyperfine splittings with high resolution since the Doppler width, which generally limits the resolution, decreases in proportion to the frequency of the transition while the hyperfine splitting has a magnitude comparable to that in the conventional microwave region. Much of the recent work has concerned itself with the exploitation of this advantage. An auxiliary objective has been to observe some nuclear quadrupole resonances in the solid state.

1994

New York U. [Dept. of Physics] N. Y.

COSMIC-RAY INCREASES OBSERVED AT COLLEGE, ALASKA, AT THE TIME OF THE NOVEMBER 1960, EVENTS AND THE ACCELERATION MECHANISM (Abstract), by S. A. Korff. [1961] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)635] and National Science Foundation) Unclassified

Presented at meeting of the Amer. Phys. Soc., Mexico City (Mexico), June 22-24, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 362, June 22, 1961.

Increases in the cosmic-ray intensity observed with a neutron monitor located at College, Alaska, during Nov. 1960, are reported. Three increases were observed, large ones on Nov. 12 and 15 and a small 1 on Nov. 20. Correlation with other geophysical variables are noted. The possible interpretation of the event is considered on the basis that both high-energy particles, and a much larger number of low-energy particles are accelerated and emitted by the sun, possibly with some difference in the direction of emission. The spectrum may be a natural result of the energy distribution of the particles in the sun before the acceleration starts.

1995

New York U. [Dept. of Physics] N. Y.

THE COSMIC RAY NEUTRON DENSITY AT HIGH ALTITUDES, by R. C. Haymes, W. P. Reidy, and S. A. Korff. [1961] [3]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)635] and National Aeronautics and Space Administration) Unclassified

Presented at Internat'l. Conf. on Cosmic Rays and the Earth Storm, Kyoto (Japan), Sept. 4-15, 1961.

Published in Jour. Phys. Soc. Japan, v. 17: Suppl. A-II: 115-117, Jan. 1962.

Experimental data from balloon flight measurements of slow neutron density (energy less than 1 kev) are reviewed. The slope of the density vs altitude curves is approx 160 gm/cm^3 up to the 100 millibar level, and then is ~ 4 gm/cm^2 to at least 122,000 ft. It appears that the neutron density was about 12% lower in 1958 (max solar activity) than in 1954 (quiet sun).

1996

New York U. Dept. of Physics, N. Y.

OBSERVATIONS AT COLLEGE, ALASKA, OF THE NOVEMBER 1960 COSMIC RAY INCREASES, by S. A. Korff. [1961] [4]p. incl. diagrs. [AF 49(638)-635] Unclassified

Presented at Internat'l. Conf. on Cosmic Rays and the Earth Storm, Kyoto (Japan), Sept. 4-15, 1961.

Published in Jour. Phys. Soc. Japan, v. 17: Suppl. A-II: 303-306, Jan. 1962.

The cosmic ray intensity and its variations, in the time interval between November 9 and 23rd, 1960 is presented and discussed. The time-sequence of the fluctuations and the connections with other geophysical parameters such as aurorae, magnetic indices, and forward-scatter ionosphere observations is described. It is suggested that the high energy particles and the low energy plasma clouds are not necessarily always emitted in the same directions from the sun. (Contractor's abstract)

1997

New York U. [Dept. of Sociology] N. Y.

COALITIONS AND INTERACTION CONCEPTS OF SUPPORT IN THREE-PERSON GROUPS, by E. F. Borgatta and M. L. Borgatta. [1961] [13]p. incl. tables. (AFOSR-1414) (In cooperation with Cornell U., Ithaca, N. Y.) (AF 49(638)195 and AF AFOSR-61-30) Unclassified

Also published in Social Forces, v. 41: 68-75, 1962.

For abstract see item no. 614, Vol. V.

1998

New York U. [Dept. of Sociology] N. Y.

MAKE A SENTENCE TEST: AN APPROACH TO OBJECTIVE SCORING OF SENTENCE COMPLETIONS, by E. F. Borgatta. [1959] [63]p. incl. tables, refs. (AF 49(638)195) Unclassified

Published in Genetic Psychol. Monographs, v. 63: 3-65, Feb. 1961.

A report is presented on a sentence completion test administered to college males and females at N. Y. U. The test consists of several introductory phrases of which the subject was to write whatever comes to one's mind first to make a sentence. Twelve possible categories were established, known as the MAST category system, into which the graders placed the

subject depending upon his answers. The categories were, briefly: paranoid, hostile, boastful, bored, common morality, withdrawal, depressive, worry, introspective mood, sickness, euphoric, and unscorable. Some results were that males made significantly more MAST assertive responses; males make significantly more MAST conventional responses; females made significantly more MAST avoidance responses; and females made significantly more MAST anxious responses. An extensive analysis of each category is given.

1999

New York U. [Inst. of Mathematical Sciences] N. Y.

ROTATION AND STRAIN, by F. John. [1961] [23]p. (AFOSR-339) (AF 49(638)161) Unclassified

Also published in Commun. Pure and Appl. Math., v. 14: 391-413, Aug. 1961.

Let $x = (x_1, \cdots, x_n)$, $\bar{x} = (\bar{x}_1, \cdots, \bar{x}_n)$ denote points of Euclidean n-space and let $\bar{x} = f(x)$ be a mapping defined in an open set R of x-space. Let f' denote the Jacobian matrix $f' = (\partial \bar{x}_i / \partial x_j)$ and let e denote the strain matrix (with (1 + e) positive symmetric) and c the orthogonal rotation matrix in the unique decomposition $f' = c(1 + e)$. Mappings are considered for which $|e(x)| \leq \varepsilon$ for x in R. It is shown that no pointwise estimate for rotations in terms of strains can exist. The above condition is shown to imply the existence of an orthogonal matrix γ and a point x^0 such that: $|f(z) - f(x^0) - \gamma(z - x^0)| \leq \varepsilon A_n$ for z in R, where the constant A_n depends upon R. Further, if R is a cube with volume V, then there exists an orthogonal matrix γ such that $\int_R |f'(x) - \gamma|^2 dv \leq D_n^2 \varepsilon^2 V$, where D_n is a universal constant. The author then remarks that analogous results can be established for regions of sufficiently smooth shape by suitable coverings with cubes. (Math. Rev. abstract)

2000

New York U. Inst. of Mathematical Sciences, N. Y.

ASYMPTOTIC ESTIMATES FOR THE STURM-LIOUVILLE SPECTRUM, by H. Hochstadt. Feb. 1961 [26]p. (Research rept. no. BR-36) (AFOSR-276) (AF 49(638)229) AD 257782 Unclassified

Also published in Commun. Pure and Appl. Math., v. 14: 749-764, Nov. 1961.

It is shown that the differential equation $y'' + [\lambda + \Phi(x)] y = 0$ can, under suitable conditions, be solved by assuming a solution of the form $y = A(x) \sin \varphi(x)$ where $\varphi'(x) = \sqrt{\lambda + \Phi(x)} + 1/4 \dfrac{\Phi'(x)}{\lambda + \Phi(x)} \sin 2\varphi(x) A'(x) = -A(x) \dfrac{\Phi'(x)}{2\lambda + 2\Phi(x)} \cos^2 \varphi(x)$. Use of the first equation leads, when boundary conditions are applied, to asymptotic estimates of the eigenvalues. In particular, in the case of Hill's equation, it is shown that the instability intervals vanish faster than any inverse power of k, k being the order of the corresponding eigenvalues, when $\Phi(x)$ is an analytic function. (Contractor's abstract)

2001

New York U. Inst. of Mathematical Sciences, N. Y.

THE EXPONENTIAL SOLUTION FOR THE HOMOGENEOUS LINEAR DIFFERENTIAL EQUATION OF THE SECOND ORDER, by J. Mariani and W. Magnus. Feb. 1961, 17p. (Research rept. no. BR-37) (AFOSR-391) (AF 49(638)229) AD 254788 Unclassified

A linear 2nd order differential equation may be considered as a 2 x 2 system of 1st order equations. The question is whether the solutions of this system can be written in the form $\exp \Omega$ where Ω is a 2 x 2 matrix. A motivation for the problem is given, based on the question of defining lump constants for an inhomogeneous layer. Conditions necessary for the existence of Ω are given for a variety of circumstances. (Contractor's abstract)

2002

New York U. Inst. of Mathematical Sciences, N. Y.

SOME UNIQUENESS THEOREMS FOR THE REDUCED WAVE EQUATION, by L. M. Levine. June 1961, 96p. incl. refs. (Technical rept. no. BR-33) (AFOSR-1017) (AF 49(638)229) AD 265259 Unclassified

Also published in Commun. Pure and Appl. Math., v. 17: 147-176, May 1964.

Various extensions of the Magnus-Rellich uniqueness theorem for the reduced wave equation in infinite domains are treated. The theorem is extended to cover piecewise smooth boundary surfaces of a general kind, and mixed boundary conditions; no auxiliary edge conditions are required at edges or at discontinuities in the boundary conditions - continuity of the wave function in the closure of the domain is sufficient. Another extension treats infinite boundaries; for real values of the propagation constant, these are restricted to surfaces which are (generalized) cones sufficiently far from the origin. (Contractor's abstract)

2003

New York U. [Inst. of Mathematical Sciences] N. Y.

A STABILITY CRITERION FOR HILL'S EQUATION, by H. Hochstadt. [1961] [3]p. (AFOSR-3967) (AF 49-(638)229) Unclassified

Also published in Proc. Amer. Math. Soc., v. 13: 601-603, Aug. 1962.

It is shown that if p is an even, positive differentiable of period T and if $\int_0^{T/2}(p(t))^{1/2}dt + 1/4\int_0^{T/2}\left|\frac{p'(t)}{p(t)}\right| dt \leq \pi/2$, then all solutions of $y'' + p(t)y = 0$ are bounded on $[0, +\infty]$. If $p(t) = \lambda$, a constant > 0, this gives the best possible estimate $\lambda = \pi^2/T^2$, while Lyapunov's well-known criterion yields only $\lambda = 4/T^2$.

2004

New York U. Inst. of Mathematical Sciences, N. Y.

QUANTUM STATISTICS AND THE BOLTZMANN EQUATION, by R. M. Lewis. June 1961, 58p. incl. diagrs. refs. (Research rept. no. HT-8) (AFOSR-746) (AF 49(638)341) AD 260007 Unclassified

Also published in Jour. Math. Phys., v. 3: 1229-1246, Nov.-Dec. 1962.

The system of hierarchy equations for the reduced density operators of quantum statistical mechanics is replaced by a single functional differential equation for a generating functional. A formal solution of the initial value problem for the latter equation is obtained, leading to series expansions of the reduced density operators. These expansions are used to obtain an improved derivation of the quantum-mechanical Boltzmann equation. (Contractor's abstract)

2005

New York U. Inst. of Mathematical Sciences, N. Y.

STOCHASTIC MODELS FOR MANY-BODY SYSTEMS. I. INFINITE SYSTEMS IN THERMAL EQUILIBRIUM, by R. H. Kraichnan. July 1961, 70p. incl. diagrs. refs. (Research rept. no. HT-9) (AFOSR-1137) (AF 49(638)341) AD 264738 Unclassified

Also published in Jour. Math. Phys., v. 3: 475-495, May-June 1962.

Some model Hamiltonians are proposed for quantum-mechanical many-body systems with pair forces. In the case of an infinite system in thermal equilibrium, they lead to temperature-domain propagator expansions which are expressible by closed, formally exact equations. The expansions are identical with infinite subclasses of terms from the propagator expansion for the true many-body problem. The 2 principal models introduced correspond, respectively, to ring and ladder summations from the true propagator expansions, but augmented by infinite classes of self-energy corrections. The latter are expected to yield damping of single-particle excitations. The eigenvalues of the ring and ladder model Hamiltonians are real, and they are bounded from below if the pair potential obeys certain conditions. The models are formulated for fermions, bosons, and distinguishable particles. In addition to the ring and ladder models, 2 simpler types are discussed, 1 of which yields the Hartree-Fock approximation to the true problem. A novel feature of all model Hamiltonians (except the Hartree-Fock) is that they contain an infinite number of parameters whose phases are fixed by random choices. Explicit closed expressions are obtained for the Helmholtz free energy of all the models in the classical limit. (Contractor's abstract)

2006

New York U. Inst. of Mathematical Sciences, N. Y.

STOCHASTIC MODELS FOR MANY-BODY SYSTEMS. II. FINITE SYSTEMS AND STATISTICAL NON-EQUILIBRIUM, by R. H. Kraichnan. Aug. 1961, 88p. incl. diagrs. (Research rept. no. HT-10) (AFOSR-1138) (AF 49(638)341) Unclassified

Also published in Jour. Math. Phys., v. 3: 496-521, May-June 1962.

In a preceding paper (item no. 2005, Vol. V), some model Hamiltonians were proposed for quantum-mechanical many-body systems with pair forces. In the present paper, more general models are formulated which yield formally summable propagator expansions for finite systems. The analysis is extended to correlation and Green's functions defined for nonequilibrium ensembles. The nonequilibrium treatment is developed in the Heisenberg representation in such a way that unlinked diagrams do not arise. A basic convergence question associated with the formal closed equations for the model propagators and correlation functions is examined by means of finite-difference integration of the Heisenberg equations of motion. This procedure appears to converge independently of whether the perturbation expansions for the propagators and correlation functions converge. It yields substantial support for the validity of the formal closed model equations. (Contractor's abstract)

2007

New York U. Inst. of Mathematical Sciences, N. Y.

ON CONVECTIVE GROWTH-RATES IN A POLYTROPIC ATMOSPHERE, by E. A. Spiegel and N. Wasaburo. [1961] [5]p. (AFOSR-3526) (In cooperation with Tokyo U. Dept. of Astronomy (Japan) as rept. no. 24) (AF 49(638)341) Unclassified

Also published in Publ. Astronom. Soc. Japan, v. 14: 28-32, 1962.

This paper deals with 2 complicating features of convection theory which have recently received much attention. They are the compressibility and large density variations of the gas in the outer convection zones of late-type stars. An exact asymptotic form of convective growth-rates for large horizontal wave numbers is derived analytically for a polytropic atmosphere without viscosity and conductivity.

2008

New York U. Inst. of Mathematical Sciences, N. Y.

QUANTUM STATISTICS AND THE BOLTZMANN EQUATION, by R. M. Lewis. June 1961, 58p. incl. diagrs. refs. (Research rept. no. HT-8) (AFOSR-J228) (AF 49(638)341) AD 400856 Unclassified

Also published in Jour. Math. Phys., v. 3: 1229-1246, Nov.-Dec. 1962.

For abstract see item no. 2004, Vol. V.

2009

[New York U. Inst. of Mathematical Sciences, N. Y.]

A SIMPLIFIED ANALYSIS OF SPHERICAL AND CYLINDRICAL BLAST WAVES, by M. P. Friedman. [1961] [15]p. incl. diagrs. refs. (AFOSR-3403) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)446 and Atomic Energy Commission under AT(30-1)1486) Unclassified

Also published in Jour. Fluid Mech., v. 11: 1-15, Aug. 1961.

Investigations into the behavior of the gas flow behind spherical or cylindrical blasts have shown that secondary shocks arise within the original detonation gases. The secondary shock, at first weak, is carried outward with the expanding gases. Subsequently it strengthens and bends back toward the origin, arriving there with high intensity. By using some recently developed techniques in shock dynamics and extending them where necessary, a theory is developed by which the motion of the main shock wave, as well as the formation and subsequent motion of the secondary shock, are given by explicit formulae. In addition, a method for determining, also by explicit formulae, the location of the contact surface between the detonation gases and the outside atmosphere is given. The results of a specific problem, which has been solved by numerically integrating the total equations of motion, and has also been checked experimentally, are compared with the results of the present theory. (Contractor's abstract)

2010

New York U. Inst. of Mathematical Sciences, N. Y.

ON FAMILIES OF SETS REPRESENTED IN THEORIES, by H. Putnam. June 1961 [9]p. (Rept. no. IMM-NYU 284) (AFOSR-816) (AF 49(638)777) AD 260956 Unclassified

A necessary and sufficient condition is given for a family of sets to be the family of all sets representable in a theory. (Contractor's abstract)

2011

New York U. Inst. of Mathematical Sciences, N. Y.

A MACHINE PROGRAM FOR THEOREM-PROVING, by M. Davis, G. Logemann, and D. Loveland. June 8, 1961, 13p. (Rept. no. IMM-NYU 288) (AFOSR-819) (AF 49(638)777) AD 269378 Unclassified

Also published in Commun. Assoc. Computing Mach., v. 5: 394-397, 1962.

The programming and testing of the proof procedure developed by Davis and Putnam (Jour. Assoc. Comput. Mach., v. 7: 201-215, July 1960) on the IBM 704 is reported. A slight modification of the original procedure was used, and this modification and an outline of the programming method are given. The program however, was unable to prove the elementary group-theory theorem (a right inverse group is also a left inverse) which was believed to be within range.

2012

New York U. Inst. of Mathematical Sciences, N. Y.

EXTENSIONS AND COROLLARIES OF RECENT WORK ON HILBERT'S TENTH PROBLEM, by M. Davis. June 1961, 10p. (Rept. no. IMM-NYU 282) (AFOSR-820) (AF 49(638)777) AD 260753 Unclassified

Also published in Illinois Jour. Math., v. 7: 246-250, June 1963.

The theorem that every recursively enumerable set is exponential Diophantine is improved; a sharp form is given of Kleene's normal form theorem, a problem of Quine is proved recursively unsolvable. (Contractor's abstract)

2013

New York U. Inst. of Mathematical Sciences, N. Y.

DIOPHANTINE SETS OVER POLYNOMIAL RINGS, by M. Davis and H. Putnam. June 1961, 10p. (Rept. no. IMM-NYU 283) (AFOSR-821) (AF 49(638)777) AD 260751 Unclassified

A set S of non-negative integers is called Diophantine over the ring of polynomials $J[\xi]$ with coefficients in J and variables $\xi_1, \xi_2, \cdots$ if S satisfies the following condition: There is a polynomial $p(x, x_1, \cdots, x_n)$ with integral coefficients such that $x \in S$ if and only if there are numbers p and q (depending on x) and polynomials $p_1, \cdots, p_n$ of $J[\xi]$ in the variables $\xi_1, \cdots, \xi_p$ of degree $\leq q$ which satisfy $P(x, p_1, \cdots, p_n) \equiv 0$ identically in $\xi_1, \cdots \xi_p$. For given x and given coefficients of $p_1, \cdots p_n$ this is equivalent to a set of equations in J whose number is uniformly bounded once p and q are given (by equating coefficients in P). It is shown that

if J_0 is the ring of integers, all recursively enumerable (r.e.) sets are Diophantine over $J_0[\xi]$. Let S be called restricted Diophantine over $J[\xi]$ if, in addition, it is required that p and q be bounded uniformly in x. Then, clearly, S is restricted Diophantine over $J_0[\xi]$ if and only if S is Diophantine (over J_0 itself). (Math. Rev. abstract)

2014

New York U. Inst. of Mathematical Sciences, N. Y.

THE INITIAL VALUE PROBLEM, SOUND PROPAGATION, AND MODELING IN KINETIC THEORY, by L. Sirovich. Sept. 15, 1961 [91]p. incl. diagrs. tables. (Rept. no. MF-17) (AFOSR-1380) (AF 49(638)1006) AD 264889 Unclassified

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 naturally exhibits itself as a sequence of epochs, the last stage of which is hydrodynamic. With reference to the same problem macroscopic equations such as Euler, Navier-Stokes, Burnett, Grad's moments equations, etc., are considered. In addition the recently considered kinetic models of Gross (Phys. Fluids, v. 2: 432, 1959) are applied to the problem. These various formulations are critically analyzed and compared with each other and with the Boltzmann analysis. Lastly, several alternate molecular and macroscopic equations are offered which remedy some of the shortcomings which appear in the above mentioned approximate theories. (Contractor's abstract)

2015

New York U. Inst. of Mathematical Sciences, N. Y.

A MAGNETOFLUID-DYNAMIC KUTTA-JOUKOWSKY CONDITION, by E. Cumberbatch, L. Sarason and H. Weitzner. [1961] [1]p. (AFOSR-2844) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)1006 and Atomic Energy Commission under AT(30-1)1480) Unclassified

Also published in Jour. Aerospace Sci., v. 29: 244, Feb. 1962.

A uniqueness condition for the magnetofluid-dynamic flow is suggested and some of its consequences examined.

2016

New York U. [Inst. of Mathematical Sciences] N. Y.

MAGNETOHYDRODYNAMIC FLOW PAST AN AIRFOIL (Abstract), by E. Cumberbatch, L. Sarason, and H. Weitzner. [1961] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)1006] and Atomic Energy Commission) Unclassified

Presented at meeting of the Amer. Phys. Soc., Berkeley, Calif., Nov. 20-22, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 371, Apr. 23, 1962.

The steady flow of a perfectly conducting magnetohydrodynamic fluid past a thin nonconducting airfoil is studied in the model in which the fluid obeys the Lundquist equations linearized about a constant unperturbed flow. Particular attention is given to "hyperliptic" flows in which hyperbolic and elliptic fields are superimposed. Results of Grad, of McCune and Resler, and of Sears and Resler are extended to the case of an arbitrarily inclined unperturbed field. The general solution contains 4 line singularities along 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, by analysis. The singular parts of some flows are investigated numerically.

Nobel Inst. for Neurophysiology, Stockholm (Sweden).
see Karolinska Inst. Nobel Inst. for Neurophysiology, Stockholm (Sweden).

2017

Nobel Inst. for Physics, Stockholm (Sweden).

ALPHA ACTIVITIES AND MASS NUMBER ASSIGNMENTS OF LIGHT ASTATINE ISOTOPES PRODUCED BY HEAVY ION REACTIONS, by W. Forsling, T. Alväger and others. Nov. 15, 1960, 18p. incl. illus. diagrs. refs. (Technical note no. 3) (AFOSR-112) (AF 61(052)118) AD 253299 Unclassified

Also published in Arkiv Fysik, v. 19: 83-98, 1961.

In order to study neutron-deficient astatine isotopes, gold was bombarded by carbon and neon ions in the Stockholm 225-cm cyclotron. Chemical isolations and mass separations were made and the alpha activities found were determined with respect to half-lives and energies by use of ion chamber technique. The isotopes At^{202}, At^{203}, At^{204}, At^{205}, At^{206}, and At^{207} were studied. (Contractor's abstract)

2018

Nobel Inst. for Physics, Stockholm (Sweden).

ON NUCLEAR f5/2, p3/2, p1/2 LEVEL SPACINGS AND TRANSITION PROBABILITIES IN THE LEAD REGION, by I. Bergström, C. J. Herrlander and

others. May 1, 1961, 1v. incl. illus. diagrs. tables, refs. (Technical note no. 5) (AFOSR-851) (In cooperation with Royal Inst. of Technology, Stockholm (Sweden)) (AF 61(052)118) AD 258253
Unclassified

Also published in Arkiv Fysik, v. 20: 93-115, 1961.

A search for transitions of the type $f_{5/2} \rightarrow f_{1/2}$ has been made in Pb^{205}, Pb^{203} and Hg^{201}. It is shown that this transition in Pb^{205} has an energy of only 2.3 kev and goes directly to the $f_{5/2}$ ground state. In Pb^{203} the corresponding transition has an energy of 126 kev and a half-life of 75 + or - 3 ns. In Pb^{201} and Hg^{201} there was no evidence of a half-life longer than about 2 ns. It was essential to work out methods for a systematic search of half-lives in the ns-region in cases where the production of the nuclides to be studied leads to complicated mixtures of isotopes decaying by electron capture. Changes of the $f_{5/2}$, $p_{3/2}$ and $p_{1/2}$ level spacings and transition probabilities with the nucleon number is studied and compared with theory. The agreement between experiments and the predictions of Kisslinger and Sorenson for Pb^{205} and Pb^{203} is shown to be fairly good.

2019

Nobel Inst. for Physics, Stockholm (Sweden).

RECENT WORK ON INSTRUMENTATION FOR NUCLEAR PULSE-HEIGHT SPECTROSCOPY, by B. Astrom, N. G. E. Johansson, and G. Wickenberg. [1961] [7]p. incl. diagrs. (Technical note no. 6) (AFOSR-983) [AF 61(052)118] AD 262054
Unclassified

Abstract published in Semiconductor Nuclear Particle Detectors, Bibliographical series no. 8, Vienna, Internat'l. Atomic Energy Agency, 1962, p. 31.

Also published in Nuclear Electronics; Proc. Internat'l. Atomic Energy Agency Conf., Belgrade (Yugoslavia) (May 15-20, 1961), Vienna, Internat'l. Atomic Energy Agency, v. 1: 535-541, 1962.

The invention of the semiconductor detector for charged nuclear particles has opened up new possibilities in the use of pulse-height spectroscopy techniques for studying nuclear reactions. The high intrinsic resolution of these detectors, both in time and energy measurements, has initiated some developmental work on the associated electronic circuits which is described. In the nuclear research work at the Nobel Inst. a wide range of applications of semiconductor detectors is foreseen. The different experiments demand different types of detectors which generally have a limited life-time. In order to secure a sufficient supply of adaquate units, the production of surface-barrier detectors has been used within the institute. A description of the detectors and the production techniques is given. (Contractor's abstract)

2020

Nobel Inst. for Physics, Stockholm (Sweden).

EVIDENCE FOR OCTUPOLE AND QUADRUPOLE VIBRATIONAL STATES IN Pb^{205}, by I. Bergström, E. C. O. Bonacalza, and P. Thieberger. Sept. 1, 1961, 23p. incl. illus. table. (Technical note no. 7) (AFOSR-1565) (In cooperation with Royal Inst. of Technology, Stockholm (Sweden)) (AF 61(052)118) AD 266646
Unclassified

Also published in Arkiv Fysik, v. 22: 95-110, 1962.

It is shown by internal conversion coefficient measurements that the 2610 and 2567 kev states in Pb^{205} are 9/2 +. It is suggested that the upper state is mainly due to the coupling of the 3- octupole core vibrational state and the 5/2-neutron hole ground state. Angular correlation measurements were made between the E1 gamma rays going from the 2610 kev and 2567 kev states to the 703 kev state, and the 703 kev gamma ray de-exciting this state. If the E1 transitions are both assumed to be pure, it follows that the 703 kev gamma ray is due to 98% E2 radiation and 2% M1 radiation. The strong E2 enhancement in the 703 kev ground state transition (7/2- yields 5/2-) suggests that the 703 kev state might be due to 1 phonon quadrupole core vibration coupled to the 5/2-ground state of the odd neutron. There are also some evidences for the 1615 kev state being originated by a similar coupling between the odd neutron ground state and 2 phonon quadrupole core vibration. (Contractor's abstract)

2021

Nobel Inst. for Physics, Stockholm (Sweden).

THE DECAY OF ENERGY OF Bi^{205}, by E. C. O. Bonacalza, P. Thieberger, and I. Bergström. Sept. 25, 1961, 21p. incl. illus. (Technical note no. 8) (AFOSR-1566) (In cooperation with Royal Inst. of Technology, Stockholm (Sweden)) (AF 61(052)118) AD 266647
Unclassified

Also published in Arkiv Fysik, v. 22: 111-125, 1962.

The decay energy of Bi^{205} was determined by measuring the K and L x-rays which follow electron capture and feed the 2567 kev and 2610 kev levels. In this way the K to L, K to total and L to total capture ratios were found. Comparing these values with theoretical predictions, a total decay energy of 2703 ± 6 kev was established. This corresponds to a neutrino energy of 46 kev for K-capture to the 2567 kev level. Since this value disagreed with the previously determined maximum positron energy feeding the 703 kev level, the positron spectrum was remeasured and a value of 976 ± 10 kev was found. This yields a total decay energy of 2701 ± 10 kev, in good agreement with the capture value. K and L x-rays feeding the 1766 kev level were measured as a check of the method since, for such a large spacing, the ratios are rather insensitive to energy variations The log

ft values for the E. C. decay to the 2567 kev and 2610 kev levels were calculated yielding values of 6.60 ± 0.05 and 6.34 ± 0.06, respectively. (Contractor's abstract)

2022

Nobel Inst. for Physics, Stockholm (Sweden).

MASS NUMBER ASSIGNMENTS AND ALPHA ACTIVITIES OF LIGHT POLONIUM ISOTOPES, by W. Forsling and T. Alväger. [1961] [16]p. incl. diagrs. table, refs. [AF 61(052)118] Unclassified

Published in Arkiv Fysik, v. 19: 353-368, 1961.

Light polonium isotopes have been produced mainly by utilizing heavy ion bombardments. Mass number assignments of these nuclides have been made by use of an electromagnetic isotope separator. The alpha activities of Po^{198}, Po^{199}, Po^{200}, Po^{201}, Po^{202}, Po^{203}, Po^{204}, Po^{205}, Po^{206}, Po^{208} and Po^{210} were studied in this work. (Contractor's abstract)

2023

Nobel Inst. for Physics, Stockholm (Sweden).

ALPHA RADIOACTIVITIES FROM NUCLIDES IN THE ATOMIC NUMBER REGION 80-83, by W. Forsling. [1961] [6]p. incl. refs. [AF 61(052)118] Unclassified

Published in Arkiv Fysik, v. 19: 369-374, 1961.

By bombardment of targets of wolfram, rhenium, osmium and iridium with carbon ions in the Stockholm 225-cm cyclotron, a great number of light nuclides, mainly belonging to the elements, mercury, thallium, lead and bismuth, has been produced. Possible alpha emitters have been searched for and the results obtained hitherto are preliminarily reported in this paper. (Contractor's abstract)

2024

Nobel Inst. for Physics, Stockholm (Sweden).

INVESTIGATION OF GAMMA RADIATION FROM NUCLEAR REACTIONS, by K. G. Malmfors. Final rept. Jan. 1-Dec. 31, 1960. Mar. 14, 1961, [1]p. incl. diagrs. (AFOSR-539) (AF 61(052)336) AD 262190 Unclassified

Gamma radiation from nuclear reactions was studied by means of a time-of-flight spectrometer (trochoid spectrometer). The spectrometer was used in connection with an 80-cm cyclotron. The reaction $F^{19}(p,\alpha)O^{16}$ was studied. A thick target of CaF_2 was bombarded with 3.5 mev protons and the resulting gamma radiation was allowed to fall upon a converter at a distance of 5 cm from the target. First an aluminum converter was used and the Compton electrons were analyzed according to the flight time in the spectrometer. Electronic equipment was later constructed which made it possible to use the instrument as a pair spectrometer. In this case a gold converter was used and the flight times of the positrons and the negatrons were recorded and combined so that a gamma spectrum could be immediately obtained on a 100-channel pulse-height analyzer. Results of such measurements are shown. In accordance with the well-known level scheme of O^{16} three gamma lines with the energies 6.14, 6.92 and 7.12 mev are observed. These values are taken from the literature and the measurements reported should be considered as a calibration of the spectrometer. (Contractor's abstract)

2025

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. illus. diagrs. tables. (Rept. no. SID-61-275) (AFOSR-1493) (AF 49(638)250) AD 265237 Unclassified

Also published in Jour. Aerospace Sci., v. 29: 909-916, Aug. 1962.

Experiments carried out in the 12-in. supersonic wind tunnel to investigate the effect of 3-dimensional roughness elements (spheres) on boundary-layer transition on a 10° (apex angle) cone without heat transfer are reported. The local Mach number for these tests was 2.71. The data show clearly that the minimum (effective) size of trip required to bring transition to its lowest Reynolds number varies as the one-fourth power of the distance from the apex of the cone to the trip. Use of available data at other Mach numbers indicates that the Mach number influence for effective tripping is taken into account by the simple expression $Re_{\delta^*} = 1025\,(1 + \frac{\gamma-1}{2} M_{\delta}^{2})\,(k/\delta^*)^{-2}$. Some remarks concerning the roughness variation for transition on a blunt body are made. Finally, a general criterion is introduced which gives insight to the transition phenomenon and anticipates effects of external and internal disturbances, Mach number, and heat transfer.

2026

North American Aviation, Inc. Rocketdyne Div., Canoga Park, Calif.

TRANSVERSE GAS MOTIONS IN CYLINDRICAL AND ANNULAR THRUST CHAMBERS, by I. Mirsky. Feb. 28, 1961, 105p. (AFOSR-124) (Rept. no. R-2903) (AF 49(638)817) AD 253078 Unclassified

An analytical study is made of finite amplitude pressure waves transverse to the axis of baffled and unbaffled full and annular thrust chambers. The

nonlinear equations of motion for a compressible viscous fluid without combustion are solved to a second-order approximation. (Contractor's abstract)

2027

North American Aviation, Inc. Rocketdyne Div., Canoga Park, Calif.

THE BEHAVIOR OF PRESSURE WAVES IN A PRESSURE DEPENDENT COMBUSTION FIELD: PART 1, by I. Mirsky. Aug. 1961, 49p. incl. illus. (Rept. no. R-3152) (AFOSR-975) (AF 49(638)817) AD 262077 Unclassified

A study is made of 1 of the physical processes capable of driving and sustaining acoustic resonance in a thrust chamber, namely a pressure sensitive heat release rate. Approximate conditions are obtained on the pressure exponent n to produce decay or growth of the initial pressure disturbance. The nonlinear equations for a non-viscous compressible fluid are then solved to a second order approximation for the special case n = 1. Results indicate growth of the pressure wave for this value of n. (Contractor's abstract)

2028

[North American Aviation, Inc.] Rocketdyne Div., Canoga Park, Calif.

PHYSICAL PROCESSES OF ROCKET COMBUSTION (Abstract), by R. B. Lawhead. [1961] [1]p. [AF 49-(638)617] Unclassified

Presented at Fourteenth AFOSR Contractors' meeting on Liquid Rocket Combustion Research, Princeton U., N. J., Sept. 25-26, 1961. (AFOSR-1766; AD 267915)

Results of research studies of liquid propellant rocket combustion processes and methods for stabilizing destructive acoustic modes of instability are discussed. The results of these studies may be summarized as follows. Dynamic stability as a requirement for all rocket systems. At least 1 method of dynamic stabilization is presently available. An understanding of the physical processes of stabilization is required before stabilization design parameters can be generalized. Present droplet burning model describes steady state combustion in current LOX/Hydrocarbon systems. The model must be expanded to other propellants and operating conditions and unstable operations. Experimental studies must correspond with large engine behavior. Basic physical process data required to confirm and expand analytical models and permit development of design criteria must be investigated.

2029

North Carolina U. Dept. of Chemistry, Chapel Hill.

COPPER AS A PHOTOMETRIC INDICATOR IN THE SELECTIVE CHELOMETRIC TITRATION OF METAL ION MIXTURES, by D. A. Aikens, G. Schmuckler and others. Mar. 2, 1961, 1v. incl. diagrs. tables, refs. (Rept. no. UNC-Chem. no. 6-CNR) (AFOSR-426) (AF 49(636)333) AD 255479 Unclassified

Photometric and point detection permits selective chelometric determination of metal ions in mixtures with much less masking than required for visual or potentiometric techniques. Copper has been found to be a useful photometric indicator for such titrations. Prediction of appropriate titration conditions is readily accomplished with graphical plots of effective chelonate stability. Calcium is determined in the presence of magnesium with ethylene glycol bis(beta-amino-ethyl ether)-N,N-tetraacetic acid in 0.5 M ammonium hydroxide at pH 10. Selective determination of cadmium or of zinc in the presence of the other is carried out with diethylenetriaminepentaacetic acid under the same conditions. Attention is directed to the importance of competitive equilibria which affect chelonate stability, and stability constants for ammonia derivatives of some copper chelonates are reported. (Contractor's abstract)

2030

North Carolina U. Dept. of Chemistry, Chapel Hill.

A CONSTANT CURRENT MICROCOULOMETRIC TECHNIQUE FOR DROPPING MERCURY ELECTRODES, by H. M. Mark, Jr., E. M. Smith, and C. N. Reilley. May 27, 1961 [25]p. incl. diagrs. tables, refs. (Rept. no. UNC-Chem. no. 9-CNR) (AFOSR-788) (AF 49(638)333) AD 259140 Unclassified

Also published in Jour. Electroanal. Chem., v. 3: 98-111, Feb. 1962.

A constant current microcoulometric method for determining the number of electrons involved in a unit of reaction at a dropping mercury electrode is described in detail. A large capacitor is connected in parallel with the microcell, and a constant current applied to the combination. The results obtained from several tests with both reversible and irreversible reductions are discussed, and the optimum conditions for accurate results with the method are presented. The principal advantage of the amperostatic method over the usual potentiostatic method is the ease with which the number of coulombs passed during the electrolysis can be calculated.

2031

North Carolina U. Dept. of Chemistry, Chapel Hill.

A SENSITIVE POLAROGRAPHIC TECHNIQUE, by H. B. Mark, Jr. and C. N. Reilley. May 26, 1961 [16]p. incl. diagrs. tables, refs. (Rept. no. UNC-Chem. no. 6-CNR) (AFOSR-769) (AF 49(638)333) AD 259139 Unclassified

Also published in Jour. Electroanal. Chem., v. 3: 54-63, Jan. 1962.

A simple polarographic technique, based upon

measuring the difference between the total current in the sample solution and the residual current in the supporting electrolyte solution at a specified time during drop life, was investigated. Concentrations, ranging from 1/1,000,000 to 1/100,000 M, of a single reducible species could be determined to within ± 4/100,000 M. A similar technique permits qualitative and quantitative analysis of mixtures containing 2 or more reducible species in the 1/1,000,000 M concentration range. These methods were tested with solutions of Pb^{++}, Cu^{++}, and Zn^{++}. (Contractor's abstract)

2032

North Carolina U. Dept. of Chemistry, Chapel Hill.

CURRENT-SCAN POLAROGRAPHY. STUDY OF A SYSTEM WHICH EXHIBITS A POLAROGRAPHIC MAXIMUM, by H. B. Mark, Jr. and C. N. Reilley. [1961] [10]p. incl. diagrs. tables, refs. (AFOSR-1322) (AF 49(638)333) AD 441852 Unclassified

Also published in Jour. Electroanal. Chem., v. 3: 353-362, June 1962.

The Ni^{2+} system which gives a polarographic maximum, has also been shown, by this investigation, to give an unusual controlled current-scan polarogram. A dropping mercury electrode and a large capacitor connected in parallel with the electrolysis cell were used. The limiting currents, obtained when an increasing current-scan was applied, were poorly reproducible and were much greater than the average diffusion-controlled current. In contrast, a decreasing current-scan resulted in very precise diffusion-limited current values, which were proportional to concentration over the millimolar range. An explanation of these characteristics is presented in terms of the same phenomenon which caused the potential-scan max. Also, the effects of varying the capacitance, concentration of reducible species, and concentration of a maximum suppressor are discussed. (Contractor's abstract)

2033

North Carolina U. Dept. of Chemistry, Chapel Hill.

CHELOMETRIC TITRATIONS WITH AMPEROMETRIC END-POINT DETECTION, by R. T. Campbell and C. N. Reilley. Aug. 29, 1961 [29]p. incl. diagrs. tables, refs. (Rept. no. UNC-Chem. no. 12-CNR) (AFOSR-1547) (AF 49(638)333) Unclassified

Also published in Talanta, v. 9: 153-167, 1962.

Anodic chelon waves may be used as indicator waves in the amperometric titration of metal ions which exhibit poorly defined reduction waves. By this method, also mixtures of metal ions whose log K values differ by less than 4 units may be selectively titrated. Buffers and chelons may be selected to improve selectivity, and the procedure is more rapid than the usual amperometric methods. Results are given for selected ions and mixtures of ions. The interference of halide ions must be overcome.

2034

North Carolina U. Dept. of Chemistry, Chapel Hill.

DIFFERENTIAL KINETIC ANALYSIS: THE METHOD OF PROPORTIONAL EQUATIONS, by R. G. Garmon and C. N. Reilley. Aug. 11, 1961 [34]p. incl. diagrs. table, refs. (Rept. no. UNC-Chem. no. 11-CNR) (AFOSR-1549) (AF 49(638)333) AD 441849 Unclassified

Also published in Anal. Chem., v. 34: 600-606, May 1962. (Title varies)

The initial concentration of a species undergoing a simple or complex first-order reaction is directly proportional to the amount of product formed at any given time or to any parameter directly proportional to the product. This proportional relationship is utilized in 2 ways. First, measurements of the extent of reaction for several species undergoing completing reactions at a number of times equivalent to the number of species present permits a simultaneous determination of the mixture. Second, the change in the extent of a reaction between any 2 given times is directly proportional to the initial concentration of the reacting species. Judicious selection of a time interval in which to observe the reaction greatly reduces the effect of interfering species. (Contractor's abstract)

2035

North Carolina U. Dept. of Chemistry, Chapel Hill.

THE KINETICS OF EXCHANGE OF COPPER (II) BETWEEN ETHYLENEDIAMINETETRAACETIC ACID AND ERIOCHROME BLUE BLACK R, by D. W. Rogers, D. A. Aikens, and C. N. Reilley. [1961] [5]p. incl. diagrs. refs. (AFOSR-4476) (AF 49(638)-333) AD 441846 Unclassified

Also published in Jour. Phys. Chem., v. 66: 1582-1586, Sept. 1962.

The exchange of Cu (II) between EDTA and Eriochrome Blue Black R, 1-(2-hydroxy-1-naphthylazo)-2-naphthol-4-sulfonic acid, a typical o,o'-dihydroxyazo compound, occurs by acid-catalyzed dissociation of the chelates below pH 5 and by second-order displacement reactions above pH 5. Bonding of the attacking ligand to the Cu chelate followed by competition between the two ligands is postulated for the second-order reactions. (Contractor's abstract)

2036

North Carolina U. Dept. of Chemistry, Chapel Hill.

OBSERVATIONS ON THE EFFECTS OF TEMPERATURE, SUPPORT, AND AMOUNT OF PARTITIONING LIQUID IN GAS CHROMATOGRAPHY, by J. W. Ashley, C. N. Reilley and others. [1961] [4]p. incl. diagrs. table. (AFOSR-4477) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)333 and Atomic Energy Commission under AT(30-1)905) AD 441845 Unclassified

Also published in Anal. Chem. , v. 34: 1537-1540, Nov. 1962.

A mixture of four ketones has been used to demonstrate how the frequently adverse effect of a decrease in the amount of liquid phase can often be counteracted by a decrease in column temperature. The use of thin films of relatively volatile partitioning liquids has also been demonstrated.

2037

North Carolina U. Dept. of Chemistry, Chapel Hill.

GAS CHROMATOGRAPHIC RESPONSE AS A FUNCTION OF SAMPLE INPUT PROFILE, by C. N. Reilley, G. P. Hildebrand, and J. W. Ashley, [1961] [16]p. incl. diagrs. tables, refs. (AFOSR-4478) (Sponsored jointly by Advanced Research Projects Agency and Air Force Office of Scientific Research under AF 49(638)333) AD 441844
Unclassified

Also published in Anal. Chem., v. 34: 1198-1213, Sept. 1962.

A series of equations based on a simple principle is developed to describe the shape of chromatographic curves in terms of the mode of sample injection. This principle is used to develop useful parameters to describe step chromatography curves, and comparison is made to the corresponding parameters of impulse chromatography curves. The use of various input functions leads to many novel response shapes, thus considerably broadening the scope of gas chromatographic techniques. Applications of various sample input profiles to quantitative analysis, preparative chromatography, the study of column phenomena, and the monitoring of industrial process streams are discussed. (Contractor's abstract)

2038

North Carolina U. Dept. of Chemistry, Chapel Hill.

INCREASED SELECTIVITY IN CHELOMETRIC TITRATIONS THROUGH END POINT LOCATION BY LINEAR EXTRAPOLATION. COPPER AS A PHOTOMETRIC INDICATOR, by D. A. Aikens, G. Schmuckler and others. [1961] [8]p. incl. diagrs. tables, refs. (AFOSR-4479) (AF 49(638)333) AD 441843
Unclassified

Also published in Anal. Chem., v. 33: 1664-1671, Nov. 1961.

The inherent selectivity of end point location by linear extrapolation permits selective determinations to be carried out when the difference in effective chelonate stability constants of sought-after and interfering ions is as small as 2 log K units. The necessary masking often can be provided by careful choice of chelon and buffer systems. Photometric titrations with a Cu(II) indicator are presented as an example. Ca is determined in the presence of Mg in 0.5M ammonium hydroxide at pH 10 with ethylene glycol bis(bor 'B'-type beta)-N,N'-tetraacetic acid. Selective determinations of Cd and of Zn in the presence of the other are carried out with diethylenetriaminepentaacetic acid under the same conditions. Analytical and empirical methods for the determination of appropriate solution conditions are presented. (Contractor's abstract)

2039

North Carolina U. Dept. of Mathematics, Chapel Hill.

A NEW PROOF OF THEOREMS OF PERRON AND FRONBENIUS ON NON-NEGATIVE MATRICES. II, by A. Brauer. Sept. 1961, 16p. incl. refs. (Technical rept. no. 14) (AFOSR-1496) (AF 18(603)38)
Unclassified

Also published in Studies in Mathematical Analysis and Related Topics, Stanford, Stanford U. Press, 1962, p. 48-55. (Title varies)

In part 1 of this paper (item no. NCU.03:002, Vol. 1) a new proof of the Theorems of Perron and Frobenius on positive matrices was given and some of their results were improved. Moreover, a method was obtained to compute the greatest positive root of a positive matrix and a characteristic vector belonging to this root as exactly as needed. The same method can be used for non-negative matrices. But the proofs are more difficult than for positive matrices. Therefore, the results were first published for positive matrices and the publication for the case of non-negative matrices is given. The proofs become much simpler and the computation of the greatest root requires a smaller number of steps. (Contractor's abstract)

2040

North Carolina U. [Dept. of Physics] Chapel Hill.

A STUDY OF DISLOCATIONS IN SILVER CHLORIDE, by M. G. Miller. June 1961, 91p illus. diagrs. refs. (AFOSR-946) (AF 49(638)[illegible]) [illegible]259676
Unclassified

Dislocations in AgCl have been studied through the use of 3 different types of experiments: absorption edge measurements; tensile tests; decoration experiments. A shift of 1A% plastic deformation could have been detected. This is much smaller than the shift of 12A% plastic deformation found by Chiarotti. Experiments on the tensile properties of AgCl show that the history of preparation and impurity content of the crystal affects these properties. Tests were run on copper doped samples which showed that the divalent state exhibited strain aging whereas the crystal containing copper in the monovalent state showed no strain aging. Quenching raises the initial yield point by 350% with the evidence pointing toward a large part of the increase being due to quenched in point defects. Photolytic silver in the interior of AgCl locks dislocations and raises the initial yield stress by 60%. Strain aging was found to be accumulative. Part of the increase in yield stress is irrecoverable.

A technique for decorating dislocations deep in the interior of AgCl crystals using the Haynes-Shockley method was extended. (Contractor's abstract)

2041

North Carolina U. [Dept. of Physics] Chapel Hill.

EFFECTS OF QUENCHING AND ANNEALING ON IONIC CONDUCTIVITY AND ON DISLOCATION DECORABILITY IN SILVER CHLORIDE, by H. Layer, M. G. Miller, and L. Slifkin. [1961] [18]p. incl. illus. diagr. refs. (AFOSR-1432) (AF 49(638)865) AD 263713 Unclassified

Presented at Internat'l. Conf. on Chemical Physics of Nonmetallic Crystals, Evanston, Ill., Aug. 28-31, 1961. (AFOSR-2143)

Also published in Jour. Appl. Phys., Suppl., v. 33: 478-481, Jan. 1962.

Pure silver chloride crystals, when cooled rapidly from high temperatures, show enhanced ionic conductivity which may be attributed to quenched-in Schottky defects. From the annealing out of this extra conductivity one deduces that for an associated vacancy pair the binding energy is 0.42 ev and the migration energy is ≥ 1.0 ev. The decorability of interior dislocations by swept-in photoelectrons is also discussed and is shown to be sensitive to the purity of the crystal. (Contractor's abstract)

2042

North Carolina U. [Dept. of Physics] Chapel Hill.

STUDIES OF POINT DEFECTS IN SILVER CHLORIDE, by H. Layer and L. Slifkin. [1961] [11]p. (AFOSR-2644) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)865 and Atomic Energy Commission) AD 289109 Unclassified

Also published in Jour. Phys. Chem., v. 66: 2396-2398, Dec. 1962.

Experiments on excess point defects introduced into single crystals of silver chloride by pulsed plastic extension or by rapid cooling from high temperature yield the following results. Point defects are created by plastic deformation much less efficiently in silver chloride than in other substances that have been studied. Interstitial silver ions so produced have a lifetime of the order of 10^8 jumps. Rapid cooling of very pure silver chloride quenches in approximately 0.1% Schottky defects. The silver and chloride vacancies are almost completely associated at room temperature. These divacancies have an activation energy for migration of 23 kcal/mol and a dissociation energy of 9.8 kcal/mol. (Contractor's abstract)

2043

North Carolina U. [Dept. of Physics] Chapel Hill.

DISLOCATION DECORATION INSIDE SILVER CHLORIDE CRYSTALS (Abstract), by L. Slifkin and C. B. Childs. [1961] [1]p. [AF 49(638)865] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 23, Feb. 1, 1961.

A method for the decoration of dislocations throughout the interior of large AgCl single crystals which does not require an annealing treatment at elevated temperatures is developed. The crystals are moderately loaded with submicroscopic colloidal Ag by means of the Haynes-Shockely photoelectric technique. They are then allowed to age for several days at room temperature, during which time much of the Ag migrates from random scattering centers into the dislocations. This results in such an increase in the contrast between the decorated dislocations and the background that the dislocation structures then can be examined with ordinary bright-field microscopy and to depths of the order of mm. Photographs of various networks and dislocation structures obtained by this technique will be shown. Since no high-temperature annealing is necessary, this method suggests the possibility of studies of plasticity effects in the cold-worked state without the limitation of surface effects.

2044

North Carolina U. [Dept. of Physics] Chapel Hill.

DETECTION OF PRIMARY COSMIC-RAY PARTICLES IN LARGE SILVER CHLORIDE SINGLE CRYSTALS (Abstract), by C. B. Childs and L. Slifkin. [1961] [2]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)865] and Army Research Office (Durham)] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 52-53, Feb. 1, 1961.

Patterns attributable to tracks of heavy cosmic rays have been developed internally in large single crystals of AgCl. Crystals which had been flown at 120,000 ft were treated according to the procedure of Haynes and Shockley. Pulsed UV radiation produces photoelectrons near the surface of the crystal. If the surface is sufficiently undistorted, these electrons then may be swept into the interior by a synchronous electric field. Some photoelectrons become trapped along imperfections formed by the cosmic-ray track. Silver ions combine with these electrons to form Ag-atoms which then serve as further traps. Ultimately the cosmic-ray track is delineated by microscopic

Ag specks. Preliminary studies show several events which can be attributed to cosmic-ray particles. Possible advantages of this technique are lack of angular distortion during development and high density of the medium.

2045

North Carolina U. [Dept. of Physics] Chapel Hill.

DISLOCATIONS IN SILVER CHLORIDE CRYSTALS (Abstract), by M. G. Miller and L. Slifkin. [1961] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)865] and Army Research Office (Durham)] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 280, Apr. 24, 1961.

Dislocations in AgCl were studied utilizing 2 distinct experimental techniques: (1) Dislocations in the interior of crystals have been decorated by forming internal print-out, using the Haynes Shockley technique; and (2) tensile experiments, using a "hard" tensile machine have been performed to determine the effect of impurities, defects inducted by quenching, and internal print-out on the plastic properties of AgCl. The relative contrast of dislocation decoration has been found to be extremely dependent on impurity content. At the time of writing no evidence has been found for pile-ups although bowed out loops have been observed. In copper-doped crystals, the presence or absence of strain aging has been found to be dependent upon whether the impurity is in the divalent or monovalent state. Crystals containing decorated dislocations have been tested in tension and show a slight increase in initial yield point. Further similar experiments are in progress. Quenching experiments indicate that defects thus produced increase the yield point markedly and also decrease the rate of work hardening.

2046

North Carolina U. Dept. of Physics, Chapel Hill.

RENORMALIZATION OF QUANTUM ELECTRODYNAMICS IN A CLASSICAL GRAVITATIONAL FIELD, by R. Utiyama. July 1961, 45p. incl. diagrs. refs. (Publication no. 9) (AFOSR-1349) (AF AFOSR-61-72) AD 269909 Unclassified

Also published in Phys. Rev., v. 125: 1727-1740, Mar. 1, 1962.

The singularities of Green's functions of electrons and photons in a classical gravitational field are investigated. These singularities can be removed by the introduction of some suitable counter terms into the equations of Green's functions. These counter terms can be given by rewriting the conventional renormalization technique in a generally covariant way. The infinite renormalization constants appearing in the conventional quantum electrodynamics are shown to be sufficient for the removal of the singularities of the present system; any other renormalization is not necessary. The segregation of these singularities needs an exclusive use of the transformation properties of Green's functions under general coordinate transformations, Viebein rotations, and gauge transformations. (Contractor's abstract)

2047

North Carolina U. Dept. of Physics, Chapel Hill.

RENORMALIZATION OF A CLASSICAL GRAVITATIONAL FIELD INTERACTING WITH QUANTIZED MATTER FIELDS, by R. Utiyama and B. S. DeWitt. [1961] [11]p. incl. diagrs. (Publication no. 11) (AFOSR-1746) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-72 and Office of Naval Research under Nonr-85507) AD 269910 Unclassified

Also published in Jour. Math. Phys., v. 3: 608-618, July-Aug. 1962.

The behavior of the mean value of the energy-momentum tensor of a set of quantized matter fields interacting with a classical gravitational field which is, in turn, produced by this mean value, is investigated. Singularities appear in the energy-momentum tensor corresponding to divergences of 3 different orders: ∞^4, ∞^2, and $\log \infty$. These can be removed by the introduction of counter terms into Einstein's equation. The ∞^4 singularity is removed by a "cosmological term," the ∞^2 singularity by a renormalization of the gravitation constant, and the $\log \infty$ singularity by a counter term derivable from a Lagrangian which is quadratic in the Riemann tensor. The gravitational Green's function corresponding to this semiclassical approximation to the fully quantized theory is found to have the asymptotic behavior $1/p^4$ instead of $1/p^2$, and thus to have a much weaker singularity in the coordinate representation than the Green's function of the "bare" linearized theory. (Contractor's abstract)

2048

North Carolina U. Dept. of Physics, Chapel Hill.

QUANTUM THEORY WITHOUT ELECTROMAGNETIC POTENTIALS, by B. S. DeWitt. Sept. 1961, 7p. (Publication no. 10) (AFOSR-2058) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-72 and Office of Naval Research under Nonr-85507) AD 270562 Unclassified

Also published in Phys. Rev., v. 125: 2189-2191, Mar. 15, 1962.

It is well known that the potentials must appear in Schrödinger's equation, because there is no way in quantum mechanics to express the interaction of the electron with the electromagnetic field solely in

terms of field quantities. It is the purpose of this note to demonstrate that this and similar assertions are false. (Contractor's abstract)

2049

North Carolina U. Dept. of Physics, Chapel Hill.

QUANTIZATION OF FIELDS WITH INFINITE-DIMENSIONAL INVARIANCE GROUPS. II. ANTICOMMUTING FIELDS, by B. S. DeWitt. [1961] [12]p. incl. refs. (Publication no. 12) (AFOSR-2165) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-72 and Office of Naval Research under Nonr-85507) AD 271433 Unclassified

Also published in Jour. Math. Phys., v. 3: 625-636, July-Aug. 1962.

The Green's function approach to the definition of commutators for fields possessing infinite dimensional invariance groups is extended to the case of anticommuting fields. The discussion is restricted to fields which provide linear homogeneous or inhomogeneous representations of the group, a restriction which excludes no case of practical interest and facilitates setting up the formalism in a manifestly covariant way. Self-consistency of supplementary conditions, Huygen's principle and reciprocity relations are established just as for commuting fields. Careful attention must be paid to the ordering of anticommuting factors, particularly in the demonstration of the Poisson-Jacobi identity. The invariance properties of the Poisson bracket are investigated in detail and the notion of conditional invariant is introduced. A special class of conditional invariants called asymptotic invariants, which give a complete physical characterization of initial and final states of the dynamical system, is studied. (Contractor's abstract)

2050

North Carolina U. Dept. of Physics, Chapel Hill.

DEFINITION OF COMMUTATORS VIA THE UNCERTAINTY PRINCIPLE, by B. S. DeWitt. [1961] [6]p. incl. refs. (AFOSR-J21) (AF AFOSR-61-72) AD 297258 Unclassified

Also published in Jour. Math. Phys., v. 3: 619-624, July-Aug. 1962.

A general demonstration is given of the fact that the quantization of any system, as expressed by the uncertainty principle, implies the quantization of all other systems to which it can be coupled. It is also shown that the precise form which the uncertainty principle takes is uniquely specified. That is to say, the uncertainty principle effectively defines the commutator of any pair of observables. The argument serves to detach completely from its canonical origins a previously given definition of the commutator (which is a generalization of one given by Peierls) applicable to systems with infinite-dimensional invariance groups, for which the identification of canonical variables is an inconvenience. The measurements of a single observable and of a pair of observables are analyzed according to the Bohr-Rosenfeld scheme. (Contractor's abstract)

2051

North Carolina U. Inst. of Statistics, Chapel Hill.

ON THE DEFINITION OF A CERTAIN CLASS OF AUTOMATA, by M. P. Schützenberger. Jan. 1961, 33p. (Mimeograph series no. 273) (AFOSR-87) (AF 49(638)213) AD 260709 Unclassified

This note is concerned with the definition of a class of 1 way tape automata, A, that includes that of finite automata. In a schematic manner an automaton from the class A consists of a 1 way, 1 tape, finite automaton controlling a very elementary computational process in which enter a finite number of finite but not bounded integral parameters. Three main restrictions are introduced. The definitions assure that a good part of Kleene's theory remains valid for the class A. Examples and counterexamples are presented to support the definitions. Kleene's theory is applied to the class A and an intuitive interpretation of the set of words accepted by an automaton of this class is given.

2052

North Carolina U. Inst. of Statistics, Chapel Hill.

INFERENCE ON TREATMENT EFFECTS AND DESIGN OF EXPERIMENTS IN RELATION TO SUCH INFERENCE, by S. N. Roy and J. N. Shrivastava. Jan. 1961, 26p. (Mimeograph series no. 274) (AFOSR-136) (AF 49(638)213) AD 260704 Unclassified

Inference procedures and designs are discussed that are more appropriate to those situations in ANOVA or MANOVA where, against the customary or standard null hypothesis, we are interested in certain non-standard alternatives or, in other words, we are interested in increasing the discrimination along certain (non-standard) directions of deviation, even at some cost to the discrimination along other directions of deviation. It is indicated how, for several such situations, it is possible to improve upon both the customary designs and the customary inference procedure. (Contractor's abstract)

2053

North Carolina U. Inst. of Statistics, Chapel Hill.

ON THE RECURRENCE OF PATTERNS, by M. P. Schützenberger. Mar. 1961, 14p. (Mimeograph series no. 283) (AFOSR-470) (AF 49(638)213) Unclassified

Consider a Bernoulli process in which the individual outcomes are the letters $x_i \in X$ and a set of words

(or "patterns") $U = u_i$ in these letters. By definition, the event U occurs for the first time at the end of a sequence f of letters if the last letters of f form a word from U and if this occurrence has not happened earlier on f. This type of recurrent event has been considered at some length by W. Feller, especially in the case where U reduces to the word $u = x_1^n$ $(= x_1 x_1 \cdots x_1)$, i.e. in the case of the so called "success run of length n." In the present note Feller's results are developed in order to get a simple expression for the generating function of U when U is a finite set, and with the help of some combinatorial properties of free monoids, more details of the case are discussed where U reduces to a single word.

2054

North Carolina U. [Inst.] of Statistics, Chapel Hill.

ON THE CONSTRUCTION OF BOSE-CHAUDHURI MATRICES WITH THE HELP OF ABELIAN GROUP CHARACTERS, by D. C. Fosta. Mar. 1961, 21p. (Mimeograph series no. 278) (AFOSR-489) (AF 49-(638)213) Unclassified

Error-connecting codes or fractionally replicated factorial designs are built by constructing matrices having the P_d-property that any d rows of an n x r matrix A with entries from GF(s) (s prime power) are independent equivalent to the existence of an (n, n-p) s-ary t-error correcting and (t + 1)-error-detecting group code if $d = 2t + 1$, In addition, the Bose proof of the existence of a $\frac{1}{s^{n-p}} \cdot S^n$ fractionally replicated factorial design as being equivalent to $d = 2t$ in which no t-factor or lower order interaction is aliased with any t-factor or lower order interaction is used. Through use of the theory of group characters the results are formulated and it is shown how the Bose-Chaudhuri matrices can be obtained from the character tables of cyclic groups. An analogous construction is obtained with character tables of Abelian groups and hence a new family of matrices having the P_d-property.

2055

North Carolina U. Inst. of Statistics, Chapel Hill.

ON A SPECIAL CLASS OF RECURRENT EVENTS, by M. P. Schützenberger. June 1961, 15p. (Mimeograph series no. 291) (AFOSR-891) (AF 49(638)213) AD 260711 Unclassified

Also published in Ann. Math. Stat., v. 32: 1201-1213, 1961.

Let F be the set of all finite sequences (words) in the symbols $x \in X$. Let the pair (A, μ), where A is a subset of F and μ a probability measure, be a recurrent event $\mathcal{E}$ as defined by Feller (An introduction to probability theory and its applications, v. 1, ch. VIII, 2nd ed., Wiley, New York, 1957). One says that the event $\mathcal{E} = (A, \mu)$ occurs at the last letter x_{i_n} of a word $f = x_{i_1} x_{i_2} \cdots x_{i_n}$ if and only if f belongs to the set A. A is called the support of $\mathcal{E}$, and the mean recurrence time of the event $\mathcal{E}$ is denoted by $T(A, \mu)$. If the pair (B, μ') defines another recurrent event on F, the pair $(A \cap B, \mu')$ also defines a recurrent event. In accordance with the general theory of Feller [loc. cit.] when $T(B, \mu')$ is finite the ratio $\pi = T(B, \mu')/T(A \cap B, \mu')$ is, in a certain sense, the limit of the conditional probability that a random word $f \in F$ belongs to A when it is known to belong to B. For given arbitrary A, it is in general possible to find infinitely many (B, μ') having finite $T(B, \mu')$ which are such that $\pi = 0$. The main point of this note is the demonstration of the following property: If the support A is such that $T(A \cap B, \mu')$ is finite for every recurrent event (B, μ') having finite $T(B, \mu')$, then for every such (B, μ'), π^{-1} is an integer at most equal to a certain finite number δ^* which depends only upon A.

2056

North Carolina U. Inst. of Statistics, Chapel Hill.

SOME PROPERTIES OF THE LEAST SQUARES ESTIMATOR IN REGRESSION ANALYSIS WHEN THE INDEPENDENT VARIABLES ARE STOCHASTIC, by P. K. Bhattacharya. June 1961, 15p. (Mimeograph series no. 292) (AFOSR-892) (AF 49(638)213) AD 260713 Unclassified

Also published in Ann. Math. Stat., v. 33: 1365-1374, 1962.

For the linear regression of y on x observations the loss in estimating the true regression function by another function is considered as a loss function. For the loss function, it is shown under certain conditions that if the class of estimates which are linear in y's and have bounded risk is non-empty, then the estimate obtained by the method of least squares belongs to this class and has uniformly minimum risk in this class. A necessary and sufficient condition on the distribution function of x observations is obtained for this class to be non-empty, which unfortunately is not easy to verify in particular cases and is violated in a very simple situation. However, by a sequential modification of the sampling scheme, this condition may always be satisfied at the cost of an arbitrarily small increase in the expected sample size. It is also shown under certain further conditions on the family of admissible distributions that the least squares estimator is minimax in the class of all estimators. (Contractor's abstract)

2057

North Carolina U. Inst. of Statistics, Chapel Hill.

A REMARK ON FINITE TRANSDUCERS, by M. P.

Schützenberger. June 1961, 15p. (Mimeograph series no. 289) (AFOSR-893) [AF 49(638)213] AD 260714 Unclassified

Also published in Inform and Control, v. 4: 185-196, Sept. 1961.

Right finite automata reading from left to right can realize different input/output transformations from left finite automata, e.g., no right automaton can perform the task of reproducing the input word when it begins with a given letter and of printing nothing when it does not. So the composite operation consisting of first transforming the input word by a right automaton and then transforming again the resulting output word by a left automaton cannot, as a rule, be carried out in one stage. The author calls this a transduction and proves the following. (1) The transductions form a set closed under finite composition and under inversion when this is meaningful. (2) They transform regular events on the input words into regular events on the output words, and any regular event can be obtained in this way. (Math. Rev. abstract)

2058

North Carolina U. Inst. of Statistics, Chapel Hill.

INVESTIGATIONS ON FACTORIAL DESIGNS, by R. C. Bose and M. S. Patel. Apr. 1961, 218p. incl. tables, refs. (Mimeograph series no. 285) (AFOSR-895) (AF 49(638)213) AD 260716 Unclassified

Fractionally replicated designs are obtained for 2^m, 3^n, and experiments with their product with the number of treatment-combinations just sufficient to estimate the main effects, the 2-factor interactions and the error, without requiring difficult computation. With some additional treatment combinations, designs are also obtained so as to balance the estimates in the sense of the variances. Some of the designs so obtained are arranged into blocks. The analysis, both for the univariate case and the multivariate case is given. (Contractor's abstract)

2059

North Carolina U. Inst. of Statistics, Chapel Hill.

AN ALGORITHM FOR A MINIMUM COVER OF AN ABSTRACT COMPLEX, by D. K. Ray-Chaudhuri. [1961] [14]p. (AFOSR-897) (AF 49(638)213) AD 260715 Unclassified

Also published in Canad. Jour. Math., v. 15: 11-24, 1963.

Let X be a finite set, and $\mathfrak{A}$ a set of subsets of X; $(X, \mathfrak{A})$ is an abstract complex; it is regular if $|A| = |B|$ for all $A, B \in \mathfrak{A}$. For each $x \in X$ let a positive integer $c(x)$ be given; $\mathfrak{A}_1 \subset \mathfrak{A}$ is a c-cover if each $x \in X$ belongs to at least $c(x)$ members of $\mathfrak{A}_1$. A c-cover $\mathfrak{A}_1$ with $|\mathfrak{A}_1|$ as small as possible is a minimum c-cover. If $\mathfrak{A}_1$ is a minimum c-cover, the number of x's contained in exactly $c(x)$ members of $\mathfrak{A}_1$ is the c-height of $\mathfrak{A}_1$ the smallest value of this for all c-covers $\mathfrak{A}_1 \subset \mathfrak{A}$ is the c-height of $(X, \mathfrak{A})$. By altering the inequalities one obtains maximum c-matchings and c-depth. The author's basic tool is a chain $\{A_1, B_1, \cdots, B_p, A_{p+1}\}$ where $A_i \in \mathfrak{A}_1$ and $B_j \in \mathfrak{A} - \mathfrak{A}_1$, subject to various (complicated) conditions. The first 2 theorems imply algorithms for obtaining (1) a minimum c-cover, (2) all minimum c-covers. Similar methods are then developed for deriving (1) a minimum c-cover of least c-height, (2) all such c-covers. When the complex is regular, it is shown that the algorithms can be shortened by restricting attention to special kinds of chains. Finally, it is pointed out that there is a natural duality between maximum c-matchings and minimum c-covers, with maximum c-depth corresponding to minimum c-height. (Math. Rev. abstract)

2060

North Carolina U. Inst. of Statistics, Chapel Hill.

A CODING PROBLEM ARISING IN THE TRANSMISSION OF NUMERICAL DATA, by R. C. Bose and I. M. Chakravarti. Apr. 1961, 15p. incl. illus. (Mimeograph series no. 284) (AFOSR-898) (In cooperation with Case Inst. of Tech., Cleveland, Ohio) (AF 49(638)213) AD 260708 Unclassified

Also published in Bull. Inst. Internat'l. Stat., v. 39: 345-355, 1962.

The integers $i = 1, 2 \ldots, 2^n$ are to be encoded (mapped 1-1) as n-bit vectors α of 0's and 1's. If i is encoded as α, if α is sent, and if α' corresponding to i' is received (over some channel), then the error is defined as $|i - i'|$. Under the natural encoding $i \to \alpha = (a_1, \cdots, a_n)$, where $i = \Sigma\, a_r 2^{n-r}$, $a_r = 0$ or 1, the expected error is minimum (assuming only single errors occur, and making some equal-likelihood assumptions). The authors find other encodings which also produce this minimum expected error. They do this by rigidly moving the n-cube to produce several encodings with the same expected error for a given n; then they put two of these encodings together to get one for n + 1. Among such encodings f the authors show (by similar methods) how to find f* such that the minimum expected error among the integers i has the value $p(2^{n+1} + 3n - \delta)/6n$, which is known to be best possible for n = 2 and 3. ($\delta = 1$ [2], n odd [even]; p is the probability of an error in a binary digit). (Math. Rev. abstract)

2061

North Carolina U. Inst. of Statistics, Chapel Hill.

ON THE EQUATION $a^{2+n} = b^{2+m}c^{2+p}$ IN A FREE GROUP, by M. P. Schützenberger. June 1961, 15p. (Mimeograph series no. 290) (AFOSR-912) (AF 49-(638)213) AD 260710 Unclassified

The problem of proving that in a free group G the equation $a^{2+n} = b^{2+m}c^{2+p}$ (n, m, p ≥ 0) has only trivial solutions has been attacked first by R. G. Lyndon (Mich. Math. Jour., v. 6: 89-95, 1959). E. Schenkman (Ann. Math., v. 70: 562-564, 1959) generalized Lyndon's result and proved by group theoretical arguments that the result is true for all values of n when m and p are equal to n. In this note it is shown that brute force is quite enough in the general case. For this, the equation in G is replaced by 2 equations in F, the free monoid generated by a fixed set of generators of G together with their inverses. Thus, if Φ is the canonical homomorphism F → G, and if |f| denotes the length of the element f ∈ F, F can be provided with an involution f → $\bar{f}$ such that $\Phi\bar{f} = (\Phi f)^{-1}$ and $|f| = |\bar{f}|$. The complement F* of the ideal of F generated by all elements of the form $f\bar{f}$ ($|f| \neq 0$) is just the set of all words which are in reduced form.

2062

North Carolina U. Inst. of Statistics, Chapel Hill.

APPLICATION OF THE GEOMETRY OF QUADRICS FOR CONSTRUCTING PBIB DESIGNS, by D. K. Ray-Chaudhuri. June 1961, 18p. (Mimeograph series no. 294) (AFOSR-931) (AF 49(638)213) AD 260715 Unclassified

Also published in Ann. Math. Stat., v. 33: 1175-1186, 1962.

The geometry of quadrics is used to construct several series of partially balanced incomplete block (PBIB) designs with 2 associate classes. A brief discussion is given of the properties of quadrics and generators (lines contained in quadrics). Three theorems are proven and used to construct PBIB designs on the basis of configurations of generators and points, configurations of points and generators of a quadric and configurations of generators on generators. An example is given of the construction of a PBIB design with 15 treatments and blocks in blocks of size 3. (Math. Rev. abstract)

2063

North Carolina U. Inst. of Statistics, Chapel Hill.

SOME TERNARY ERROR CORRECTING CODES AND FRACTIONALLY REPLICATED DESIGNS, by R. C. Bose. May 1961, 14p. (Mimeograph series no. 295) (AFOSR-1090) (AF 49(638)213) AD 260712 Unclassified

The connection between the theory of error correcting codes and the theory of fractionally replicated designs is pointed out. It is shown that the packing problem plays a fundamental role in both theories. This is the problem of finding the maximum possible number of distinct points in the finite projective space PG(r-1, p), where p is a prime or a prime power, so that no d of the points are dependent. [illegible] found a configuration of 12 points in PG(5, 3) so that no 6 are dependent. Ternary error correcting codes and some fractional factorial designs (with or without blocking) are deduced. (Contractor's abstract)

2064

North Carolina U. Inst. of Statistics, Chapel Hill.

ON THE DEFINITION OF A FAMILY OF AUTOMATA, by M. P. Schützenberger. Jan. 1961, 33p. (Mimeograph series no. 273) (AF 49(638)213) Unclassified

Published in Inform. and Control, v. 4: 245-270, Sept. 1961.

The definition of a family A of automata derived from the family A_0 of the finite one-way one-tape automata is discussed. In loose terms, the automata from A are among the machines characterized by certain restrictions. The family A is a very elementary modification of A_0 and it is not claimed that it relates usefully to the Turing machines or to the algorithms used in actual computing practice. An automata α ∈ A is given by a (homomorphic) representation μ of the monoid F in the ring Z_N of the integral N X N matrices (N, finite) together with the rule $F\alpha = \{f \in F: \mu f_{1,N} \neq 0\}$ where $\mu f_{1,N}$ denotes the (1, N) entry of the matrix μf. It is verified that the family R of all the sets F_α with α ∈ A has the following property: If F' and F'' belong to R the same is true of their intersection, union, set product F'F''.

2065

North Carolina U. [Inst. of Statistics] Chapel Hill.

ANTE-DEPENDENCE ANALYSIS OF AN ORDERED SET OF VARIABLES, by K. R. Gabriel. [1961] [12]p. (AF 49(638)213) Unclassified

Published in Ann. Math. Stat., v. 33: 201-212, Mar. 1962.

For any set of p ordered variables, X_i, D_s denotes the condition that X_i and $X_{i-s-z-k}$ have zero partial correlation, given all the variables $X_{i-1}, X_{i-2}, \cdots, X_{i-s-z}$ for all non-negative i, s, k, z. This is equivalent for normal variates to each variable, given at least s immediate antecedent variables. The author shows that D_s is equivalent to the 1/2(p-s) (p-s-1) elements in the upper right (and lower left) corner of the inverse covariance matrix being zero. Maximum likelihood estimates under D_s are derived for the normal case, and the likelihood-ratio test of D_s against D_{s+i} is shown to be asymptotically equivalent to X^2 with p-s-1 degrees of freedom. Application to the growth of organisms and to increasingly complex psychological tests are suggested.

2066

North Carolina U. [Inst. of Statistics] Chapel Hill.

ON CONSTRUCTING THE FRACTIONAL REPLICATES OF THE 2^m DESIGNS WITH BLOCKS, by M. S. Patel. [1961] [10]p. (AF 49(638)213) Unclassified

Published in Ann. Math. Stat., v. 33: 1440-1449, Dec. 1962.

In this paper Galois fields and finite Euclidean geometry are employed to develop a procedure for constructing fractional replicate plans for the 2^m experiments. The procedure allows the arrangement of these fractional replicate plans in blocks with relatively few treatment combinations. The plans developed permit the estimation of all main effects, 2-factor interaction effects and block effects with the assumption that 3-factor and higher-order interaction effects are negligible. The estimates of the main-effects and 2-factor interaction effects are correlated (partially confounded) in sets, but are orthogonal to the block contrasts. The plans constructed by the suggested technique require fewer treatment combinations than do comparable plans which yield orthogonal estimates of all the estimable effects. (Math. Rev. abstract)

2067

North Carolina U. Inst. of Statistics, Chapel Hill.

CENTRAL LIMIT THEOREM FOR SUMS OVER SETS OF RANDOM VARIABLES, by F. Eicker. Mar. 1961, 15p. (Mimeograph series no. 279) (AFOSR-491) (AF 49(638)929) Unclassified

Also published in Ann. Math. Stat., v. 34: 439-446, 1963.

The classical problem of the probabilistic limit laws is to determine conditions for random variables in order that their sums for increasing number of terms tend to a limit law. In statistical estimation the situation occurs frequently where the distributions of these random variables are not exactly known. They may be assumed to be members of a certain family of distribution functions. In a general approach presented in this paper the family is replaced by a set of random variables. Then conditions are given for this set and the linear coefficients occurring in the sums in order that these sums converge for any selection of random variables out of F to a normal law. It seems to be much more difficult if not impossible to find similar simple conditions for the convergence to other limit laws.

2068

North Carolina U. Inst. of Statistics, Chapel Hill.

A MINIMUM AVERAGE RISK SOLUTION FOR THE PROBLEM OF CHOOSING THE LARGEST MEAN, by R. P. Bland. Apr. 1961, 93p. incl. diagrs. tables, refs. (Mimeograph series no. 280) (AFOSR-933) (AF 49(638)929) AD 260717 Unclassified

The problem of choosing the largest of n means is considered as a multiple decision problem which is generated from n component 2-decision problems. With additive losses Bayes rules for the component problems yield Bayes rules for the multiple decision problem. Some properties of these Bayes rules are found. Also a conservative-near-Bayes rule is presented with tabulated values for any number of means. (Contractor's abstract)

2069

North Carolina U. Psychometric Lab., Chapel Hill.

THE DESIGN OF A FUNGUS-EATER, by M. Toda. Jan. 1961, 10p. incl. diagr. tables. (Research memo no. 7) (AFOSR-256) (AF 49(638)729) AD 250706 Unclassified

Presented in part at Research Computation Center Seminar, North Carolina U., Chapel Hill, Nov. 2, 1960.

The experimenter has hypothesized a theoretical environment of a uranium-containing planet to be mined by hypothetical fungus-eating robots. Human subjects in a laboratory situation will be used to simulate the fungus-eating robots - perceiving and learning the structure of the environment, solving problems, and making decisions. The experimenter will observe the human behavior and try to find the type of fungus-eater robot that would best simulate it. Through this hypothetical situation, the experimenter intends to develop more precisely the problems of perception, cognition, and learning by specifying in more detail the characteristics of the environment. When the environment is defined, he also intends to study the robot in this environment, together with other robots, leading to problems in social psychology, economics and other problems within psychology which may be synthesized through this hypothetical case study.

2070

North Carolina U. Psychometric Lab., Chapel Hill.

BAYES STRATEGIES AS ADAPTIVE BEHAVIOR, by R. A. Wiesen and E. H. Shuford. Oct. 1961, 10p. incl. diagrs. tables. (AFOSR-1491) (AF 49(638)729) Unclassified

Also published in Biological Prototypes and Synthetic Systems; Proc. Second Annual Bionics Symposium, Cornell U., Ithaca, N. Y. (Aug. 30-Sept. 1, 1961), New York, Plenum Press, v. 1: 303-310, 1962.

The central tendency or regression effect is one of the most commonly observed phenomena in psychophysical judgment. Regression effect means that the

subject tends to overestimate the low values in the stimulus distribution and underestimate the high values. On each trial of an experiment the subject sees a 3 x 3 matrix. His task is to estimate the percentage of 1's in a large 16 x 16 matrix. The subject does not see this larger matrix. He sees only the smaller 1 which contains the 9 elements near the center of the large matrix. After the subject records his estimate he is told the actual proportion of 1's in the 16 x 16 matrix and is paid a fixed amount of money for each estimate which is correct to the nearest percentage point. On each trial, the subject's task is analogous to estimating the parameter p of a binomial process, where p is the proportion of 1's in the large matrix. One such estimate is the maximum likelihood estimate which gives $\delta = \frac{x}{n}$, where δ is the estimate, x is the number of 1's in the 3 x 3 matrix and n is the number of elements in the 3 x 3 matrix. Many investigations have shown that the distribution of stimuli over a series of trials affects the relation between stimulus and response. Consideration is given here of a statistical estimation procedure which takes into account this distribution, namely a Bayes procedure. By specifying a normative model for a very specific situation and indicating that this model constitutes a partial description of the situation, it is shown that behavior in a psychophysical judgment task is adaptive and optimal. The general class of Bayes strategies provides a very broad and powerful set of potential models for the analysis of behavior and for the development of adaptive automata.

2071

North Carolina U. Psychometric Lab., Chapel Hill.

APPLICATIONS OF BAYESIAN PROCEDURES BASED ON DISCRETE PRIOR DISTRIBUTIONS, by E. H. Shuford. Oct. 1961, 12p. incl. diagrs. (Rept. no. 31) (AFOSR-1492) (AF 49(638)729) Unclassified

Presented at annual convention of the Amer. Psychological Association, New York, Sept. 5, 1961.

There is a characteristic of Bayesian inference which is not widely known, but which is essential to a proper understanding of the relation between Bayesian statistics and statistics as currently practiced. This characteristic is illustrated by comparing in some detail the Bayesian and orthodox analyses of 2 statistical problems: (1) the evaluation of 2 competing theories of behavior in the light of experimental evidence and (2) the experimental evaluation of the proportion of individuals in a population who are of a specified type. In each case it is shown that the orthodox procedure is a special case of the more general Bayesian procedure. It is hoped that Bayesian inference can broaden the range of application of statistics and can yield a more fitting and useful analysis of data.

2072

Northwestern U., Evanston, Ill.

PROCEEDINGS OF THE FOURTH BIENNIAL GAS DYNAMICS SYMPOSIUM ON MAGNETOHYDRODYNAMICS, Evanston, Ill., Aug. 23-25, 1961, ed. by A. B. Cambel, T. P. Anderson, and M. M. Slawsky. Evanston, Northwestern U. Press, 1962, 393p. incl. illus. diagrs. tables, refs. (AFOSR-2787) (In cooperation with American Rocket Society) (Sponsored jointly by Advanced Research Projects Agency, Air Force Office of Scientific Research, Army Research Office (Durham), National Aeronautics and Space Administration, and Office of Naval Research) Unclassified

The central problem considered during this symposium was the subject of magnetohydrodynamics, with particular emphasis on propulsion and power generation. The science, the technology, and the state of the art were treated in 25 papers and during 1 panel discussion. The topics included research findings and interpretative reviews concerning not only magnetohydrodynamics but also plasma physics and plasma dynamics.

2073

Northwestern U., Evanston Ill.

PROCEEDINGS OF THE 1961 INTERNATIONAL CONFERENCE ON CHEMICAL PHYSICS OF NONMETALLIC CRYSTALS, Northwestern U., Evanston, Ill., 1961, New York, W. A. Benjamin, Inc., 1962, 518p. incl. illus. diagrs. tables, refs. (AFOSR-2143) (Sponsored jointly by Advanced Research Projects Agency, Air Force Office of Scientific Research under AF AFOSR-61-76, American Chemical Society, American Physical Society, Atomic Energy Commission, and National Science Foundation) Unclassified

Also published in Jour. Appl. Phys., Suppl., v. 33: 1-518, Jan. 1962.

The papers presented at the Conference on Chemical Physics of Nonmetallic Crystals held at Northwestern U. are grouped into 4 categories: (1) Quantum Theory of Nonmetallic Crystals, (2) Characterization of Point Defects in Crystals, (3) Equilibrium Properties of Dilute Solid Solutions, and (4) Kinetic Methods that Characterize Point Defects. With the cooperation of the American Institute of Physics the papers were first published as a supplement to the Jour. Appl. Phys., Jan. 1962. The reader is referred to this publication or to the conference proceedings itself for an account of the presentations.

2074

Northwestern U. Dept. of Chemistry, Evanston, Ill.

[HETEROGENEOUS CATALYSIS IN LIQUID SYSTEMS] by R. Ciola, J. Carter and others. Final rept. Oct. 1958-Dec. 1960. Jan. 1961 [27]p. incl. diagrs. tables, refs. (AFOSR-93) (AF 18(603)132) AD 250207; PB 154361 Unclassified

Investigations were aimed at applying the following idea to the determination of the degree of diffusional control in heterogeneous catalytic reactions. In any

catalytic reaction, the reactants must diffuse to the surface, adsorb, react on the surface, desorb and diffuse back to the reactant stream. The diffusional steps have continually befogged attempts to derive the mechanisms of the catalytic reactions themselves. Attempts were made to develop a simple experimental method which would directly reveal the extent of diffusional control. Given the following reaction sequence which occurs on the surface of a heterogeneous catalyst: (1) A-A → A-B; and (2) A-B → B-B, A-A is a molecule containing 2 independent and non-reacting groups. Reaction of each group occurs independently and only 1 group can react during 1 period of residence on the surface. If diffusion within the pores of a catalyst is fast, then at low conversions the only apparent initial product will be A-B. If diffusion is slow, A-B has the chance to react further before escape into the vapor stream and B-B will appear as an initial product and to a degree which diagnoses the degree of diffusion control. The problem, then, is what actual compounds can be used to represent A-A. (Contractor's abstract)

2075

Northwestern U. [Dept. of Chemistry] Evanston, Ill.

SYNTHESIS AND ISOMERIZATION OF NITRITOPENTAMMINE COMPLEXES OF RHODIUM(III), IRIDIUM(III), AND PLATINUM(IV), by F. Basolo and G. S. Hammaker. [1961] [5]p. incl. diagr. tables, refs. (AFOSR-1321) (AF 49(638)315) AD 429276 Unclassified

Also published in Inorg. Chem., v. 1: 1-5, Feb. 1962.

The syntheses and properties of the new nitritopentammine complexes, $[(NH_3)_5M\text{-}ONO]^{n+}$ where M = Rh(III), Ir(III), and Pt(IV), are reported. The method of preparation of these complexes was based on the mechanism proposed earlier for the formation of the known Co(III) compounds. The rates of formation of these nitrito complexes and of their rearrangement to the nitro isomers, $[(NH_3)_5M\text{-}NO_2]^{n+}$, were determined. (Contractor's abstract)

2076

Northwestern U. [Dept. of Mathematics] Evanston, Ill.

FOURIER TRANSFORMS, by R. R. Goldberg. Final rept. New York, Syndics of the Cambridge U. Press, 1961, 76p. incl. refs. (No. 52) (AFOSR-689) [AF 49(638)383] Unclassified

This tract is designed to provide a background in those classical theorems concerning Fourier transforms on the real line which have found fruitful generalization in abstract harmonic analysis. In chapter I, all the theorems on integration used in subsequent chapters are stated. The Fourier transforms on L^1 are introduced. After determining its functional properties it is proven that an analytic function of a Fourier transform is locally a Fourier transform. An algebraized reformulation of some of the preceding results is given in terms of ideals in a commutative Banach algebra. The generalizations of the theorem proved in Chapter 2 are considered. The problem of whether or not the zeros of the Fourier transform of an L^1 function determine the span of the translates of the function is taken up. Bochner's characterization of Fourier-Stieltjes transforms of non-decreasing bounded functions is the subject of the last chapter. In addition, there is an appendix in which it is pointed out how many of the concepts and theorems can be carried over to an arbitrary locally compact abelian group.

2077

Northwestern U. [Dept. of Mathematics] Evanston, Ill.

A NEW LIMIT THEOREM FOR RECURRENT EVENTS, by M. Dwass. May 8, 1961, 8p. (AFOSR-602) (AF 49(638)877) AD 259504 Unclassified

Consider a recurrent event on the positive integers. Let N(n) denote the number of recurrences up to and including time n. For $0 < \alpha \leq 1$, it is known that if $EN(n)/n^{\alpha}$ has a limit as $n \to \infty$, then $N(n)/n^{\alpha}$ has a limiting distribution as $n \to \infty$. The limiting distribution is 1 of the so-called Mittag-Leffler distributions. On the other hand, consider the distribution of N(n) under the condition that a recurrence takes place at time n. The purpose of this note is to show that under a slightly stronger condition, $N(n)n/n^{\alpha}$ again has a limiting distribution. Now the limiting distribution is no longer of the Mittag-Leffler type; the distribution is 1 whose Laplace transform is the derivative of the Laplace transform of a Mittag-Leffler distribution. (Contractor's abstract)

2078

Northwestern U. [Dept. of Mathematics] Evanston, Ill.

AN EXTENSION OF THE FUNCTIONAL EQUATION OF SKITOVICH CHARACTERIZING THE MULTIVARIATE NORMAL DISTRIBUTION, by S. G. Ghurye and I. Olkin. July 21, 1961, 11p. (AFOSR-901) (AF 49-(638)877) AD 260507 Unclassified

Let $X_1, X_2, \cdots, X_n$ be independent, p-dimensional random vectors and let there exist non-singular p x p matrices $A_1, \cdots, A_n, B_1, \cdots, B_n$, such that the random vectors $A_1X_1 + \cdots + A_nX_n$ and $B_1X_1 + \cdots + B_nX_n$ are stochastically independent. Then the X_i are normally distributed. This result is proved by discussing the following functional equation

$$\sum_{1 \leq i \leq n} f_i(t + C_iu) = A(t|u) + B(u|t),$$

where t, u are p-dimensional vectors, the C_i are nonsingular matrices and $A(x|y)$, $B(x|y)$ are polynomials in x, for each fixed p-vector y. (Contractor's abstract)

2079

Northwestern U. [Dept. of Mathematics] Evanston, Ill.

A FLUCTUATION THEOREM FOR CYCLIC RANDOM VARIABLES, by M. Dwass. [1961] [5]p. incl. tables. (AFOSR-J24) [AF 49(638)877] AD 610991
Unclassified

Also published in Ann. Math. Stat., v. 33: 1450-1454, Dec. 1962.

A sequence of random variables $X_1, \cdots, X_n$ is said to be cyclic if its distribution law is invariant under all cyclic permutations. If $X_1, \cdots, X_n$ is a cyclic sequence of random variables, with $S_k = X_1 + \cdots + X_k$ for $k = 1, \cdots, n$, $M_n = \max(S_1, \cdots, S_n)$, and x^+ (x^-) denoting the positive (negative) part of x, then it is proved that $E(M_n^- | S_n = s) = s^- | n$. For independent identically distributed random variables it is shown that $E(t^{M_n^+}) = Et^{X_1} Et^{M_{n-1}^+} + P(M_n < 0) - E(T^{M_n} | M_n < 0)$ for $|t| \leq 1$. From this it is deduced that in case $\lim_{n\to\infty} P(M_n < 0) > 0$, then $\lim_{n\to\infty} M_n = M$ is well-defined and $Et^{M^+} = \dfrac{P(M < 0)[1 - E(t^M | M < 0)]}{1 - Et^{X_1}}$.

Also, if $-\infty < EX_1 < 0$, then $E(M | M < 0) = E(X_1)$ and if X_i are integer-valued, then $P(S_k < 0, k = 1, 2, \cdots) = -E(X_1)$. Finally a theorem of Kac and Spitzer, $EM_n^+ - EM_{n-1}^+ = ES_n^+/n$, is extended from an exchangeable to a cyclic sequence of random variables. (Math. Rev. abstract)

2080

Northwestern U. [Dept. of Mathematics] Evanston, Ill.

A CHARACTERIZATION OF THE MULTIVARIATE NORMAL DISTRIBUTION, by S. G. Ghurye and I. Olkin. [1961] [9]p. (In cooperation with Minnesota U., Minneapolis) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)877 and Office of Naval Research) Unclassified

Published in Ann. Math. Stat., v. 33: 533-541, June 1962.

The authors prove the following extension of the Darmois-Skitovič theorem: Let $x_1, \cdots, x_n$ be n independent, p-dimensional random row-vectors and let $A_1, \cdots, A_n$, $B_1, \cdots, B_n$ be non-singular p x p matrices. If $\Sigma_{i=1}^n A_i x_i'$ is independent of $\Sigma_{i=1}^n B_i x_i'$ then the x_i are normally distributed. Using matrices A_i, B_i instead of scalars as coefficients of the linear forms leads to certain problems which are also discussed. (Math. Rev. abstract)

2081

Northwestern U. Dept. of Mathematics, Evanston, Ill.

A STARLIKE INFINITE PRODUCT, by E. P. Merkes and W. T. Scott. June 1961, 2p. (Technical note no. 2) (AFOSR-902) (AF 49(638)888) AD 259509
Unclassified

The following theorem is proven. Let $\{\alpha_n\}_1^\infty$ be a sequence of positive integers and let $\{a_n\}_1^\infty$ be a sequence of complex numbers such that $|a_n| \leq \dfrac{a_n}{s_n^+ \alpha_n}$, (n = 1, 2, ...), (1), where $Sn \geq 0$ and $\Sigma_1^\infty s_n \leq 1$. Then the function $f(z) = z \prod_{n=1}^\infty (1 + a_n z^{\alpha_n})$, (2), is univalent and starlike for $|z| < 1$. There exist functions of the form (2), whose coefficients satisfy (1), which are not univalent in any concentric disc containing the disc $|z| < 1$.

2082

Northwestern U. Dept. of Mathematics, Evanston, Ill.

CONTINUED FRACTION SOLUTIONS OF THE RICCATI EQUATION, by E. P. Merkes and W. T. Scott. June 1961, 21p. incl. refs. (Technical note no. 3) (AFOSR-903) (AF 49(638)888) AD 259502
Unclassified

Also published in Jour. Math. Anal. and Appl., v. 4: 309-327, Apr. 1962.

Attention is confined to solutions of the general Riccati differential equation with a singular point at the origin. The Riccati differential equation has the formal property that a linear fractional transformation yields a new Riccati differential equation in a new dependent variable. An obvious connection with continued fractions arises from the fact that a continued fraction may be interpreted as a sequence of linear fractional transformations. Attention is focused on those linear fractional transformations which generate a continued fraction.

2083

Northwestern U. [Dept. of Mathematics] Evanston, Ill.

ON THE USE OF PARAMETERS IN CONTINUED FRACTION TRANSFORMATIONS, by E. P. Merkes. June 1961, 17p. (Technical note no. 4) (AFOSR-1082) (AF 49(638)888) AD 262932 Unclassified

There is a one-to-one correspondence between formal power series $w = 1 + \Sigma_n^\infty = 1\, c_n z^n$ and C-fractions

$$1 + \frac{a_1 z^{\delta_1}}{1} + \frac{a_2 z^{\delta_2}}{1} + \cdots + \frac{a_n z^{\delta_n}}{1} + \cdots,$$

where $\{a_n\}$ is a sequence of complex numbers and $\{\delta_n\}$ is a sequence of positive integers. The problem of obtaining the C-fraction expansion for the image under a transformation of the power series associated with a given C-fraction is difficult even for many elementary cases. When the dependent variable w or the independent variable z is changed by a linear fractional transformation, the C-fraction which corresponds to the image of the power series w is obtained from the C-fraction associated with w in a relatively simple manner for some special cases. An attempt is made to unify the known results on this problem by presenting a systematic method to introduce certain parameters, which, in turn, facilitate the transformation. In some cases the class of continued fractions for which the transformation is known to be applicable has been enlarged. Applications of the transformations are made to the Stieltjes and Hausdorff moment problems. (Contractor's abstract)

2084

Northwestern U. Dept. of Medicine, Chicago, Ill.

THE INTERACTION OF A NONIONIC DETERGENT WITH PROTEIN. I. PHYSICAL PROPERTIES OF THE SAME PROTEIN DETERGENT COMPLEX, by R. M. Dowben and W. R. Koehler. [1960] [5]p. incl. diagrs. table, refs. (AFOSR-23) (AF 49(638)321) Unclassified

Also published in Arch. Biochem. and Biophys., v. 93: 496-500, May 1961.

The addition of Triton X-100, a nonionic detergent, to solutions of bovine plasma albumin resulted in a small but significant increase in intrinsic viscosity and a decrease in electrophoretic mobility. The specific optical rotation of bovine plasma albumin, ribonuclease, and oxidized ribonuclease was unchanged by the addition of detergent. The number of reactive sulfhydryl groups of bovine serum albumin and muscle aldolase was unchanged in the presence of detergent. These data indicate that no gross structural change occurs in the protein but are consistent with the view that the degree of hydration is increased in the presence of detergent. (Contractor's abstract)

2085

Northwestern U. Dept. of Medicine, Chicago, Ill.

THE INTERACTION OF A NONIONIC DETERGENT WITH PROTEIN. II. EFFECTS ON A BOVINE PLASMA ALBUMIN-AZOMERCURIAL COMPLEX, by W. R. Koehler and R. M. Dowben. [1960] [7]p. incl. diagrs. table, refs. (AFOSR-343) (AF 49(638)321) Unclassified

Also published in Arch. Biochem. and Biophys., v. 93: 501-507, May 1961.

The titration curve of bovine plasma albumin showed a slight shift in the acidity constants of the carboxyl groups to higher values in the presence of the polyoxyethylene nonionic detergent, Triton X-100. The pK_a of the dimethylamino group of an azomercurial linked to protein is lowered by addition of Triton X-100 to the solvent. This change is accompanied by a blue shift in the absorption peak of the dye, a shift similar to that observed when such dyes are transferred from an aqueous to a nonaqueous solvent. The change in pK_a and absorption spectrum of the albumin-dye complex are reversed, in part, by the further addition of 8 M urea. These data are consistent with the view that the detergent interacts with the protein reinforcing and enlarging the envelope of structured water around the protein.

2086

Northwestern U. Dept. of [Metallurgy] and Materials Science, Evanston, Ill.

KINETICS OF INITIAL SINTERING OF VACUUM-REDUCED TITANIUM DIOXIDE, by D. H. Whitmore and T. Kawai. Dec. 1, 1961 [18]p. incl. diagrs. refs. (AFOSR-1858) (AF 49(638)436) AD 269923 Unclassified

Also published in Jour. Amer. Ceram. Soc., v. 45: 375-379, Aug. 1962.

Observations of sphere-to-plate bonding of vacuum-reduced, monocrystalline rutile were carried out over the temperature range 1200° to 1275°C. The rate law governing the interfacial growth between sphere and plate indicated that the predominate mechanism of material transport in this sintering process was volume diffusion. In the light of the reasonably satisfactory agreement between the oxygen self-diffusion coefficients calculated from the present sintering data and those directly observed by Haul and Just utilizing an isotopic exchange technique, it was indicated that oxygen ion diffusion is the rate-determining step in the sintering experiments described. (Contractor's abstract)

2087

Northwestern U. Dept. of [Metallurgy] and Materials Science, Evanston, Ill.

PRECIPITATE HARDENING IN AN ALUMINUM-COPPER ALLOY, by J. G. Byrne, M. E. Fine, and A. Kelly. Feb. 1961 [31]p. incl. illus. diagrs. refs. (AFOSR-120) (AF 49(638)524) AD 253629 Unclassified

Also published in Philos. Mag., v. 3: 1119-1145, Sept. 1961.

Plasticity studies were made on single crystals (Al-1.7 at-% Cu) at 4.2°, 77°, 198°, 273° and 373° K. The critical resolved shear stress (CRSS), tension stress-strain curves, and the dependence of the flow stress on strain rate were determined for (1) supersaturated α solid solution, (2) α + Guinier-Preston

(GP) Zone 1, (3) α + GP II, (4) $\alpha + \theta'$, and (5) $\alpha + \theta$. The difference between the CRSS at 4.2° and 273°K is large for the first 2 structures, but small with GP II, θ', or θ precipitate. With α, α + GP 1, and α + GP II, a single slip system is operative over a significant portion of the stress-strain curve, and the rate of work hardening is about the same as that for pure Al. With θ and θ' a multiple slip is immediately detected before the yield stress, the work hardening rates are initially very rapid, and fall to small values after some strain so that a plateau occurs in the stress-strain curves. (Contractor's abstract, modified)

2088

Northwestern U. Dept. of [Metallurgy] and Materials Science, Evanston, Ill.

RESISTIVITY CHANGES DUE TO FORMATION OF G. P. ZONES (CLUSTERS RICH IN SOLUTE), by H. Herman and J. B. Cohen. [1961] [3]p. incl. diagrs. (AFOSR-952) (AF 49(638)524) Unclassified

Also published in Nature, v. 191: 63-64, July 1, 1961.

An anomalous increase in resistivity has been observed during formation of G. P. zones (clusters rich in solute) in several aluminum alloys. The object of this research has been to test whether a zone of definite size is associated with the maximum in resistance which occurs during aging. An alloy of aluminum-5.3 at.-% zinc has been studied, using both resistance measurements and small-angle scattering of x-rays. The results show that the resistance maxima are associated with zones of an average size of 10A in diameter.

2089

Northwestern U. [Dept. of Metallurgy and Materials Science] Evanston, Ill.

REVERSION AND REFORMATION OF GP 1 IN Al-1.7 AT. PCT Cu, by H. Herman and M. E. Fine. [1961] [3]p. incl. diagrs. table. (AFOSR-1336) (AF 49(638)-524) Unclassified

Also published in Trans. Metall. Soc. AIME, v. 224: 503-505, June 1962.

Kinetics of reversion and reformation of GP 1 were studied resistometrically in Al-1.7 at. pct Cu. The reversion process is over in roughly 1/2 min at 205°C irrespective of the amount of primary aging. After reversion the occurrence of an incubation time before reaging begins has been substantiated. The reaging kinetics is drastically accelerated by plastic deformation to the specimen. An incubation time is observed only if the specimen is aged before reversion. The incubation time and the effect of plastic deformation indicate that nucleation of GP 1 is heterogeneous. Simple clusters of copper atoms apparently do not act as nuclei for GP 1. (Contractor's abstract)

2090

Northwestern U. [Dept. of Metallurgy and Materials Science] Evanston, Ill.

ELASTICITY AND INTERNAL FRICTION OF α-Fe_2O_3, by R. W. Maikay, G. H. Geiger, and M. E. Fine. [1961] [3]p. incl. diagrs. (AFOSR-1455) [AF 49(638)524] AD 295885 Unclassified

Also published in Jour. Appl. Phys., v. 33: 914-916, Mar. 1962.

Young's modulus and internal friction of natural crystals of α-Fe_2O_3 (Congonhas, Brazil) were measured as functions of temperature in the region of the Morin transition with and without a 1570-oe magnetic field. Nonelastic components of strain occur and these, it is suggested, are due to stress-induced changes in the directions of the magnetization vectors. (Contractor's abstract)

2091

Northwestern U. Dept. of [Metallurgy] and Materials Science, Evanston, Ill.

PRECIPITATE HARDENING IN AN ALUMINUM-COPPER ALLOY, by J. G. Byrne, M. E. Fine, and A. Kelly [1961] [28]p. incl. illus. diagrs. refs. (AFOSR-3993) (AF 49(638)524) Unclassified

Also published in Philos. Mag., v. 6: 1119-1145, Sept. 1961.

For abstract see item no. 2087, Vol. V.

2092

Northwestern U. Dept. of Metallurgy and Materials Science, Evanston, Ill.

AN EXPERIMENT ON THE INFLUENCE OF ALLOYING ELEMENTS ON THE INTERNAL FRICTION OF COLD WORKED AND QUENCHED MARTENSITIC IRON AND STEEL, by I. Tamura, T. Mura, and J. O. Brittain. Jan. 12, 1961 [13]p. incl. diagrs. table, refs. (AFOSR-115) (AF 49(638)780) AD 250703 Unclassified

Also published in Trans. Metall. Soc. AIME, v. 221: 1158-1162, Dec. 1961.

Plain carbon steel in the cold worked or martensitic conditions has an internal friction peak at about 250°C at a frequency of 1 cps. The influence of substitutional alloying elements on this peak was examined experimentally. The alloys which were vacuum melted Co-, Cr-, Mo-, Ni-, and Si-iron (about 3% alloying elements), and carburized Si-iron were used as specimens for the determination of internal friction versus temperature as measured by torsional pendulum method. The cold worked alloys had a peak at about 250°C which was much lower in height than that of plain C-iron and steel. Carburized Si-iron

in the quenched condition had a peak which occurred at a slightly lower peak temperature than in quenched plain C-steel, but the height of the peak was substantially greater than that found for the same alloy in the cold worked condition. The activation energy of this peak for martensitic St-steel was about 35 kcal/mol. (Contractor's abstract)

2093

Northwestern U. [Dept. of Metallurgy and Materials Science] Evanston, Ill.

THE EFFECT OF STRESS ON GRAIN BOUNDARY SLIDING IN CREEP, by N. R. Adsit and J. O. Brittain. Feb. 2, 1961 [15]p. incl. illus. diagrs. tables, refs. (AFOSR-282) (AF 49(638)780) AD 252068 Unclassified

A number of zinc bicrystal specimens were tested with the boundary loaded in simple shear. Creep tests were run in a vacuum at 200°C and under an argon atmosphere at 350°C. Results indicated that the maximum amount of grain boundary sliding at a given time was proportional to the resolved shear stress on the slip plane. Curves of grain boundary sliding versus time were found to be cyclic but with no regular periodicity. The magnitude of the grain boundary sliding was not proportional to the grain boundary orientation. A model is proposed that involves ledges in the grain boundary and micromigration of these ledges. (Contractor's abstract)

2094

Northwestern U. Dept. of Metallurgy and Materials Science, Evanston, Ill.

STRAIN AGING OF ALPHA-IRON, by E. Lautenschlager and J. O. Brittain. Mar. 10, 1961 [18]p. incl. diagrs. table, refs. (AFOSR-505) (AF 49(638)780) AD 255288 Unclassifted

Also published in Trans. Metall. Soc. AIME, v. 224: 48-53, Feb. 1962. (Title varies)

An investigation was conducted on fine grained alpha-iron wire to measure the influence of the temperature of deformation on strain aging near room temperature. Specimens were deformed various amounts at 77°, 195°, or 273°K; aged; and the strain aging followed by either internal friction or return of the yield point measurements. The results show that strain aging occurs in 3 stages. During the first stage there is small, almost immediate return of the yield point. The solute carbon concentration, as measured by internal friction, remains constant in stage I but is lower than the concentration in the unstrained condition. In the second stage, the solute concentration decreases while the magnitude of the yield point increases. In the third stage, the solute atoms continue to drain from the solution, the yield point approaches a maximum, and the strain hardening coefficient and flow curve increased. The kinetics of the strain aging reaction were not the same for the 2 sets of measurements since the internal friction results lag behind the yield point measurements. However, the strain aging kinetics measured at 44° and 64°C showed no effect due to the difference in initial deformation temperature; nor were the strain aging kinetics influenced by low temperature anneals at 77°, 195° and 273°K. (Contractor's abstract)

2095

Northwestern U. [Dept. of Metallurgy] and Materials Science, Evanston, Ill.

THEORY OF CONTINUOUS DISLOCATION AND ITS APPLICATION, by T. Mura. Apr. 11, 1961 [14]p. incl. diagrs. (AFOSR-581) (AF 49(638)780) AD 255506 Unclassified

A new theory of the continuous dislocation is proposed by introducing the ideas that the stored energy of the continuous dislocation and the kinetic energy can be expressed by deformation tensors and their time derivatives as a natural extension of concepts in the classical theory of dislocations. The slip process in plastic deformation, Frank's network, and the propagation and vibration of dislocations are taken as examples derived from a few fundamental equations which have a correspondence to Maxwell's equations. (Contractor's abstract)

2096

Northwestern U. Dept. of Metallurgy and Materials Science, Evanston, Ill.

EFFECT OF PRESTRAIN TEMPERATURE ON THE STRAIN AGING OF ALPHA-IRON, by E. Lautenschlager and J. O. Brittain. Sept. 20, 1961 [15]p. incl. diagrs. refs. (AFOSR-1467) (AF 49-(638)780) AD 263932 Unclassified

Also published in Trans. Metall. Soc. AIME, v. 224: 606-610, June 1962.

Yield point measurements were made on polycrystalline specimens of α-iron deformed various amounts at 77°, 195° and 273°K; aged; and redeformed at 77°, 195°, and 273°K. When the prestrain temperature is lower than that subsequent to aging, the yield point return is suppressed relative to specimens deformed at the same temperature both before and after aging. The degree of suppression is a function of both the magnitude of prestrain at the lower temperature and the difference between the deformation temperatures before and after aging. It is proposed that the suppression is caused by the formation of dislocation barriers during the initial low temperature deformation. The aging kinetics of polycrystalline α-iron wires deformed at 77° or 303°K were studied at 44° and 64°C using internal friction measurements. No change was noted as a result of the difference in prestrain temperature. (Contractor's abstract)

2097

Northwestern U. Dept. of Metallurgy and Materials Science, Evanston, Ill.

THE INFLUENCE OF ALLOYING ELEMENTS ON THE INTERNAL FRICTION OF COLD WORKED AND QUENCHED MARTENSITIC IRON AND STEEL, by I. Tamura, T. Mura, and J. O. Brittain. [1961] [5]p. incl. diagrs. table, refs. (AFOSR-2320) [AF 49-(638)780] Unclassified

Also published in Trans. Metall. Soc. AIME, v. 221: 1158-1162, Dec. 1961.

Plain carbon steel in the cold worked or martensitic conditions has an internal friction peak at about 250°C at a frequency of 1 cps. The influence of substitutional alloying elements on this peak was examined experimentally. The alloys were vacuum melted Co-, Cr-, Mo-, Ni-, and Si-iron (about 3% alloying elements), and carburized Si-iron. The internal friction of the alloys in the temperature range 30° to 500°C was determined by means of a torsion pendulum. The 250°C peak of the cold-worked alloys was lower in height than that observed in plain C-iron and steel. Carburized Si-iron in the quenched condition had a peak which occurred at a slightly lower temperature than in quenched plain C-steel, but the height of the peak was substantially greater than that found for the same alloy in the cold-worked condition. The activation energy of this peak for martensitic Si-steel was about 35 kcal/mol. (Contractor's abstract)

2098

Northwestern U. Dept. of Metallurgy and Materials Science, Evanston, Ill.

THE INFLUENCE OF THE TEMPERATURE OF DEFORMATION ON STRAIN AGING OF ALPHA-IRON, by E. Lautenschlager and J. O. Brittain. [1961] [6]p. incl. diagrs. table, refs. (AFOSR-3577) [AF 49(638)780] AD 612343 Unclassified

Also published in Trans. Metall. Soc. AIME, v. 224: 48-53, Feb. 1962.

An investigation was conducted on fine grained α-iron wire to measure the influence of the temperature of deformation on strain aging near room temperature. Specimens were deformed various amounts at 77°, 195°, or 273°K and aged. The strain aging was followed by either internal friction or return of the yield-point measurements. The results show that strain aging occurs in 3 stages. During the first stage there is small, almost immediate return of the yield point. The solute carbon concentration, as measured by internal friction, remains constant in stage I but is lower than the concentration in the unstrained condition. In the second stage, the solute concentration decreases while the magnitude of the yield point increases. In the third stage, the solute atoms continue to drain from the solution, the yield point approaches a maximum, and the strain-hardening coefficient and flow curve increase. The kinetics of the strain aging reaction are not the same for the 2 sets of measurements since the internal friction results lag behind the yield-point measurements. However, the strain-aging kinetics measured at 44° and 64°C showed no effect due to the difference in initial deformation temperature; nor were the strain aging kinetics influenced by low-temperature anneals at 77°, 195°, and 273°K.

2099

Northwestern U. [Dept. of Metallurgy and Materials Science] Evanston, Ill.

ANALOGY BETWEEN MAXWELL'S EQUATIONS AND A NEW THEORY OF CONTINUOUS DISLOCATION DENSITY (Abstract), by T. Mura. [1961] [1]p. [AF 49(638)780] Unclassified

Presented at meeting of the Amer. Phys. Soc., Los Angeles, Calif., Dec. 27-29, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 521, Dec. 27, 1961.

The potential energy and the kinetic energy of moving dislocations which are distributed through a material are expressed by deformation tensors and their time derivatives as a natural extension of concepts in the usual theory of dislocations. The proposed theory is found to have a number of correspondences with electromagnetic theory, in a different way, however, from that suggested by Kroner. These correspondences are in the strength of the magnetic field and the strength of the dislocation density, the strength of the electric field and the deformation rate, the electric current and the stress, and the velocity of light and the velocity of sound. Thus, the fundamental equations for the dislocation density have the same form as Maxwell's equations of the electromagnetic field.

2100

Northwestern U. Gas Dynamics Lab., Evanston, Ill.

A SPECTROSCOPIC TECHNIQUE FOR THE MEASUREMENT OF TEMPERATURE IN TRANSPORT PLASMAS, by C. F. Knopp, C. F. Gottschlich, and A. B. Cambel. July 1961, 106p. incl. illus. diagrs. tables, refs. (AFOSR-1100) (AF 49(638)879) AD 277352 Unclassified

A spectroscopic technique developed by Fowler and Milne has been employed to evaluate the temperature in a plasma produced by an electric arc. Design of the experimental apparatus used in this study is discussed and representative results obtained with the apparatus are given. In the course of the investigation, the theoretical particle densities as well as the partition function of an argon plasma have been calculated. (Contractor's abstract)

2101

Northwestern U. [Gas Dynamics Lab.] Evanston, Ill.

THE EFFECT OF RADIATION ON SHOCK VELOCITY

ATTENUATION IN ELECTROMAGNETIC SHOCK TUBES, by J. A. Thornton and A. B. Cambel. Apr. 1961, 55p. incl. illus. refs. (AFOSR-1101) (AF 49-(638)879) AD 277360 Unclassified

Observations are reported in a study of effects of radiation on shock velocity attenuation in the conical electromagnetic shock tube. A summary is included of findings which have appeared in the literature along with the approximate blast wave theory, which has become the primary method of making theoretical velocity attenuation calculations. These published observations lead to the question of the effect of radiation on the velocity attenuation in a tube with highly reflective walls such as might be employed in a propulsion system. The approximate blast wave theory is then adapted in developing a modified approximate method for calculating the effect of radiation on shock velocity attenuation. Approximate radiation equations are combined with the velocity attenuation equations and a study is made of factors which might influence the velocity attenuation by radiation. It is concluded that radiation will be an important factor only for strong shocks moving into a dense gas (approximately 1/10 atmosphere or greater and room temperature). A description of the electromagnetic shock tube is given, and some of the velocity attenuation experiments which are being conducted are discussed. No attenuation due to radiation has been noted. These experiments conducted at low velocities and densities thus agree with the predictions of the approximate blast wave theory modified to account for radiation effects. (Contractor's abstract)

2102

Northwestern U. Gas Dynamics Lab., Evanston, Ill.

MICROWAVE MEASUREMENTS OF MAGNETO-GAS DYNAMIC PLASMAS, by R. C. Warder, Jr., M. Brodwin, and A. B. Cambel. Aug. 1961, 60p. incl. illus. diagrs. (AFOSR-1468) (AF 49(638)879) AD 266593 Unclassified

The use of microwave probes as a diagnostic tool to determine the electrical conductivity and the dielectric constant of a plasma were adapted to the arc jet facility in the Gas Dynamics Laboratory. In particular an x-band microwave interferometer and a reflection, and transmission type experiment were designed and utilized. The microwave techniques were investigated using models. The studies described in this analysis show that the infinite slab hypothesis is invalid for the given plasma slab size using x-band microwaves. (Contractor's abstract)

2103

Northwestern U. Gas Dynamics Lab., Evanston, Ill.

THERMOPHYSICAL PROPERTIES OF PLASMAS (Abstract), by C. F. Knopp, J. A. Thornton and others. [1961] [1]p. (Bound with AFOSR-582; AD 257892) (AF 49(638)879) Unclassified

Presented at Fourth annual AFOSR Contractors' meeting on Ion and Plasma Acceleration, Beverly Hills, Calif., Apr. 20-21, 1961.

A long range, systematic study is being conducted to determine the thermophysical properties of argon and air plasmas. The properties are being measured in plasmas with and without magnetic fields. In principal the work is being pursued along three lines, namely (1) the measurement of electrical properties using microwave techniques; (2) the measurement of plasma temperature distribution and physico-chemical composition using spectroscopic techniques; and (3) the determination of the influence of radiation on shock attenuation. The experimental data are being obtained with argon plasma generated in the GDL hyperthermal facility and air plasma generated in the GDL electromagnetic shock tube. Three different microwave techniques have been employed. These are: simple transmission measurements, interferometer measurements, and reflection and transmission measurements. The spectroscopic method of Fowler and Milne has been adapted to determine the temperature of argon plasma produced by an electric arc. A computer program for the IBM-650 is being completed to determine particle densities and partition functions in the temperature range 5000°K to 35,000°K. From the studies of radiation effects on shock attenuation, it was concluded that radiation will be an important factor when strong shocks move into a dense gas, i.e., when the pressure is 0.1 that of atmospheric or greater.

2104

Norway Technical U. Inst. for Theoretical Chemistry, Trondheim.

AN ELECTRON DIFFRACTION INVESTIGATION OF THE MOLECULAR STRUCTURE OF BUTATRIENE, by A. Almenningen, O. Bastiansen, and M. Traetteberg. [1961] [14]p. incl. diagrs. tables. (AFOSR-152) (AF 61(052)72) AD 265318 Unclassified

Also published in Acta Chem. Scand., v. 15: 1557-1562, 1961.

The electron diffraction sector method was used to determine the structure of the butatriene molecule in the vapor phase. The molecular parameters are determined to be the following: C – H 1.083A (u = 0.080A), $C_1 = C_2$ 1.318A (u = 0.040A), and $C_2 = C_3$ 1.283A (u = 0.039A). The error limits of all the parameters are approximately ± 0.005A. As in several other molecules with linear equilibrium conformation, a shrinkage effect is observed; i.e., the observed non-bonded CC distances are a trifle shorter than that calculated from the sum of the individual bond distances. The effect is explained by out-of-linearity vibrations. (Contractor's abstract)

2105

Norway Technical U. Inst. for Theoretical Chemistry, Trondheim.

THEORETICAL INVESTIGATIONS USING ELECTRON DIFFRACTION METHODS, by O. Bastiansen, T. Strand, and M. Traetteberg. Final rept. July 13, 1961, 26p. incl. diagrs. tables, refs. (AFOSR-1439) (AF 61(052)72) AD 265198 Unclassified

The results of this research are published in three technical notes, (1) item no. 1434, Vol. III; (2) item no. 1907, Vol. IV; and (3) item no. 2104, Vol. V. As usual a large number of additional difficulties have presented themselves in the course of the problems being studied. This report discusses these additional problems briefly. They include: (1) Precision measurements of C-C bond distances, (2) Shrinkage effect, (3) Study of the conformation of large molecules and conformation analysis, (4) Miscellaneous molecular structure problems, (5) Molecular vibration and determination of u-values, and (6) Background and F-value studies. Some of these problems have been solved while others must await the results of further research.

2106

Norway Technical U. Inst. for Theoretical Chemistry, Trondheim.

THE NATURE OF BONDS BETWEEN CARBON ATOMS. HOW THEY VARY WITH ENVIRONMENT, by O. Bastiansen and M. Traetteberg. [1961] [8]p. incl. diagr. tables, refs. (AFOSR-3921) [AF 61(052)72] Unclassified

Also published in Tetrahedron, v. 17: 147-154, 1962.

Because the whole theory of the chemical bond is based on approximation calculations, a brief recapitulation of bond properties, specifically the carbon-carbon bond is presented. Emphasis is placed on the fact that precision measurement of structure parameters are difficult to carry out, but it is still more difficult to give a realistic evaluation of the error limits. Each molecule presents the investigator with new problems and every new experiment may be obscured by unexpected irregularities. Such parameters as covalent radii for carbon, the resonance effects of the sp^2-sp^2 C-C single bond, influence of negative groups, rings and bent bonds, condensed aromatic ring systems, and free and restricted rotation are discussed.

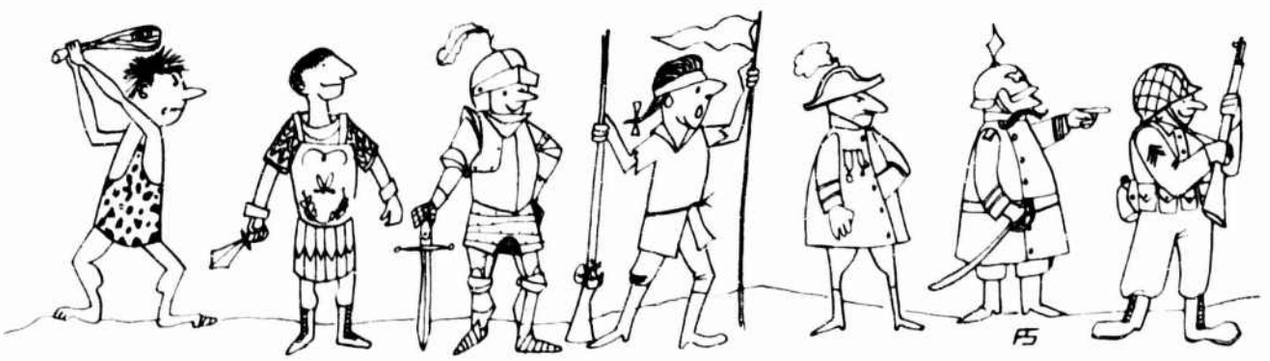
2107

Norway Technical U. Inst. for Theoretical Chemistry, Trondheim.

PRELIMINARY RESULTS OF AN ELECTRON DIFFRACTION REINVESTIGATION OF CYCLOBUTANE AND CYCLOPENTANE, by A. Almenningen, O. Bastiansen, and P. N. Skancke. [1961] [2]p. incl. refs. (AFOSR-3922) [AF 61(052)72] Unclassified

Also published in Acta Chem. Scand., v. 15: 711-712, 1961.

Preliminary results of an investigation of the molecular structure of cyclobutane and cyclopentane by the electron diffraction sector method are presented. For cyclobutane the carbon ring is definitely found to be puckered. The magnitude of the deviation from planarity is not determined with any reasonable accuracy at this stage of the investigation. The question of the existence of an inversion flopping of the carbon ring has not yet been settled unambiguously. The C-C and C-H bond distances were found to be significantly shorter than previously reported. For cyclopentane the ring system is found to deviate from planarity. The amplitude of the puckering, however, has not been determined. Within the limits of error the C-C bond length was found to be the same as that in the chain paraffins.



2108

Ohio State U., Columbus.

MINIMUM-EXPECTED-COST FILTERS FOR ARBITRARY COST FUNCTIONS, by J. P. Martino. 1961, 22p. incl. diagr. table, refs (AFOSR-1560) Unclassified

The minimum-expected-cost approach is applied to the following problem: Let the signal and noise be stochastic processes, x_t and y_t, respectively. Both are assumed to be continuous in probability and bounded, and are also assumed to start at t = 0. The desired operation on the signal will be represented by the filter function $\varphi(t)$; the actual operation on the signal (and noise), represented by the filter function f(t). The error is defined to be $e = \int_0^t \varphi(t - T)x_T dT - \int_0^t f(t - T)x_T dT - \int_0^t f(t - T)y_T dT$. Here the first term is the desired output from the receiver, and the sum of the last two is the actual output. Let F(e) be the distribution function for the error e, and C(e) the cost function giving cost of error for the specific application for which the filter f(t) is intended. The object then is to choose f(t) so as to minimize $E[C(e)] = \int_{-\infty}^{\infty} C(e)dF(e)$. Since by assumption F(e) is not known completely, the best that can be done is some approximation to the minimizing f(t). There are basically 2 alternatives. One is to use the partial information about the distributions of x_t and y_t to approximate F(e). The other is to approximate C(e) by a function C*(e) such that E[(C*(e)] can be calculated by using the partial information available. This latter alternative is shown to be possible although tedious from a computational standpoint.

2109

Ohio State U. [Research Foundation]. Dept. of Chemistry, Columbus.

SYNTHESIS OF HIGHLY-HINDERED ALIPHATIC COMPOUNDS, by M. S. Newman. Final rept. Nov. 1961, 6p. incl. diagrs. table. (AFOSR-1767) (AF 33-(616)3412) Unclassified

The synthesis of highly hindered aliphatic nitriles has been studied, triisopropylacetonitrile being the most hindered example obtained. As a side reaction in alkylation of hindered nitriles alkylated ketenimines are formed. Highly hindered aliphatic nitriles were found to be remarkably resistant to hydrolysis under drastic acidic or basic conditions. Hindered amides on alkaline treatment are converted largely into the corresponding nitriles. Di-t-butylacetic acid has been synthesized for the first time, and from it di-t-butylketene has been obtained. Studies of the latter show it to be the most stable ketene yet discovered. Treatment of di-t-butylketene with formaldehyde and boron fluoride etherate yields a β-lactone which on reduction with lithium aluminum hydride yields di-t-butylmethylacetic acid, possibly the most hindered aliphatic acid known. Ionization constants of all the highly hindered aliphatic acids prepared in this work (except for di-t-butylmethylacetic acid) have been determined at 40° in 50% methanol. (Contractor's abstract)

2110

Ohio State U. [Research Foundation]. Dept. of Chemistry, Columbus.

SYNTHESIS AND REACTIONS OF 4-TRICHLOROMETHYL-2,4,5-TRIMETHYL-2,5-CYCLOHEXADIENONE, by M. S. Newman, D. Pawellek, and S. Ramachandran. [1961] [3]p. incl. refs. (AFOSR-2728) (AF 49(638)277) AD 454650 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 84: 995-997, Mar. 20, 1962.

2,4,5-Trimethylphenol (I), aluminum chloride and carbon tetrachloride react to give 4-trichloromethyl-2,4,5-trimethyl-2,5-cyclohexadienone (II) in 70% yield; II reacts with phosphorus pentachloride to yield 2,4-dimethyl-5-(β,β,β-trichloroethyl)-chlorobenzene (III) in 91% yield, and with polyphosphoric acid to yield 2,4,5-trimethylchlorobenzene (IV) (ca. 20%) and 2-chloro-3,5,6-trimethylbenzoic acid (V) (ca. 40%). (Contractor's abstract)

2111

Ohio State U. Research Foundation. Dept. of Chemistry, Columbus.

NEUTRON DIFFRACTION STUDY OF SOLID DEUTEROAMMONIA, by J. W. Reed and P. M. Harris. [1961] [8]p. incl. illus. diagrs. tables, refs. (Technical note no. 1) (AFOSR-729) (AF 49(638)397) Unclassified

Also published in Jour. Chem. Phys., v. 35: 1730-1737, Nov. 1961.

The crystal structure of the stable cubic modification of solid deuteroammonia has been determined by neutron diffraction. The space group is $P2_13-T^4$, and at -196°C the positions of the atoms are 4N at (a) with u = 0.2127 ± 0.0021 and 12D at (b) with x = 0.3740 ± 0.0019, y = 0.2632 ± 0.0037, and z = 0.1094 ± 0.0016. Each nitrogen atom is hydrogen bonded to the 6 nearest neighbor nitrogen atoms. There is 1 deuterium atom per site, in contrast to the "half-hydrogen" structure of ice. The N-D bond length of 1.005 ± 0.023 A is indistinguishable from that of the free molecule, while the D-N-D bond angle of 110.4° ± 2.0° is appreciably larger than the free molecule value. (Contractor's abstract)

2112

Ohio State U. Research Foundation. Dept. of Electrical Engineering, Columbus.

ELECTRICAL PROPERTIES OF HIGH-PURITY

BORON, by W. J. Taylor, R. Chintakindi and others. Final rept. July 1961 [179]p. incl. illus. diagrs. tables, refs. (AFOSR-1177) (AF 49(638)424) AD 265266 Unclassified

A critical review of existing data on the structure and properties of boron is followed by a formulation of the band structure problem for α-rhombohedral boron using the Bloch tight-binding method. New theoretical methods are introduced to take full advantage of crystal symmetry, and a new approach to the calculation of the effective one-electron potential is presented. Experimental data on zone melted boron are also included. (Contractor's abstract)

2113

Ohio State U. [Research Foundation. Dept. of Electrical Engineering] Columbus.

RARE EARTHS. III. A MASS-SPECTROMETRIC INVESTIGATION OF THE ISOMOLECULAR OXYGEN-EXCHANGE REACTIONS OF LANTHANUM, CERIUM, PRASEODYMIUM AND NEODYMIUM WITH THEIR MONOXIDES, by P. N. Walsh, D. F. Dever, and D. White. [1961] [4]p. incl. diagr. tables, refs. (AFOSR-4284) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)424] and Office of Naval Research) Unclassified

Also published in Jour. Phys. Chem., v. 65: 1410-1413, Aug. 1961.

The equilibrium constants for the reactions Ce(g) + LaO(g) ⇌ La(g) + CeO(g) (1); Pr(g) + LaO(g) ⇌ La(g) + PrO(g) (2); and Nd(g) + PrO(g) ⇌ Pr(g) + NdO(g) (3) and their temperature dependence have been determined with a time-of-flight mass spectrometer. The heats of the 3 reactions in kcal/mol^{-1} calculated from the results are: ΔH_1 (1870°K) = 1.05 ± 0.20, ΔH_2 (1913°K) = 15.8 ± 0.4, ΔH_3 (1910°K) = 6.9 ± 0.6. These heats of reaction give directly the difference in dissociation energies, at the indicated temperatures, of the 2 gaseous monoxides in each of the reactions. The dissociation energies at absolute zero D_0^0 in ev calculated from these results and appropriate thermal functions are D_0^0 (CeO) = 8.03 ± 0.2, D_0^0 (PrO) = 7.40 ± 0.3, D_0^0 (NdO) = 7.06 ± 0.2. The electronic contributions to the entropy of the gaseous monoxides at elevated temperatures are discussed in terms of the measured entropy changes in the above reactions. (Contractor's abstract)

2114

Ohio State U. [Research Foundation. Dept. of Electrical Engineering] Columbus.

RARE EARTHS. II. A MASS SPECTROMETRIC DETERMINATION OF THE HEATS OF SUBLIMATION (OR VAPORIZATION) OF NEODYMIUM, PRASEODYMIUM, GADOLINIUM, TERBIUM, DYSPROSIUM, HOLMIUM, ERBIUM AND LUTETIUM, by D. White, P. N. Walsh and others. [1961] [6]p. incl. diagrs. tables, refs. (AFOSR-4285) (Sponsored jointly by [Air Force Office of Scientific Research under AF 49-(638)424] and Office of Naval Research) Unclassified

Also published in Jour. Phys. Chem., v. 65: 1404-1409, Aug. 1961.

A time of flight mass spectrometer has been adapted for thermodynamic investigations at elevated temperatures. The apparatus is described in detail. The heats of sublimation (or vaporization) of several rare earth metals have been determined by the mass spectrometric method, from the variation with temperature of the intensity of an atomic beam effusing from a Knudsen cell, in the temperature 1253 to 2044°K. (Contractor's abstract)

2115

Ohio State U. [Research Foundation]. Dept. of Electrical Engineering, Columbus.

RARE EARTHS. I. VAPORIZATION OF La_2O_3 AND Nd_2O_3: DISSOCIATION ENERGIES OF GASEOUS LaO AND NdO, by H. W. Goldstein, P. N. Walsh, and D. White. [1961] [5]p. incl. diagr. tables, refs. (AFOSR-4286) [AF 49(638)424] Unclassified

Also published in Jour. Phys. Chem., v. 65: 1400-1404, Aug. 1961.

The vaporization of the rare earth oxides, La_2O_3 and Nd_2O_3, at elevated temperatures has been studied by a combination of Knudsen effusion and mass spectrometric techniques. Both vaporize almost stoichiometrically to the monoxide and oxygen. The heats of formation, ΔH_0^0, in kcal/mol^{-1}, and dissociation energies, D_0^0, in ev are: LaO, −29.8 ± 4, 8.08 ± 0.2; NdO, −30.0 ± 6, 7.18 ± 0.3, respectively. (Contractor's abstract)

2116

Ohio State U. Research Foundation. Dept. of Mathematics, Columbus.

BERGMAN OPERATORS FOR THE THREE- AND FOUR-DIMENSIONAL LAPLACE EQUATIONS, by E. Kreyszig. Aug. 1961, 21p. (AFOSR-490) (AF 49-(638)362) AD 264875 Unclassified

The function theoretical approach to elliptic partial differential equations, as developed by Bergman and others, leads to a general characterization of various basic properties on the corresponding solutions and may be regarded as a translation principle of results in complex analysis into theorems about those

solutions. Harmonic functions of 3 and 4 real variables are treated. The harmonic functions of 3 variables are represented by a Bergman operator involving a single integration.

2117

Ohio State U. Research Foundation. Dept. of Mathematics, Columbus.

ELLIPTIC PARTIAL DIFFERENTIAL EQUATIONS, by E. Kreyszig. Aug. 1961, 9p. (AFOSR-1308) (AF 49(638)362) Unclassified

The research summarized in this report represents a contribution to a systematic development of certain elliptic partial differential equations in 3 or more variables, on the basis of function theory. The method employs the Bergman technique of representing the solutions of such equations by means of integral operators which transform analytic functions into solutions.

2118

Ohio State U. [Research Foundation. Dept. of Physics and Astronomy] Columbus.

PARAMAGNETIC RESONANCE OF IRON IN BERYL (Abstract), by N. L. Milder and L. C. Brown. [1961] [1]p. (AF 18(600)772) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 20, Feb. 1, 1961.

Dvir and Low (see Item no. 807, Vol. 1V) have published data on the EPR spectrum of Fe^{+++} in a single beryl crystal for certain crystal orientations. These spectra at room temperature in a similar beryl crystal have been studied as a function of crystal orientation. The spectra obtained for the Al sites are in substantial agreement with the earlier work. The variations in line positions can be interpreted in terms of 2 equivalent but differently oriented Al sites occupied by Fe^{+++}. A plot of the variation in line position with crystal orientation will be displayed. The question of assignments and the determination of physical constants will be discussed. No attempt was made to analyze the many weaker lines observed.

2119

Ohio State U. [Research Foundation. Dept. of Physics and Astronomy] Columbus.

NITROSYL CHLORIDE STRUCTURE, by J. D. Rogers and D. Williams. [1961] [2]p. incl. table. [AF 18(600)772] Unclassified

Published in Jour. Chem. Phys., v. 34: 2195-2196, June 1961.

Rotational constants obtained earlier from microwave measurements were used to compute the bond angle and distances for NOCl. The methods of Weatherly and Williams (Jour. Chem. Phys., v. 25: 716, 1956) and Kraitchman (Amer. Jour. Phys., v. 21: 17, 1953) were used. Results from the latter were not precise because of the large uncertainty introduced in taking differences of nearly like-valued numbers for I_x and I_x'. The rigid-rotor plane body assumption with the sum of the moments of inertia giving the third was used. The results obtained are presented in tabular form.

2120

Ohio State U. [Research Foundation. Dept. of Physics and Astronomy] Columbus.

NUCLEAR MAGNETIC RELAXATION TIMES OF PROTONS IN AQUEOUS AMMONIUM NITRATE SOLUTIONS (Abstract), by F. J. Leech and L. C. Brown. [1961] [1]p. [AF 18(600)772] Unclassified

Presented at meeting of the Amer. Phys. Soc., Ohio U., Athens, Oct. 20-21, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 138, Feb. 23, 1962.

The spin lattice relaxation time T_1 and the spin-spin relaxation T_2 of protons in aqueous solutions of ammonium nitrate were measured. Two types of systems were considered: 1 group of solutions to which no acid was added (unacidulated) and another group of solutions to which small quantities of concentrated HNO_3 were added (acidulated). The variation of T_1 and T_2 with concentration and acidity will be discussed. In general, the high resolution nmr spectra of the proton in the unacidulated solutions were observed to consist of a single broad line. The spectra of the acidulated solutions were found to split into 1 narrow, strong line and 3 weak, narrow lines of equal intensity. In the strongly acidulated solutions 2 characterlstic relaxation times T_2 were measured. Evidently, one of these values of T_2 is associated with the single strong line and the other with the weak lines.

2121

Ohio State U. Research Foundation. [Dept. of Physics and Astronomy] Columbus.

ASYMMETRY PARAMETER FUNCTIONS, by L. C. Brown and P. M. Parker. [1961] [4]p. incl. diagr. table. (Bound with its Technical rept. no. 10; AD 251670) [AF 18(600)772] Unclassified

A tabulation of $\beta = \beta(\delta)$ from the relation $1 - \delta = (1 - \beta^2)^2/(1 + \beta^2/3)^3$ for $0 \leq \delta \leq 1$, $0 \leq \beta \leq 1$, with δ varying in steps of 0.001 has been made. As

described previously, this relationship is useful in determining from energy moments (1) the asymmetry parameter β in rigid and non-rigid rotator systems, (2) the asymmetry parameter η ($\eta = \beta$) in nuclear electric quadrupole systems, and (3) similar quantities, involved in electron paramagnetic resonances in crystals. (Contractor's abstract)

2122

Ohio State U. [Research Foundation]. Dept. of Physics and Astronomy, Columbus.

ELECTRONIC STRUCTURE OF THE F CENTER IN LiCl, by R. F. Wood and J. Korringa. Oct. 1961 [7]p. incl. diagrs. tables, refs. (Technical note no. 3) (AFOSR-1544) (AF 49(638)264) AD 448908 Unclassified

Also published in Phys. Rev., v. 123: 1138-1144, Aug. 15, 1961.

The electronic structure of the F-center lattice defect in LiCl is investigated with calculations based on the usual model of the F center proposed by de Boer. The ground- and excited-state wave functions and energies of the trapped electron are determined by 2 different methods. First, the method of linear combination of atomic orbitals (LCAO) is used. This method is capable of yielding good results but the complexity of the necessary calculations is great. In an effort to avoid this complexity the method of vacancy-centered wave functions is investigated. Very simple wave functions are used in this method with satisfactory results. The coefficient of the hyperfine interaction of the F-center electron with the nearest-neighbor lithium ion and the oscillator strength of the optical transition are calculated. The distortions of the lattice in the vicinity of the F center are calculated. A very small outward movement of the first and second nearest neighbors occurs in the ground state. The situation in the excited state is complicated by the p-type symmetry of the F-electron wave function. In this case, the 2 nearest-neighbor lithium ions located on the symmetry axis of the wave function are found to undergo a large displacement outward from the vacancy. (Contractor's abstract)

2123

Ohio State U. [Research Foundation]. Dept. of Physics and Astronomy, Columbus.

INSTABILITY OF ANTIFERROMAGNETIC SCREW-TYPE STRUCTURE OF AN ELECTRON GAS, by A. Yoshimori. [1961] [3]p. incl. diagrs. (AFOSR-1855) [AF 49(638)264] Unclassified

Also published in Phys. Rev., v. 124: 326-328, Oct. 15, 1961.

An analysis of antiferromagnetic screw-type structures in a 3-dimensional electron gas is given, using a self-consistent field method. It is shown that a screw-type state appears to be always unstable. The expression for the susceptibility of an electron gas found by Wolff is also obtained with this method. (Contractor's abstract)

2124

Ohio State U. Research Foundation. Dept. of Physics [and Astronomy] Columbus.

SPIN WAVES IN AN ANTIFERROMAGNET WITH S = 1/2, by J. Korringa. [1961] [3]p. incl. diagrs. (AFOSR-3058) [AF 49(638)264] Unclassified

Also published in Phys. Rev., v. 125: 1972-1974, Mar. 15, 1962.

It is shown that of 2 conflicting corrections to the dispersion law for spin waves in an antiferromagnetic, Fu-Cho Pu's is rather accurate for short waves, whereas Oguchi's is quite good for long waves. The operator method in terms of spin-flip operators is used in first and second approximation. (Contractor's abstract)

2125

Ohio State U. [Research Foundation]. Dept. of Physics and Astronomy, Columbus.

NUCLEAR MAGNETIC RELAXATION IN THE PRESENCE OF PARAMAGNETIC IONS, by J. S. Dohnanyi. [1961] [8]p. incl. diagr. tables, refs. (AFOSR-3366) [AF 49(638)264] Unclassified

Also published in Phys. Rev., v. 125: 1824-1831, Mar. 15, 1962.

The influence of independent processes of relaxation of paramagnetic ions on nuclear magnetic relaxation in the presence of these ions is discussed theoretically, using the Kubo and Tomita method. The nuclei are assumed to relax as a result of their contact with the ions through the usual dipole-dipole mechanism and this interaction is, in turn, considered to be of negligible influence on the ionic relaxation. Following a suggestion by Abragam, the ionic interactions are described as a coupling of the ionic spins to an effective local field varying randomly in time: this coupling is finally expressed in terms of experimentally more accessible parameters such as the ionic correlation and relaxation times. All dissipative interactions are approximated by autocorrelation functions with simple exponentially decaying time dependence, thereby limiting the applicability of this calculation to liquids and to liquid-like solids. The second-order terms in the perturbation expansion of the relaxation tensor yield contributions to the Bloch relaxation times of the system of nuclear spins that agree with previous calculations by Solomon. The fourth-order terms describing ionic relaxation yield a contribution to the nuclear relaxation times with a narrowing influence, except in the limit of very strong fields when a broadening is produced. (Contractor's abstract)

2126

Ohio State U. Research Foundation. Dept. of Psychology, Columbus.

VALUE ORIENTATIONS AND PREFERENCE FOR A MINIMAX STRATEGY, by A. Scodel. Jan. 1961 [11]p. incl. tables. (Technical note no. 3) (AFOSR-379) (AF 49(638)317) AD 255652 Unclassified

Also published in Jour. Psychol., v. 52: 55-61, July 1961.

Thirty-five pairs of subjects played a two-person, zero-sum-game with a saddle point. The game ran for 50 trials, and the positions were reversed after the first 25 trials. Each subject had been administered an Allport-Vernon-Lindzey prior to the game. With respect to behavior in the game it was found that the group that was ahead of its opponents at the end of the first half of the game tended to converge more readily on a minimix strategy when the positions of the players were reversed. Players who inclined toward a minimax strategy were lower on the theoretical value and higher on the religious value of the Allport-Vernon-Lindzey than players who avoided such a strategy. The relationships between this study and some other studies involving correlations between values and behavior were briefly discussed. (Contractor's abstract)

2127

Ohio State U. [Research Foundation. Dept. of Psychology] Columbus.

COUNSELING AND PSYCHOTHERAPY AS AN INSTANCE OF COALITION, by H. B. Pepinsky. [1961] [16]p. (AFOSR-58) [AF 49(638)373] AD 430660 Unclassified

Also published in Counseling in the Rehabilitation Process, New York, Bureau of Publications, Teachers Coll., Columbia U., 1961, p. 61-76.

Coalitions are temporary alliances for joint action. Their elements are persons, who negotiate agreements that establish and maintain the coalition in an environment. In doing so, the coalition members come to act like a single decision-maker. Counseling and psychotherapy are assumed to be instances of coalition and can be treated in this way. They are, however, representatives of a special case of coalition--the dyad or two-person case. Therapeutic situations, studied as coalitions, can be compared with other kinds of coalition in American society. A variety of perspectives are suggested from which therepeutic and other coalition events can be analyzed and interpreted. Comparative research on counseling or psychotherapy and other kinds of coalition is recommended, and the case study of interaction records is offered as a preliminary step in such research. (Contractor's abstract)

2128

Ohio State U. [Research Foundation. Dept. of Psychology] Columbus.

DISPLAYING AS A PSEUDOPRODUCTIVE ORGANIZATIONAL TASK, by K. E. Weick and H. B. Pepinsky. [1961] [2]p. (AFOSR-944) [AF 49(638)-373] Unclassified

Presented at Sixty-ninth annual convention of the Amer. Psychol. Assoc., New York, Aug. 31-Sept. 6, 1961.

Also published in Amer. Psychol., v. 16: 434-435, July 1961.

The industrial psychologist must learn to understand the human social organization and how it maintains itself in American society. With this in mind, this paper attempts to show how the large organization can promote among its members a kind of pseudoproductivity identified as displaying. Relevant evidence is drawn from interviews with members of 2 research teams and their supervisors in an industrial research institute. Displaying is analyzed and discussed as a task that results from and contributes to autistic thinking of organization members. The task is pseudoproductive because it tends to substitute for the actual performance of an assigned task.

2129

Ohio State U. Research Foundation. Dept. of Psychology, Columbus.

THE GROWTH AND EXTINCTION OF EXPECTANCIES IN CHANCE CONTROLLED AND SKILLED TASKS, by J. R. Rotter, S. Liverant, and D. P. Crowne. July 1961 [17]p. incl. illus. diagrs. tables, refs. (Technical note no. 1) (AFOSR-459) (AF 49-(638)741) AD 260949 Unclassified

Also published in Jour. Psychol., v. 52: 161-177, 1961.

In the present study an attempt was made to study the differences in the growth and extinction of expectancies using 2 different tasks which were hypothesized as skill and chance controlled tasks on the basis of previous cultural experience of the subjects, rather than by instructions. Eight groups of subjects were studied with an apparatus involving a motor skill of steadiness and 1 of guessing cards. For each task a group of 20 subjects were given 25% positive reinforcement, 50% positive reinforcement, 75% positive reinforcement, and 100% positive reinforcement, for 8 training trials. On nonreinforced trials the subjects failed to achieve a criterion score. Following this all groups were given continuous failure until they extinguished by stating expectancies for future success of 1 or 0 for 2 consecutive trials. The general hypothesis tested was that under chance conditions the occurrence of reinforcement leads to less learning in that previous experience is a less stable predictor of the future occurrence of the event. In general, the results strongly supported the 2 hypotheses. First, that under skill conditions positive and

negative reinforcement leads to greater increments and decrements in verbalized expectancies. Second, that the extinction of expectancies under continuous negative reinforcement will reverse under chance and skill conditions so that 50% is more resistant to extinction than 100% reinforcement under chance conditions, and 100% reinforcement is more resistant to extinction than 50% reinforcement under skill conditions.

2130

Ohio State U. Research Foundation. [Dept. of Psychology] Columbus.

A NONVERBAL MEASURE OF EXTINCTION IN SKILL AND CHANCE SITUATIONS: SUPPLEMENTARY REPORT, by K. B. Holden and J. B. Rotter. [1960] [2]p. incl. table. (AFOSR-3937) (AF 49(638)741) Unclassified

Also published in Jour. Exper. Psychol., v. 63: 519-520, May 1962.

A previous study (Jour. Exper. Psychol., v. 55: 397-403, 1958) showed that partial reinforcement does not lead to more resistance to extinction than 100% reinforcement if S feels that reinforcements are produced as a consequence of his own skill. This study also employed verbal expectancies as a measure of learning and extinction. The present study expands the generality of this finding by using a nonverbal behavior. The same effects of skill and chance instructions were found with the nonverbal response. There is also a sex difference in the effects of the instructions.

2131

Ohio State U. Research Foundation. [Dept. of Psychology] Columbus.

THE CONDITIONING OF VERBAL BEHAVIOR AS A FUNCTION OF THE NEED FOR SOCIAL APPROVAL, by D. P. Crowne and B. R. Strickland. [1960] [7]p. incl. diagrs. tables, refs. [AF 49(638)741] Unclassified

Published in Jour. Abnorm. and Social Psychol., v. 63: 395-401, Sept. 1961.

An experiment was undertaken to compare the changes in response rate of subjects differing in the strength of need for social approval on a plural nouns verbal conditioning task. The hypotheses were that subjects with a high need for social approval, in contrast to subjects with a weaker approval need, tend to show an increase in the proportion of plural nouns under positive reinforcement and a decrease in the proportion of plural nouns under negative reinforcement. The reinforced groups were also compared with a nonreinforced control group employed to establish the base rate for plural nouns. Results supported the hypotheses, with the high need-for-approval groups increasing the positively reinforced response and inhibiting the response followed by negative reinforcement. No subjects retained in the analysis of the data were able to verbalize the reinforcement contingency. The significant differences obtained were found not to be attributable to intelligence, nor was intelligence related to verbal conditioning. The findings were interpreted as providing support for the inference of need for social approval from a personality inventory measuring the degree of personal endorsement of socially approved characteristics.

2132

Oklahoma State U., Stillwater.

LUMINESCENCE IN SEMICONDUCTING DIAMOND, by J. B. Krumme. Jan. 1961, 37p. incl. diagrs. refs. (AFOSR-272) (AF 18(603)40) AD 252995; PB 155100 Unclassified

Luminescence exhibited by semiconducting diamonds is studied and a correlation with other effects in the same stones observed by other investigators is sought. Particular emphasis is placed on the study of luminescence of slow decay in order to definitely establish whether the process corresponds to slow fluorescence or phosphorescence. Some observations of electroluminescence and triboluminescence are made. None of the investigated semiconducting diamonds is found to exhibit fluorescence. Exciting wavelengths used are 364 mμ which excites fluorescence in type I diamond and 225 mμ which is sufficiently energetic to excite carriers across the forbidden energy gap. The temperature dependence of intensity and decay lifetime of the slow decay luminescence indicate that this process is phosphorescence rather than slow fluorescence. No intensity peaks are found in the phosphorescence spectrum to correspond with photoconductive or photovoltaic peaks, nor is it possible to correlate the decay lifetime of phosphorescence with carrier lifetimes. A red phosphorescence was found during the investigation and observations are included. Each of the investigated specimens exhibits triboluminescence. Electroluminescence is found to correspond to carrier injection rather than intrinsic electroluminescence. Inhomogeneity of surface states which was observed in early studies of photovoltaic effect are also observed in the study of electroluminescence. (Contractor's abstract)

2133

Oklahoma State U., Stillwater.

ELECTRON SPIN RESONANCE IN SEMICONDUCTING DIAMOND (Abstract), by M. D. Bell and W. J. Leivo. [1961] [1]p. [AF 18(603)40] Unclassified

Presented at meeting of the Amer. Phys. Soc., Monterey, Calif., Mar. 20-23, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 142, Mar. 20, 1961.

Three semiconducting diamonds are being investigated by electron spin-resonance techniques. The p-type diamonds have resistivities of the order of 100 ohm cm. Two different spin-resonance spectra were obtained at room temperature. In an intensely blue

diamond a resonance line of moderate strength occurred with a g value near 2. A second, partially blue diamond showing strong photoconductivity maxima in the visible and unusual red luminescence gave a broad, as yet unresolved resonance different from that of the intensely blue diamond. A good, definable spectrum could not be obtained in the third specimen. Spectra were also obtained on nonconducting diamonds. The spectrum obtained from the intensely blue semiconducting diamond differs from the spectra observed in diamonds containing nitrogen. Optical measurements show that nitrogen is not present in these semiconducting diamonds; however, free carriers are present; also, photoconductivity and lifetime measurements show that there are imperfections which could conceivably exhibit spin resonance.

2134

Oklahoma State U. [Dept. of Physics] Stillwater.

ATOMIC COLLISIONS, by B. Roth. Interim final rept. Sept. 1, 1960-Aug. 31, 1961 [1]p. (AFOSR-1814) (AF 49(638)907) Unclassified

The scattering of He^+ by He^0 results in a cross section for the production of He^0, He^+ and He^{++}. The cross section for production of He^+, $^0He^+$, is being calculated using only the Coulomb force as an interaction and providing for (a) Antisymmetrization of the electrons (b) Exchange scattering of the electrons (c) Center of mass correction. The calculation is carried out using the Born approximation, and an argument is presented showing it to be valid in this method of calculating, while its validity is doubtful, as is well known, when unsymmetrized functions are used. The results are in good agreement with experiment, although they depend sensitively on the type of He wave function used.

2135

Oklahoma U. [Dept. of Physics] Norman.

THEORY OF THE MULTIPLE STATE TRANSFER OF EXCITATION OF HELIUM (Abstract), by C. C. Lin and R. G. Fowler. [1960] [1]p. [AF 49(638)41] Unclassified

Presented at Thirteenth Annual Gaseous Electronics Conf., Monterey, Calif., Oct. 12-15, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 388, June 22, 1961.

A theory is presented to explain the multiple state mechanism for the transfer of excitation from singlet to triplet states in helium atoms proposed by St. John and Fowler. The spin-orbit interactions of the intra- and inter-atomic type are believed to be responsible for the singlet-triplet transfer in the highly excited states. It is shown that a helium atom in an upper nP state, after colliding with a normal atom, transfers primarily into either a P or an F state. Qualitative results derived from this theory are in good agreement with the essential features of the new process.

2136

Oklahoma U. Dept. of Physics, Norman.

OSCILLOSCOPE CALIBRATION AT KILOMEGACYCLE PER SECOND FREQUENCIES, by R. I. Duncan. [1961] [2]p. incl. diagr. (AFOSR-2308) [AF 49(638)-639] Unclassified

Also published in Proc. Okla. Acad. Sci., v. 41: 125-126, 1961.

A source of radio-frequency voltage of over 100 v peak-to-peak at a frequency of approximately 1200 mc was needed for calibrating the sweep of a high speed oscilloscope. Ordinary vacuum tube circuits were not considered adequate to provide the amount of voltage required. This paper describes a cavity resonator built for the purpose. In this type of device it is desirable to make the characteristic impedance of the output line as high as practicable. This maximizes the number of reflections in the cavity.

2137

Olin Mathieson Chemical Corp., New Haven, Conn.

STUDY OF SUPEROXIDIZERS, by F. Martinez and J. A. Wojtowicz Final rept. June 5, 1958-Nov. 5, 1960. Apr. 1961 [79]p. incl. illus. tables, refs. (Rept. no. OMCC-9038-GFR-1) (AFOSR-105) (AF 29(600)1667) AD 256787 Unclassified

The results are presented of studies conducted on the preparation of higher oxides of H. The reaction of ozone with hydrazobenzenes, substituted hydroquinones, isopropyl magnesium chloride and cumene did not produce higher oxides. The reaction of O atoms with secondary butyl alcohol produced a normal peroxide. Electrolysis and uv irradiation of dilute hydrogen peroxide solutions did not produce higher peroxides. The reactions of hydrogen atoms with ozone at -196°C gave rise to superoxides, presumable HO_2 and H_2O_4. These species decomposed at -120° and -90°C, respectively, to give molecular O and H_2O_2.

A mechanism is advanced for the production of these products. The heat of formation of HO_2 is +13 + or - 10 kcal/mol, and -2 + or -10 kcal/mol for H_2O_4.

The products obtained from H_2O and H_2O_2 in a discharge tube and by the reaction of H atoms with O are compared to the peroxides formed in the H atom-ozone reaction. (Contractor's abstract)

2138

Olin Mathieson Chemical Corp., New Haven, Conn.

STUDY OF SUPEROXIDIZERS, by F. Martinez, J. A.

Wojtowicz, and H. D. Smith. Dec. 1961 [56]p. incl. illus. tables, refs. (AFOSR/DRA-61-7) (AF 29-(600)2695) AD 272855 Unclassified

Studies were conducted on the preparation and characterization of hydrogen superoxide and superoxidizers such as NF_2O_2, NF_2OONF_2, ClF_5 and Cl_2O_8. Electron spin resonance measurements on the H + O_3 product revealed the presence of a free radical (HO_2) which disappeared in the temperature range -130° to -120°C. Kinetic studies revealed that the decomposition of the H + O_3 product was affected by phase transformations in the frozen matrix. The heat of crystallization of 50 wt % H_2O_2-ice was determined calorimetrically to be 45 cal/g. The mechanism of peroxide formation from dissociated water vapor was investigated. The reactions of tetrafluorohydrazine with O_3, O atoms, NO_2 dioxide, NO, Cl_2O_7 and ClF_3 were investigated. Evidence for low temperature N-O-F-containing complexes was found. (Contractor's abstract)

2139

Olin Mathieson Chemical Corp., New Haven, Conn.

THE CHARACTERIZATION OF HYDROGEN SUPEROXIDES IN FROZEN MATRICES, by F. Martinez, J. A. Wojtowicz and J. A. Zaslowsky. [1960] [21]p. incl. diagrs. tables, refs. [AF 29(600)2695] Unclassified

Also published in Fifth Internat'l. Symposium on Free Radicals; Preprints of papers, Uppsala U. (Sweden) (July 6-7, 1961), Stockholm, Almqvist and Wiksell, 1961, p. 42-1—42-21. (AFOSR-1495)

The reaction of atomic hydrogen with liquid ozone at -196°C has been studied. The yields of water, hydrogen peroxide, "formed" and "evolved" oxygen under various conditions are compatible with a radical recombination mechanism. Hydroxyl is the immediate precursor of all the water formed while the fate of some or all of the "formed" oxygen is the formation of prehydroxyl radicals and under certain conditions, hydrogen peroxide. Product yields are a function of hydrogen atom concentration and reactor geometry. Chemical, calorimetric and electron spin resonance evidence is presented to support the contention that the source of the "evolved" oxygen is the decomposition of two species of hydrogen superoxide (HO_2 and H_2O_4). (Contractor's abstract)

2140

Oregon State U. Dept. of Chemistry, Corvallis.

CENTRIFUGAL DISTORTION OF BOND DISTANCES AND BOND ANGLES, by M. Iwasaki and K. Hedberg. [1961] [3]p. incl. tables. (AFOSR-2403) (AF 49(638)-783) Unclassified

Also published in Jour. Chem. Phys., v. 36: 2961-2963, June 1, 1962.

A simple method has been developed to estimate the changes of bond distances and bond angles produced by the centrifugal force arising from rotational motions of molecules. The method has been applied to the PCl_3 molecule and the predicted effect found to be small but significant in comparison to the effect of vibrational motion. The theoretical results for PCl_3 at 300° and 505°K are in good agreement with experimental results from gaseous electron diffraction. (Contractor's abstract)

2141

Oregon State U. Dept. of Chemistry, Corvallis.

EFFECT OF TEMPERATURE ON THE STRUCTURE OF GASEOUS MOLECULES. MOLECULAR STRUCTURE OF PCl_3 AT 300° AND 505°K, by K. Hedberg and M. Iwasaki. [1961] [6]p. incl. diagrs. tables, refs. (AFOSR-2677) [AF 49(638)783] AD 408221 Unclassified

Also published in Jour. Chem. Phys., v. 36: 589-594, Feb. 1, 1962.

The molecular structure of PCl_3 was studied by electron diffraction from the vapor at nozzle temperatures of 300° and 505°K. The experimental intensity curves I_E clearly show the effect of temperature on the amplitudes of vibration: the greater over-all damping of the 505°K curve is a reflection of the greater amplitudes for both distances at this temperature, and the lesser prominency of the high-frequency features is a reflection of the greater Cl...Cl amplitude. The final results at 300° and 505°K respectively, are r_{P-Cl} = 2.039 ± 0.0014A and 2.045 ± 0.0016A; $r_{Cl...Cl}$ = 3.130 ± 0.0026A and 3.142 ± 0.0038A; Cl-P-Cl = 100.27° ± 0.09° and 100.40° ± 0.16°; l_{P-Cl} = 0.0501 ± 0.0013A and 0.0594 ± 0.0017A; $l_{Cl...Cl}$ = 0.0834 ± 0.0023A and 0.1097 ± 0.0035A.

2142

Oregon State U. Dept. of Chemistry, Corvallis.

POTENTIAL CONSTANTS OF PCl_3 FROM AMPLITUDES OF VIBRATION AND NORMAL VIBRATION FREQUENCIES, by M. Iwasaki and K. Hedberg. [1961] [5]p. incl. diagrs. tables, refs. (AFOSR-2678) [AF 49(638)783] AD 408223 Unclassified

Also published in Jour. Chem. Phys., v. 36: 594-598, Feb. 1, 1962.

Using the mean square amplitudes of vibration obtained from gaseous electron diffraction experiments at 300° and 505°K together with the normal vibration

frequencies, a reasonable set of values has been derived for the potential constants of a general quadratic function. (Contractor's abstract, modified)

2143

Oregon State U. Dept. of Chemistry, Corvallis.

THE EFFECT OF TEMPERATURE ON THE STRUCTURE OF GASEOUS MOLECULES, by K. Hedberg and M. Iwasaki. [1961] [3]p. incl. diagrs. tables. (AF 49(638)783) Unclassified

Presented at Internat'l. Conf. on Magnetism and Crystallography, Kyoto (Japan), Sept. 25-30, 1961.

Published in Jour. Phys. Soc. Japan, v. 17, Suppl. B-II: 32-34, Mar. 1962.

The molecular structure of PCl_3 has been studied by electron diffraction from the vapor at nozzle temperatures of 300°K and 505°K. Both the size of the molecule and the displacement of the atoms during molecular vibration are found to be significantly greater at the higher temperature. The P-Cl and Cl...Cl distances are longer by 0.3% and 0.4%, respectively, and the root-mean-square amplitudes associated with these distances are greater by a striking 19% and 31%. Both the increased size of the molecule and increased amplitudes are in very good agreement with prediction from simple theory. The results at 300°K and 505°K, are r_{P-Cl} = 2.039 ± 0.0014A and 2.045 ± 0.0016A; $r_{Cl...Cl}$ = 3.130 ± 0.0026A and 3.142 ± 0.0038A; Cl-P-Cl = 100.27 ± 0.09° and 100.40 ± 0.16°; l_{P-Cl} = 0.0501 ± 0.0013A and 0.0594 ± 0.0017A; $l_{Cl...Cl}$ = 0.0834 ± 0.0023A amd 0.1097 ± 0.0035A. The interatomic distances given are r_a values obtained from the third cycle of least squares refinement of intensity curves and differ from the equilibrium values of r_e by small amounts; the l_{ij} values differ similarly from the l_e values. The estimated standard errors include standard deviations from the least squares procedure, estimates of correlation among the data, uncertainty in the constants of the experiment, and uncertainty in the factors employed in the data reduction. (Contractor's abstract)

2144

Oregon U. Dept. of Chemistry, Eugene.

CHROMATOGRAPHIC ADSORPTION OF AZOBENZENES AND AROMATIC NITROGEN HETEROCYCLES ON ALUMINA STUDIES WITH ALUMINA-PREGNATED GLASS PAPER, by L. H. Klemm. P. Antoniades and others. [1961] [9]p. incl. diagr. tables, refs. (AFOSR-221) (AF 49(638)473) AD 611386 Unclassified

Also published in Jour. Chromatog., v. 6: 420-428, Nov. 1961.

A semi-quantitative method is described for chromatography of fluorescent polynuclear aromatic hydrocarbons and aromatic nitrogen heterocycles on alumina-impregnated glass paper. Combining data obtained from such papers with those from alumina columns it is noted that the isomeric azobenzenes and nitrogen heterocycles are more strongly adsorbed than their hydrocarbon analogs (where CH replaces N). It is proposed that adsorption of such nitrogen compounds occurs preferentially by means of the electron pairs on the nitrogen atoms to form n-complexes. If steric hindrance to n-complexation is too great the substrate may form a π-complex or a σn-hybrid complex instead.

2145

Oregon U. [Dept. of Mathematics] Eugene.

A WEAK TYCHONOFF THEOREM AND THE AXIOM OF CHOICE, by L. E. Ward, Jr. [1961] [2]p. (AF 49(638)889) Unclassified

Published in Proc. Amer. Math. Soc., v. 13: 757-758, Oct. 1962.

The weak Tychonoff theorem is stated as follows: The product of a family of mutually homeomorphic compact spaces is compact. A brief and direct proof is given so that the product of a family of mutually homeomorphic compact spaces is compact, implies the axiom of choice, establishing the equivalence of these propositions.

2146

Oslo U. Inst. of Chemistry (Norway).

INVESTIGATION OF MOLECULAR STRUCTURES, by O. Hassel. Final technical rept. Aug. 21, 1961, 34p. incl. diagrs. table, refs. (AFOSR-1643) (AF 61(052)71) AD 267293 Unclassified

X-ray crystallographic structure determinations were made of solids in which charge transfer bonds were established between different molecules (addition compounds) or between molecules of the same kind. New examples of halogen molecule bridges were found and the rule firmly established that the arrangement donor atom-halogen-halogen-donor atom is always at least nearly linear. Several addition compounds formed by organic halides (acceptor molecule) and varying donor molecules were also studied. In this case an arrangement donor atom-halogen-carbon is observed which is very nearly linear. Interest was focused on structures of crystals built up of a single molecular species that contains both electron accepting and electron donating atoms. It was found that charge transfer bonding occurs joining a particular molecule to the greatest possible number of nearest neighbors. The geometry of the arrangement conforms to the rules already established in the case of addition compounds. (Contractor's abstract)

2147

Oslo U. Inst. of Chemistry (Norway).

INVESTIGATION OF MOLECULAR STRUCTURES. I. CRYSTAL STRUCTURE OF THE 1:1 ADDITION COMPOUND DITHIANE-IODOFORM, by T. Bjorvatten and O. Hassel. Aug. 14, 1961 [16]p. incl. diagrs. tables. (Technical scientific note no. 4) (AFOSR-1687) (AF 61(052)71) AD 266611 Unclassified

Also published in Acta Chem. Scand., v. 15: 1429-1436, 1961.

The crystal structure of a new (1:1) addition compound formed by 1,4-dithiane and iodoform has been determined. The crystals have a melting point of 72°C and an observed density of 2.8 g/cm^{-3}. The monoclinic unit cell (space group $P2_1/m$) containing 2 formula units has the parameters a = 6.56A, b = 21.06A, c = 4.47A and β = 104.4°C. The dithiane molecules are situated in centers of symmetry, the iodoform molecules in symmetry planes. Two iodine atoms belonging to a particular iodoform molecule form charge transfer bonds with sulphur atoms belonging to neighboring dithiane molecules and the I-S distance (3.32A) is about 0.7A shorter than anticipated for a van der Waals contact. Each iodoform molecule is therefore linked to 2 neighboring dithiane molecules and vice versa and chains of alternating donor and acceptor molecules are present in the crystal. (Contractor's abstract)

2148

Oslo U. Inst. of Chemistry (Norway).

CRYSTAL STRUCTURE OF THE 1:3 ADDITION COMPOUND IODOFORM-SULPHUR (CHI_3-$3S_8$), by T. Bjorvatten. [1961] [6]p. incl. diagrs. tables. (AFOSR-3635) (AF 61(052)71) Unclassified

Also published in Acta Chem. Scand., v. 16: 749-754, 1962.

The crystal structure of the 1:3 compound iodoform-sulphur, $CHI_3 \cdot 3S_8$, has been determined by x-ray methods. The structure is trigonal rhombohedral with the (hexagonal) lattice parameters: a = 24.32A; c = 4.44A. The space group is R3m. Charge transfer bonds connect every iodine atom with a sulphur atom belonging to a S_8-ring. The I-S bond distance (3.50A) is about 0.50A shorter than the van der Waals radius sum of iodine and sulphur and the C-I-S angle is found equal to 177.7°. (Contractor's abstract)

2149

Oslo U. Inst. of Chemistry (Norway).

CRYSTAL STRUCTURE OF THE 1:3 ADDITION COMPOUND IODOFORM-QUINOLINE, by T. Bjorvatten and O. Hassel. [1961] [7]p. incl. diagrs. tables. (AFOSR-3636) (AF 61(052)71) Unclassified

Also published in Acta Chem. Scand., v. 16: 249-255, 1962.

Details of the crystal structure determination of the 1:3 addition compound iodoform-quinoline are reported. The structure is trigonal rhombohedral with the (hexagonal) lattice parameters: a = 22.40A; c = 4.59A, both figures with a probable error not exceeding 0.5%. The primitive (rhombohedral) unit cell contains one molecule of iodoform and three molecules of quinoline. The space group is R3. Charge transfer bonds connect every iodine atom with a quinoline nitrogen atom. The I-N distance (3.05A) is about 0.60A shorter than the van der Waals radius sum of nitrogen and iodine and the C-I-N angle is found equal to 176.8°. (Contractor's abstract)

2150

Oslo U. [Inst. of] Chemistry (Norway).

CHARGE-TRANSFER BONDS IN SOLIDS: CRYSTAL STRUCTURE OF OXALYL BROMIDE, by P. Groth and O. Hassel. [1961] [2]p. incl. diagrs. (AFOSR-3638) [AF 61(052)71] Unclassified

Published in Proc. Chem. Soc. (London): 343-344, Sept. 1961.

The oxalyl bromide crystals are monoclinic, space group $P2_1/c$ with a = 6.18, b = 5.46, c = 7.80A, β = 112°24'. The unit cell contains 2 centrosymmetrical and at least very nearly planar molecules. The structure is based on non-planar sheets in which each molecule is linked to 4 neighbors by charge-transfer bonds between oxygen and bromine of length 3.27A. An electron-density map is described. The shortest distances observed between atoms belonging to neighboring sheets are: Br-O = 3.90, Br-Br = 3.90, and C-O = 3.40A. It is concluded that charge-transfer bonds are mainly responsible for the cohesion within the sheets.

2151

Oslo U. [Inst. of Chemistry] (Norway).

CHARGE TRANSFER COMPLEXES IN WHICH ORGANIC HALIDES ACT AS ELECTRON ACCEPTORS, by O. Hassel. [1961] [3]p. incl. diagrs. table. (AFOSR-3639) [AF 61(052)71] Unclassified

Also published in Tideskrift for Kjemi, Bergvesen Og Metalluigi, v. 3: 60-62, 1961.

A survey is given of recent results obtained in Oslo regarding the atomic arrangement in solids in which the presence of bonds between halogen atoms directly linked to carbon and electron donor atoms (oxygen, sulphur or nitrogen) have been demonstrated. The structure of solid cyanogen halides and their trimeric forms – the cyanuric halides – may easily be interpreted in terms of intermolecular nitrogen-halogen bonding.

2152

Oslo U. Inst. of Chemistry (Norway).

CRYSTAL STRUCTURE OF THE 1:1 ADDITION COMPOUND DITHIANE-IODOFORM, by T. Bjorvatten and O. Hassel. [1961] [8]p. incl. diagrs. tables. (AF 61-(052)71) Unclassified

Published in Acta Chem. Scand., v. 15: 1429-1436, 1961.

The crystal structure of a new (1:1) addition compound formed by 1,4-dithiane and iodoform has been determined. The crystals have a melting point of 72°C and an observed density of 2.8 $g \cdot cm^{-3}$. The monoclinic unit cell (space group $P2_1/m$) containing 2 formula units has the parameters a = 6.56A, b = 21.06A, c = 4.47A, β = 104.4°. The dithiane molecules are situated in centers of symmetry, the iodoform molecules in symmetry planes. Two iodine atoms belonging to a particular iodoform molecule form charge transfer bonds with sulphur atoms belonging to neighboring dithiane molecules and the I-S distance (3.32A) is about 0.7A shorter than anticipated for van der Waals contact. Each iodoform molecule is therefore linked to 2 neighboring dithiane molecules and vice versa and chains of alternating donor acceptor molecules are present in the crystal. (Contractor's abstract)

2153

Oslo U. Inst. of Theoretical Astrophysics (Norway).

SECULAR VARIATIONS OF SHORT-LIVED SUNSPOTS, by T. S. Ringnes. [1961] [2]p. incl. diagrs. [AF 61-(052)49] Unclassified

Published in Nature, v. 192: 151-152, Oct. 14, 1961.

Based on an analysis of Greenwich Photo-Heliographic Results, 1879-1957, it is shown that a large secular variation of the frequency of occurrence of short-lived sunspots exists. Frequency distribution of spots with respect to area is found to vary systematically from one 11 yr cycle to the next in such a way that the frequency max decreases with increasing area.

2154

Oslo U. Neurophysiological Lab. (Norway).

RESEARCH ON FUNCTIONAL SIGNIFICANCE OF "LIMBIC" AND RELATED STRUCTURES IN THE BRAIN, by B. [R.] Kaada. Summary technical status rept. no. 2, May 1, 1960-Jan. 31, 1961 [7]p. (AFOSR-538) (AF 61(514)1127) Unclassified

The work of this project has encompassed 3 main topics: (a) studies concerned with the cortical and amygdaloid 'attention' or 'arousal' mechanisms and with emotion, (b) studies concerned with the electrophysiology of the hippocampus, and (c) behavior studies in rats with lesions in limbic and related structures. It is reported that the work performed under (a) has been completed and that performed under (b) is nearing completion. The status of the various phases of (c) is discussed in detail. A list of publications resulting from all of the work performed is appended.

2154A

Oslo U. Neurophysiological Lab. (Norway).

THE LOCAL CORTICAL RESPONSE IN THE HIPPOCAMPUS OF RABBIT, by P. Andersen and J. Jansen, Jr. [1961] [20]p. incl. diagrs. illus. refs. (AFOSR-2743) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(514)1127 and Norwegian Research Council for Science and the Humanities) Unclassified

Also published in Arch. Ital. Biol., v. 99: 349-368, 1961.

For abstract see item no. 1969, Vol. IV.

2155

Oslo U. Neurophysiological Lab. (Norway).

INTERACTION OF VARIOUS AFFERENTS ON CA_1 NEURONS AND DENTATE GRANULE CELLS, by P. Andersen and Y. Lømyning. [1961] [23]p. incl. illus. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 61(514)1127 and Norwegian Research Council for Science and the Humanities) Unclassified

Published in Physiologie de L'Hippocampe; Colloq. Internationaux du Centre National de la Recherche Scientifique, Montpellier (France) (Aug. 24-26, 1961), Paris, Centre National de la Recherche Scientifique, No. 107: 23-45, 1962.

The interaction of entorhinal and commissural afferent impulses on dentate granule cells and CA1 neurons have been studied. Interaction experiments were performed with afferents from the ipsilateral Ca1, ipsilateral entorhinal area, ipsilateral septum and the contralateral CA3 field on the CA1 neurons. Entorhinal impulses regularly resulted in the discharge of the granule cells, but was less effective than the commissural impulses in this respect. Granule cells were refractory to a new entorhinal activation for about 8 msec, while the corresponding figure for commissural activation was about 1-2 msec. Results indicate that peripherally located synapses are less effective than are synapses located near the cell body in discharging the cell. Entorhinal afferents could not make the CA1 neurons discharge but they lowered the threshold for simultaneous activation through other synapses ending on CA1 neurons, especially for the commissural afferents. The commissural, septal and local volleys could all discharge the CA1 neurons, the commissural being the most effective one. Results show that the spikes elicited by one of

the above mentioned afferent volleys inhibit the production of similar spikes by another afferent volley for some msec. When 2 of these afferent volleys arrive simultaneously to the recording electrode, the effect summated giving an increased amplitude of the spikes. The results are interpreted as if the entorhinal, local, septal and commissural volleys converge on the same population of neurons, and assist each other in the firing of the CA1 neurons. No signs of inhibition other than those due to refractoriness were observed. (Contractor's abstract)

2156

Oxford U. (Gt. Brit.).

THE EFFECT OF ISOLATION FROM THE FATHER ON THE BEHAVIOR OF MALE THREE-SPINED STICKLEBACKS TO MODELS, by E. Cullen. Final technical rept. Mar. 30, 1961, 22p. incl. diagrs. tables, refs. (AFOSR-1033) (AF 61(052)29)
AD 262189 Unclassified

The main experiment which has been carried out shows that three-spined Sticklebacks which have been prevented from seeing their fathers discriminate between male and female models no differently from controls. Whether experience gained during the breeding season can modify this discrimination remains unsettled. An experiment involving beating up males with one or other model, showed that changes in the response of the fish to the models immediately afterwards affected both models and not just the one used for beating, and therefore did not alter the discrimination. However the unnaturalness of the beating is fully realized. More realistic experience with live fish should be tried. There will be fewer practical difficulties in making such experiments, now that it has been established that the sight of the father does not materially affect the discrimination, for there will then be no need to rear the young under stringent conditions of isolation. Indeed the young need not be raised in the laboratory at all, but could be collected in the field in their first winter.

2157

Oxford U. [Dept. of Biochemistry] (Gt. Brit.).

THE INFLUENCE OF GROWTH SUBSTRATES ON METABOLIC PATHWAYS IN MICROCOCCUS DENTRIFICANS, by H. L. Kornberg, J. F. Collins, and D. Bigley. 1959 [16]p. incl. diagrs. tables, refs. (AF 61(514)1180) Unclassified

Published in Biochim. et Biophys. Acta, v. 39: 91, 9-24, Mar. 1960.

Autotrophically grown M.denitrificans incorporated C^{14} from $C^{14}O_2$ initially into phosphorylated compounds, the chief component of this fraction being 3-phosphoglyceric acid. Extracts of such cells catalyzed the incorporation of isotope from $NaHC^{14}O_3$ into 3-phosphoglyceric acid, in the presence of ribulose 1,5-diphosphate, or of ribose 5-phosphate + adenosine triphosphate (ATP). These results show that autotrophic growth of the organism involves the Calvin cycle of assimilation of carbon dioxide. Extracts of the organisms grown on acetate did not catalyze the incorporation of isotope from $NaHC^{14}O_3$ described above, indicating that the Calvin cycle did not operate under these conditions. Extracts of M.denitrificans grown autotrophically or on a variety of carbon substrates differed in their ability to effect the component reactions of the glyoxylate cycle. While all extracts were qualitatively shown to contain citrate condensing enzyme and malate synthetase, only those from acetate-grown cells contained high isocitratase activity. The activity of glyoxylate cycle enzymes in acetate-grown cells was sufficiently high to account for the growth of M.denitrificans on acetate as sole carbon source. These findings show that change in the mode of growth, from autotrophy to growth on acetate, was accompanied by an alteration of metabolic pathways from Calvin cycle to glyoxylate cycle, and suggest that isocitratase is under adaptive control. Studies on the effect of other carbon sources on the isocitratase formed by acetate-grown cells indicate that they control both the activity and formation of the enzyme by feed-back mechanisms. It is suggested that such feed-back mechanisms control the intracellular operation of the glyoxylate cycle. (Contractor's abstract)

2158

Oxford U. Dept. of Biochemistry (Gt. Brit.).

CRYSTALLINE TARTRONIC SEMIALDEHYDE REDUCTASE FROM PSEUDOMONAS OVALIS CHESTER, by A. M. Gotto and H. L. Kornberg. [1961] [2]p. incl. table. (AFOSR-1722) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)-180, Public Health Service, and Rockefeller Foundation) Unclassified

Also published in Biochim. et Biophys. Acta, v. 48: 604-605, Apr. 15, 1961.

Pseudomonas spp. growing on glycollate as sole carbon source adaptively form enzymes which catalyze the conversion of glyoxylate to glycerate. This process is the sum of 2 reactions, catalyzed by glyoxylate carboligase and by tartronic semialdehyde reductase. The purpose of this report is to describe a method for the preparation of crystalline tartronic semialdehyde reductase.

2159

Oxford U. Dept. of Biochemistry (Gt. Brit.).

THE METABOLISM OF C_1- AND C_2- COMPOUNDS IN MICROORGANISMS, by H. L. Kornberg, J. R. Quayle, and H. Krebs. Annual summary rept. no. 1, Sept 1, 1960-Aug. 31, 1961. Sept. 31, 1961 [14]p. incl. diagr. refs. (AFOSR-1986) (AF 61(052)180) Unclassified

The glyoxylate cycle, which has been shown to be a necessary pathway for the net formation of cell constituents in most aerobic organisms growing on acetate as sole carbon source, has now been demonstrated in the obligatorily photosynthetic and anaerobic purple sulfur bacterium chromatium. The cycle operates only during growth on acetate and key enzymes of the cycle are not formed when the organism grows on malate or carbon dioxide.

2160

Oxford U. Dept. of Biochemistry (Gt. Brit.).

THE METABOLISM OF C_2 COMPOUNDS IN MICROORGANISMS. 7. PREPARATION AND PROPERTIES OF CRYSTALLINE TARTRONIC SEMIALDEHYDE REDUCTASE, by A. M. Gotto and H. L. Kornberg. [1961] [12]p. incl. illus. diagrs. tables, refs. (AFOSR-2020) (AF 61(052)180) Unclassified

Also published in Biochem. Jour., v. 81: 273-284, Nov. 1961.

Tartronic semialdehyde reductase was purified 200-fold and crystallized from glycollate-grown Pseudomonas ovalis Chester. The enzyme catalyzed the reduction of tartronic semialdehyde to glyceric acid with reduced di- or tri-phosphopyridine nucleotide as electron donor. K_m for tartronic semialdehyde at pH 8·5 was measured to be 2×10^{-4} M. K_m for reduced diphosphopyridine nucleotide under these conditions was 2×10^{-5} M and for reduced triphosphopyridine nucleotide 5×10^{-5} M. The crystalline enzyme oxidized 160 µmol of reduced diphosphopyridine nucleotide/min/mg of protein at pH 8·5, 23° in the presence of tartronic semialdehyde. On the basis of the measured weight-average molecular weight M_w of 91,000, this gave a turnover number of 14,600 mol of reduced diphosphopyridine nucleotide oxidized/min/mol of enzyme. The enzyme was shown also to catalyze the oxidation of glycerate with concomitant reduction of oxidized diphosphopyridine nucleotide. The equilibrium constant K at 23° was 2×10^{-6} at pH 7·5 and $1·6 \times 10^{-5}$ at pH 8·5; K_H was calculated to be $5·1 \times 10^{-14}$ M. From these data, $\Delta G'$ at pH 7, 25°, was determined as 8·6 kcal/mol and $\Delta G°$ as 18 kcal/mol. Similarly, the oxidation-reduction potential for the reaction Glycerate$^-$ ⇌ tartronic semialdehyde$^-$ + 2H + 2e was found to be E'_0 = -0·092v at 25° and pH 7. The enzymic oxidation of glycerate to tartronic semialdehyde was also demonstrated by coupling it to the reduction of pyruvate to lactate, in the presence of oxidized diphosphopyridine nucleotide and crystalline lactic dehydrogenase, and to the reduction of 2:6-dichlorophenol-indophenol in the presence of oxidized diphosphopyridine nucleotide and reduced diphosphopyridine nucleotide dehydrogenase. The latter system served as a convenient assay of the enzyme. The enzyme catalyzed the reduction only of C_3 compounds of structure CHO·R·CO_2H, where R = CH·OH, CH_2 or CO. Tartronic semialdehyde (R = CH·OH) reacted more than 5 times as fast as any other substrate. The enzyme catalyzed the oxidation only of glyceric acid and of hydroxypyruvate. The significance of these findings to the pathways of biosynthesis from glyoxylate is discussed. (Contractor's abstract)

2161

Oxford U. [Dept. of Biochemistry] (Gt. Brit.).

SEDIMENTATION BEHAVIOR OF THE ENZYME, by A. Rodgers. [1961] [1]p. (AFOSR-2021) [AF 61-(052)180) Unclassified

Also published in Biochem. Jour., v. 81: 285, Nov. 1961.

A preparation of crystalline tartronic semialdehyde reductase was examined in the ultracentrifuge and appeared to be homogeneous at low protein concentration. A value of $S_{20,w}$ of 6.14×10^{-13} sec at 0.765% (w/v) protein concentration was obtained; the molecule weight was found to be 90,800. Zinc, calcium, manganese, iron, copper and magnesium were not detected in the preparation by flame photometry.

2162

Oxford U. Dept. of Biochemistry (Gt. Brit.).

THE METABOLISM OF C_2-COMPOUNDS IN MICROORGANISMS. 8. A DICARBOXYLIC ACID CYCLE AS A ROUTE FOR THE OXIDATION OF GLYCOLLATE BY ESCHERICHIA COLI, by H. L. Kornberg and J. R. Sadler. [1961] [11]p. incl. diagrs. tables, refs. (AFOSR-2625) (AF 61(052)130) Unclassified

Also published in Biochem. Jour., v. 81: 503-513, Dec. 1961.

Although the tricarboxylic acid cycle has been established as the major route for the oxidation of acetate, and of compounds catabolized to acetate, in a wide variety of organisms, little is known of the pathways of oxidation of C_2 compounds more highly oxidized than acetate, such as glycollate or glyoxylate. The main purpose of this paper is to show that, whereas the tricarboxylic acid cycle plays an essential role in the growth of Escherichia coli on glycollate as sole carbon source, this cycle is not necessary for glycollate oxidation. The results obtained with the mutant M22-64 of E. coli, strain w, which is devoid of the citrate-forming condensing enzyme, and with its parent wild type, support the view that glyoxylate, derived from the oxidation of glycollate, can be oxidized completely via a dicarboxylic acid cycle in which glyoxylate condenses with acetyl-coenzyme A to form malate, which is oxidized via oxaloacetate and pyruvate to regenerate the acetyl-coenzyme A required for the initial condensation.

2163

Oxford U. Dept. of Biochemistry (Gt. Brit.).

MICROBIAL GROWTH ON C_1 COMPOUNDS. 2. SYNTHESIS OF CELL CONSTITUENTS BY METHANOL- AND FORMATE-GROWN PSEUDOMONAS AM 1, AND METHANOL-GROWN HYPHOMICROBIUM VULGARE, by P. J. Large, D. Peel, and J. R. Quayle. [1961] [10]p. incl. diagrs. tables, refs. (AFOSR-2626) (AF 61(052)180) AD 612241 Unclassified

Also published in Biochem. Jour., v. 81: 470-480, Dec. 1961.

This research describes an investigation of the path of carbon incorporation from [C^{14}]methanol, [C^{14}]-formate, and [C^{14}]bicarbonate into cell constituents during growth of Pseudomonas AM 1 on methanol or formate. Similar experiments, involving [C^{14}] methanol and [C^{14}]bicarbonate, have been performed with methanol-grown Hyphomicrobium vulgare, and the data obtained with the 2 organisms are compared.

2164

Oxford U. Dept. of Biochemistry (Gt. Brit.).

MICROBIAL GROWTH ON C_1 COMPOUNDS. 1. ISOLATION AND CHARACTERIZATION OF PSEUDOMONAS AM 1, by D. Peel and J. R. Quayle. [1961] [5]p. incl. illus. diagr. tables, refs. (AFOSR-2627) (AF 61(052)180) Unclassified

Also published in Biochem. Jour., v. 81: 465-469, Dec. 1961.

An organism has been isolated which grows aerobically on methylamine, methanol, formate or formamide as sole sources of carbon and energy. Neither methane nor formaldehyde serves as growth substrate, nor can the organism grow autotrophically at the expense of oxidation of hydrogen. Certain mono- and di-carboxylic acids, amino acids, amines and glucose will also support growth in an otherwise mineral medium. The organism is a pink-colored, Gram-negative, motile rod (0.8 μ x 2.0 μ) with a single polar flagellum. It is identified as a species of Pseudomonas and is referred to as Pseudomonas AM 1. With methanol as growth substrate, the optimum growth conditions of Pseudomonas AM 1 are obtained at pH 7, at a temperature of 30°, and at a methanol concentration of 0.5-1% (v/v). No requirement for any growth factor was found. The oxidative abilities of the methanol-, formate- and succinate-grown organism have been examined manometrically. The solubility and spectral characteristics of the pink pigments suggest that they are unsaturated carotenoids.

2165

Oxford U. Dept. of Biochemistry (Gt. Brit.).

MICROBIAL GROWTH ON C_1 COMPOUNDS. 3. DISTRIBUTION OF RADIOACTIVITY IN METABOLITES OF METHANOL-GROWN PSEUDOMONAS AM1 AFTER INCUBATION WITH [^{14}C] METHANOL AND [^{14}C] BICARBONATE, by P. J. Large, D. Peel, and J. R. Quayle. [1961] [6]p. incl. diagr. tables, refs. (AFOSR-3454) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)180, Public Health Service, and Rockefeller Foundation) Unclassified

Also published in Biochem. Jour., v. 82: 483-488, 1962.

The distribution of radioactivity in glycine, serine, phosphoglyceric acid and malic acid isolated from methanol-grown Pseudomonas AM1 after incubation with C^{14} methanol or C^{14} bicarbonate has been investigated. The data indicate that the carboxyl group of glycine is mainly derived from carbon dioxide, and the methylene carbon from methanol. The hydroxylmethyl group of serine is derived mainly from methanol, whereas the distribution of radioactivity between C-1 and C-2 of serine is the same under all conditions as that between C-1 and C-2 of glycine. The labelling patterns of serine and malate are consistent with the formation of malate by carboxylation of a C_3 fragment derived from serine, rather than with the reverse reaction. Two possible schemes for synthesis of cell constituents from methanol are outlined. Both schemes implicate hydroxymethylation of glycine to give serine as the major step in the synthesis of C_3 compounds. Alternative means whereby the glycine necessary for such a reaction might be made from methanol are discussed.

2166

Oxford U. Dept. of Biochemistry (Gt. Brit.).

CHEMICAL SYNTHESIS OF OXALYL-COENZYME A AND ITS ENZYMIC REDUCTION TO GLYOXYLATE, by J. R. Quayle. [1961] [3]p. incl. table, refs. (AFOSR-3455) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)180, Public Health Service, and Rockefeller Foundation) Unclassified

Also published in Biochim. et Biophys. Acta, v. 57: 398-400, 1962.

The existence of oxalyl-coenzyme A as an intermediate in the conversion of cell constituents into oxalate has been a matter of supported speculation. Confirmation of its postulated mechanism has awaited its synthesis. It is the purpose of this communication to report the chemical synthesis of oxalyl-coenzyme A and its enzymic reduction to glyoxylate. It was prepared by ester interchange between thiocresyl-oxalic acid and coenzyme A at pH 7.2. Extraction with ether, which removed the thiocresol formed, resulted in yields of 90-100%. The identity of oxalyl-coenzyme A was established by its rapid hydrolysis in 0.1 N NaOH at room temperature to oxalate and coenzyme A, and its reaction with neutral hydroxylamine

to give oxalyl monohydroxamate. In view of the suggested metabolic role in the reduction of oxalyl-coenzyme A rather than in the oxidation of glyoxylate, the enzyme is better termed oxalyl-coenzyme A reductase rather than glyoxylate dehydrogenase.

2167

Oxford U. [Dept. of Biochemistry] (Gt. Brit.).

RESEARCH ON NEURAL MECHANISMS UNDERLYING PERCEPTION, by G. K. Wallace. Aug. 30, 1961, 23p. incl. diagrs. tables, refs. (Technical note no. 4) (AFOSR-2986) (In cooperation with Reading U. Inst. of Experimental Psychology, Oxford (Gt. Brit.)) (AF 61(052)114 and AF 61(052)420) AD 288411 Unclassified

The problem is raised concerning the mechanisms underlying visually controlled orientation in the Desert Locust. The experiments are concerned with 3 aspects of this problem; inhibition of information from, or response to, irrelevant stimuli; the processes of orientation to 1 of several possible stimuli; 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 oriented 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. (Contractor's abstract)

2168

Oxford U. [Dept. of Biochemistry] (Gt. Brit.).

MAZE LEARNING AND DISCRIMINATION IN ANTS, by D. M. Vowles. May 30, 1961, 36p. incl. diagrs. refs. (Technical note no. 1) (AFOSR-3220) (In cooperation with Reading U. Inst. of Experimental Psychology, Oxford (Gt. Brit.)) (AF 61(052)114 and AF 61(052)420) AD 288454 Unclassified

A technique is described for training ants in a T-maze. The walls of the maze are covered with patterns which serve as cues for the correct solution of the maze. These patterns can be varied in order to test the visual discrimination of the ant. It was found that ants would discriminate between vertical and diagonal stripes, but not between diagonal stripes of opposite slope. In an experiment on generalization between stripes of different sizes, the ants appeared able to generalize satisfactorily. The implications of these experiments for insect pattern vision are discussed.

2169

Oxford U. [Dept. of Biochemistry] (Gt. Brit.).

THE ELECTRORETINOGRAM IN THE COMPOUND EYE OF THE DESERT LOCUST (SCHISTOCERCA GREGARIA FORSKAL), by D. M. Vowles. July 1, 1961, 28p. incl. diagrs. tables, refs. (Technical note no. 2) (AFOSR-3221) (AF 61(052)420) AD 288416 Unclassified

The form of the locust electroretinogram is reported. This depends upon the type of electrode used, and the contact of the electrode with the retina. The critical flicker frequency (c.f.f.) was measured. This is of the order of 30-40 c/sec under the conditions of illumination used. The c.f.f. is higher when the flicker is produced by a moving shadow than when produced by stroboscopic illumination. Dark adaptation takes about 30 min. If the ventral region of the eye is illuminated the threshold for the dorsal region of the eye is raised. The results are compared with those of previous workers and in the light of Autrum's categories of slow and fast types of compound eye.

2170

Oxford U. [Dept. of Biochemistry] (Gt. Brit.).

MAZE LEARNING AND BRAIN LESIONS IN ANTS, by D. M. Vowles. Sept. 21, 1961, 76p. incl. diagrs. tables, refs. (Technical note no. 3) (AFOSR-3222) (In cooperation with Reading U. Inst. of Experimental Psychology, Oxford (Gt. Brit.)) (AF 61(052)114 and AF 61(052)420) AD 288453 Unclassified

A method is described for training ants in simple and difficult visual discriminations. The ants are tested for interocular transfer, monocular blinding following binocular training, and binocular testing following monocular training. In a simple problem no disturbance is caused by the experimental changes. In the difficult problem all 3 changes produce a disturbance. The effect of severing the tracts unilaterally between the optic ganglia and the mushroom bodies following binocular and monocular training in both a difficult and a simple problem was studied. With one exception a disturbance in learned performance was caused by the operation, even if on the blinded side. The exception was following binocular training in the simple problem. Control lesions did not produce any disturbance. Lesions to the optic ganglia showed that these were involved in the engram. A hypothesis based on neurophysiological evidence is proposed to explain all of the results.

2171

Oxford U. [Dept. of Biochemistry] (Gt. Brit.).

OLFACTORY LEARNING AND BRAIN LESIONS IN THE WOOD ANT (FORMICA RUFA), by D. M. Vowles. Sept. 30, 1961 [25]p. incl. diagrs. tables. (Rept. no. 6) (AFOSR-3462) (In cooperation with Reading U., Dept. of Psychology (Gt. Brit.)) (AF 61-(052)420 and AF 61(052)114) AD 284348 Unclassified

Also published in Jour. Compar. and Physiol. Psychol., v. 58: 105-111, 1964.

A technique is described for training ants in a T-maze, using olfactory cues. True olfactory learning occurs and amputation of the antenna prevents the use of olfactory cues. Amputation of one antenna causes a slight falling off in performance, but the ants still perform well above chance level after the operation. After ants have been trained in an olfactory discrimination, the effect of brain lesions on performance is studied. Severing the tracts between both antennal lobes and the alpha lobes of the mushroom bodies causes performance to fall back to chance level. Severing the tracts on only 1 side of the brain, or lesions placed elsewhere, does not disturb performance. Results are discussed in relation to the involvement of the mushroom bodies and antennal lobes in learning. (Contractor's abstract)

2172

Oxford U. [Dept. of Biochemistry] (Gt. Brit.).

EFFECTS OF NITRATE ON THE ELECTRICAL AND MECHANICAL ACTIVITY OF INTESTINAL SMOOTH MUSCLE, by J. Axelsson. [1961] [1]p. (AFOSR-J305) (AF 61(052)476) AD 408047 Unclassified

Also published in Biochem. Pharmacol., v. 8: 1, Aug. 1961.

Replacement of chloride with nitrate increases the frequency of spontaneous spike discharge which partly explains the increased tension in nitrate solution. In experiments in which no change in spike frequency was observed, the increased tension might still have been secondary to a change of spike duration and configuration. However, indirect evidence indicated that nitrate might have an effect on tension apart from its effect on the electrical activity. At 37°C the taenia coli maintained tension only as long as spike discharge persisted and usually it did not respond with a contracture to a depolarization with high KCl. Exposure to 10-20 times the normal concentration of KCl caused depolarization, stopped spikes and the muscle relaxed. When all the NaCl has been replaced by KCl, replacement of KCl with KNO_3 caused repolarization and initiated spikes, in spite of the 27 times the normal K concentration. However, in solution in which solid KCl was added or NaCl was only partly substituted, replacement of NaCl with $NaNO_3$ caused a slow increase in tension while the muscle remained depolarized and no spikes were recorded. It is therefore likely that nitrate has an effect on tension which is not mediated by its effect on the electrical activity. (Contractor's abstract)

2173

Oxford U. [Dept. of Biochemistry] (Gt. Brit.).

SODIUM EXCHANGE IN SMOOTH MUSCLE, by P. J. Goodford. [1961] [1]p. (AFOSR-J306) (AF 61(052)-476) AD 408046 Unclassified

Also published in Biochem. Pharmacol., v. 8: 1, Aug. 1961.

Nearly all the Na in the tissue exchanged with a half-life of 0.5 min when the bathing solution had been labelled with 4Na, and this exchange was too rapid to permit any resolution into intracellular and extracellular components. Other pieces of taenia were equilibrated in a normal Ringer's solution and then transferred to 1 in which all the Na salts had been replaced by Li; the Na again washed out of the tissue with an initial half-life of 0.5 min but a portion remained in the muscle during the 1 hr immersion in the Li Ringer. The experiment in Li solution was repeated at that temperature and the proportion of non-exchangeable Na was then much greater. It is suggested that the Na which remained in the tissue in the presence of Li was intracellular. The low content of bound Na at 35°C would then indicate a low intracellular concentration, which, however, approached the concentration in the external solution at 4°C. (Contractor's abstract)

2174

Oxford U. [Dept. of Biochemistry] (Gt. Brit.).

THE UPTAKE OF ETHANESULPHONATE-S^{35} IONS BY MUSCULAR TISSUE, by P. J. Goodford and H. Lüllman. [1961] [8]p. incl. diagrs. table, refs. (AFOSR-J307) (AF 61(052)476) AD 408049 Unclassified

Also published in Jour. Physiol. (London), v. 161: 54-61, Apr. 1962.

The uptake of radioactivity at different times, by pieces of skeletal, atrial and smooth muscle immersed in a physiological saline solution containing 3 mM ethanesulphonate-S^{35}, has been measured. Uptake occurred at 2 rates, a rapid phase completed in a few minutes (corresponding in magnitude to the extracellular space) and a much slower phase. After 3 hr immersion the intracellular concentration of ethanesulphonate-S^{35} was about 1/3 of the concentration in the bathing fluid. The extracellular spaces calculated from the results were: rat diaphragm, 21 ml/100 g wet wt; guinea-pig atria, 26 ml/100 g wet wt; guinea-pig taenia coli, 30 or 41 ml/100 g wet wt; depending on the method used to remove superficial saline from the tissue. The results suggested that ethanesulphonate was a relatively impermeant ion. (Contractor's abstract)

2175

Oxford U. [Dept. of Biochemistry] (Gt. Brit.).

SPIKE GENERATION BY INTESTINAL SMOOTH MUSCLE DURING COMPLETE ABSENCE OF SODIUM IN THE EXTERNAL MEDIUM, by E. Bülbring and H. Kuriyama. [1961] [1]p. (AFOSR-J308) (AF 61(052)476) AD 408050 Unclassified

Presented at First Internat'l. Pharmacological meeting, Stockholm (Sweden), Aug. 22-25, 1961.

Published in Biochem. Pharmacol., v. 8: 154, Aug. 1961.

Sucrose decreases membrane activity which ceases after 20-40 min. Choline depolarizes the membrane and rapidly abolishes spike generation but in the presence of atropine, choline increases membrane activity and spikes do not cease for 30 min or more. Lithium, after transient depression, increases discharge frequency. Membrane potential and spike height are slightly decreased, but spike generation continues for 1 hr or more. Tetraethylammonium transiently increases spike height, then it depolarizes, reduces spike height and prolongs the spike duration 100 times. Within 5 min spike discharge ceases. Tris(hydroxymethyl)aminomethane increases spike frequency and sometimes spike height. Spike generation continues for 30-60 min. Decreased membrane activity in sodium-free solutions may not be primarily due to sodium lack but to a change of membrane permeability or of metabolic processes by the substances used as substitutes. Spike generation in taenia coli may be independent of sodium. On the other hand, the substitutes used may maintain activity for short periods by acting in place of sodium. (Contractor's abstract)

2176

Oxford U. [Dept. of Biochemistry] (Gt. Brit.).

MOTILITY OF THE INTESTINE, by E. Bülbring. [1961] [3]p. incl. refs. (AFOSR-J309) [AF 61(052)-476] AD 408051 Unclassified

Also published in Proc. Royal Soc. Med., v. 54: 773-775, Sept. 1961.

It is clear that in rhythmically active smooth muscle of the intestine the rate of metabolic energy supply is an important factor influencing membrane potential and excitability. The tissue which is continuously in a condition of excitation requires a very active mechanism for keeping up the differences in ionic concentration. The tendency to depolarize (due to the peculiar properties of the membrane, particularly its high sodium permeability) is constantly opposed by forces which try to stabilize the membrane.

2177

[Oxford U. Dept. of Biochemistry (Gt. Brit.)]

ELECTRICAL ACTIVITY IN INTESTINAL SMOOTH MUSCLE, by E. Bülbring. [1961] [19]p. incl. illus. refs. (AFOSR-J311) (AF 61(052)476) AD 408053 Unclassified

Also published in Physiol. Rev., v. 42: 160-178, July 1962.

Evidence is given in support of the idea that mechanical changes are associated with the initiation of impulses, that the cause for discharge of impulses is probably the depolarization of the cell surface and that this in turn is due to a change in metabolism. The properties of smooth muscle are discussed. It is pointed out that the complicated pattern of activity is the consequence of the smooth muscle cell being much less specialized than other excitable tissue. Each cell is rather like a primitive organism combining several functional possibilities within one and the same cell. An explanation of control of the membrane potential is given dealing with such questions as what processes cause the fluctuations of the mean level of the membrane potential and the changes in excitability, and what is the ionic basis for the electrical activity. The role that acetylcholine plays in depolarization is also investigated. It is pointed out that the mode of action of adrenaline has thrown new light on the behavior of this interesting muscle, mainly because of the ability to measure biophysical and biochemical changes in parallel and to correlate them with changes in ion movements. The future holds many experimental possibilities of this kind before an understanding of the fascinating oscillating system and the servo-mechanism contained in the cells of intestinal smooth muscle can be achieved.

2178

Oxford U. Dept. of Pharmacology (Gt. Brit.).

THE DISTRIBUTION OF 5-HYDROXYTRYPTAMINE AND ADENOSINETRIPHOSPHATE IN CYTOPLASMIC PARTICLES OF THE DOG'S SMALL INTESTINE, by W. H. Prusoff. [1960] [5]p. incl. diagrs. refs. (AFOSR-252) (AF 61(052)235) AD 253884 Unclassified

Also published in Brit. Jour. Pharmacol. and Chemotherapy, v. 15: 520-524, Dec. 1960.

The distribution of 5-hydroxytryptamine, adenosinetriphosphate, and succinic dehydrogenase in sucrose homogenates of the dog's small intestine has been studied. The adenosinetriphosphate was present in 2 different layers which could be separated by density gradient centrifugation. The upper layer contained also much succinic dehydrogenase, but no amine; it is probably composed of mitochondria. The lower layer contained not only adenosinetriphosphate but also the major portion of the particle-held 5-hydroxytryptamine. The mean molar ratio, amine: adenosinetriphosphate, in the lower layer was 2.6. The experiments suggest that adenosinetriphosphate in the intestine is of importance in the storage of 5-hydroxytryptamine, resembling the function of adenosinetriphosphate in the storage of the catechol amines of the adrenal medulla. (Contractor's abstract)

2179

Oxford U. Dept. of Pharmacology (Gt. Brit.).

COMPARATIVE STUDY OF HYDROXYINDOLE OXIDASES, by H. Blaschko and W. G. Levine. [1960] [9]p. incl. diagrs. tables, refs. (AFOSR-253) (AF 61(052)235) AD 253839 Unclassified

Also published in Brit. Jour. Pharmacol. and Chemotherapy, v. 15: 625-633, Dec. 1960.

A comparative study has been carried out of the oxidation of 5-hydroxytryptamine and related compounds by the oxidase present in the gill plates of Mytilus edulis and of caeruloplasmin, the copper containing oxidase of mammalian plasma. Both preparations oxidized indole derivatives carrying a hydroxyl group in the 4-, 5-, 6-, or 7- position. The oxidation of bufotenine was compared with that of its 4- and 6-hydroxy analogues; the 4-hydroxy analogue is psil ocine, a naturally occurring hallucinogenic compound. The evidence suggests that the 2 enzymes catalyse the same reactions, but that the substrate specificity of the mammalian oxidase is somewhat more restricted. Both enzymes are hydroxyindole oxidases, not specific for 5-hydroxyindoles alone. Inhibitors of the Mytilus oxidase included inhibitors of copper enzymes but not edetate or carbon monoxide. The action of pig serum on 5-hydroxytryptamine was due to caeruloplasmin and not to amine oxidase. (Contractor's abstract)

2180

Oxford U. Dept. of Pharmacology (Gt. Brit.).

SEPARATION OF CELL COMPONENTS BY DIFFERENTIAL CENTRIFUGATION, by H. Blaschko. [1961] [5]p. incl. diagr. refs. (AFOSR-2022) [AF 61(052)-235] AD 455615 Unclassified

The use of a centrifuge tube called a chondriocrit is described. It enables one to get a measure of the volume of a sediment and also makes it possible to see if a sediment is homogeneous; different layers show up readily in the capillary part at the bottom of the tube. In this experiment one was able to see that the so-called mitochondrial sediment from the bovine adrenal medulla was not homogeneous. An upper and lower layer could be distinguished; the lower layer was found richer in catechol amines and the upper richer in succinic oxidase. A mitochondrial sediment was prepared in 0.3 M sucrose. It was resuspended in sucrose of the same concentration, and layered over a sucrose density gradient. In these experiments the gradient was prepared from sucrose solutions, beginning with 2.25 M sucrose at the bottom and 1.6 M sucrose at the top. High-speed centrifugation in the Spinco ultracentrifuge led to a resolution of the mitochondrial sediment. A very conspicuous opaque layer was seen at the top of the gradient and more opaque layers were recovered from the lower part of the tube. Three enzymes were studied in these experiments: succinic dehydrogenase, fumarase and amine oxidase. All 3 were found to be present in the opaque layer of particles at the top of the gradient. This layer did not contain catechol amines. The amines were recovered in the lower layers of the gradient; these layers did not contain significant amounts of the 3 enzymes. In the experiments with the bovine adrenal medulla, adenosine triphosphate (ATP) was also determined. In the density gradient, the distribution of the ATP so closely followed that of the catechol amines that there can be little doubt that amines and ATP are present in 1 and the same granule. This work is in good agreement with recent cytological studies of the adrenal medulla. Similar procedures were used to determine a resolution of the particulate material isolated from the Harding-Passey mouse melanoma. Electron micrographs were prepared from the fractions isolated using again the Schuster cutter. The grey opaque layer contained a practically pure suspension of typical mitochondria; the intensity black layers at the bottom of the sucrose gradient contained melanin granules. The study of the distribution of the 2 enzymes showed that a very satisfactory separation had been achieved.

2181

Oxford U. Dept. of Pharmacology (Gt. Brit.).

EFFECT OF RESERPINE ON THE 5-HYDROXYTRYPTAMINE AND ADENOSINETRIPHOSPHATE OF THE DOG INTESTINAL MUCOSA, by W. H. Prusoff. [1961] [5]p. incl. diagrs. tables, refs. (AFOSR-2023) (Sponsored jointly by Air Force Office of Scientific Research under [AF 61(052)235] and National Institute of Neurological Diseases and Blindness) Unclassified

Also published in Brit. Jour. Pharmacol. and Chemotherapy, v. 17: 87-91, Aug. 1961.

Homogenates were prepared of the mucous membrane of the small intestine from dogs previously treated with high doses of reserpine. The granular material sedimented from these homogenates was centrifuged over a density gradient. The dense fraction usually rich in adenosinetriphosphate and 5-hydroxytryptamine contained little amine and no nucleotide; on the other hand, the less dense material, believed to consist mainly of mitochondria, contained amounts of adenosinetriphosphate similar to those found in animals not treated with reserpine.

2182

Oxford U. Dept. of Pharmacology (Gt. Brit.).

SPERMINE OXIDASE AND BENZYLAMINE OXIDASE. DISTRIBUTION, DEVELOPMENT AND SUBSTRATE SPECIFICITY, by H. Blaschko and R. Bonney. [1961] [12]p. incl. diagrs. tables, refs. (AFOSR-3615) (Sponsored jointly by Air Force Office of Scientific Research under [AF 61(052)235] and [British] Agricultural Research Council) Unclassified

Also published in Proc. Royal Soc. (London), v. 156B: 268-279, 1962.

A survey has been made of the distribution of the 2 types of amine oxidase that occur in mammalian blood plasma. Spermine oxidase has been found in all ruminants (Ruminantia and Tylopoda) examined, and also in the hippopotamus and 2 members of the order Hyracoidea. Benzylamine oxidase has a much wider distribution; it occurs not only in Ungulates and Carnivores, but has also been found in some Primates. Benzylamine oxidase was not found in the blood

plasma of newborn pigiets; in newborn foals the enzymic activity was low. Spermine oxidase activity, absent or very low in the newborn kid, developed at similar rates in kids kept with the mother, bedded on straw, and in those removed from the mother and bedded on wood shavings. The plasma amine oxidases differ from the intracellular amine oxidase in that they are unable to oxidize N-methylated secondary amines. (Contractor's abstract)

2183

[Oxford U. Engineering Lab. (Gt. Brit.)]

[MILLIMETER WAVE AND SUB-MILLIMETER WAVE RESEARCH]. Mar. 1, 1957-Feb. 28, 1961, 5p. incl. refs. (AFOSR-824) (AF 61(514)1183) AD 257574 Unclassified

Research was concerned with the exploration of the undulator principle for the generation of submillimeter waves. Other methods for generating such waves were also studied. The objective of the work on millimeter and submillimeter waves is the study of hot plasma. Wave propagation in a plasma was studied theoretically. (Contractor's abstract)

2184

Oxford U. Engineering Lab. (Gt. Brit.).

THE APPLICATION OF PHASE SPACE CONCEPTS TO THE DESIGN OF AN ELECTRON LINAC BUNCHER, by A. J. Lichtenberg. [1961] [70]p. incl. diagrs. (Technical note no. 9) (AFOSR-2245) (AF 61(514)1183) AD 289466 Unclassified

The report covers the preliminary design of a linac buncher to produce relativistic electrons for injection into an undulator. The function of a buncher is to confine the electrons within a narrow axial distance, while keeping the axial momentum spread as small as possible. In this paper it is proposed to vary the parameters in a manner such that the axial ratio changes exponentially. It is suggested by the transformation properties of the axial ratio that this would lead to a rational design method for field and velocity change along the structure to ensure good bunching. Mathematically this procedure leads to a differential equation which is solved numerically for the design parameters. With these parameters the equations of particle motions are solved, also numerically, and good agreement with the expected performance is found. The effect of beam loading on the extent of the phase-areas containing the particles is taken into account. A pre-bunching cavity is proposed in order to match the electron gun output phase area (emittance) to the bunching section input phase area (acceptance), the cavity thus acting as a phase-space transformer. Finally, the effects on particle orbits of errors in beam velocity, synchronous wave velocity, and electric field are investigated.

2185

Oxford U. Engineering Lab. (Gt. Brit.).

ELECTROMAGNETIC RADIATION FROM SOURCES EMBEDDED IN AN INFINITE ANISOTROPIC MEDIUM AND THE SIGNIFICANCE OF THE POYNTING VECTOR, by H. Kogelnik and H. Motz. [1961] 29p. incl. diagr. refs. (AFOSR-4756) (AF 61(514)1183) AD 408350 Unclassified

Examples of the power radiated by a modulated ion beam and that of an elementary magnetic dipole are treated. Problems of radiation from sources in the infinite medium can be readily reduced to elementary matrix operations and integrations by the method employed herein. Without further special assumptions the imaginary part of the power radiated diverges in most cases. Radiation fields at a large distance from the sources are computed. It is shown that the wave normal need not be parallel to the direction of propagation i. e. to the group velocity. In addition, although the polarization vectors may carry out a complicated motion, the direction of the average Poynting vector is nevertheless the same as that of the group velocity.

2186

Oxford U. Engineering Lab. (Gt. Brit.).

MEASUREMENTS OF MAGNETIZATION OF GADOLINIUM NEAR THE CURIE POINT IN HIGH PULSED FIELDS, by C. S. Gaskell and H. Motz. [1961] [7]p. incl. diagrs. [AF 61(514)1183] Unclassified

Published in Proc. Internat'l. Conf. on High Magnetic Fields, Cambridge, Mass. (Nov. 1-4, 1961) Cambridge, M. I. T. Press and New York, Wiley and Sons, 1962, p. 562-567. (AFOSR-2299)

The rare earth elements offer an attractive series for studying the relationship between electronic structure and the physical properties of metals. The special apparatus developed for measurements on gadolinium which has a ferromagnetic Curie point at 289° K is described. The field measurements, demagnetization correction and magneto thermal effects are explained. The results are compared with those of Elliott and reasons for the discrepancies suggested.

2187

Oxford U. Engineering Lab. (Gt. Brit.).

DEPENDENCE OF POWER RADIATED ON BEAM CURRENT IN A MAGNETIC UNDULATOR, by H. Motz and D. Walsh. [1961] [4]p. incl. diagrs. table. (AFOSR-J82) [AF EOAR-62-62] Unclassified

Also published in Jour. Appl. Phys., v. 33: 978-981, Mar. 1962.

It was found that with a particular 10-cm electron linear accelerator power radiated from undulating electrons in the 8-mm band increased as (current) 1.7.

At higher frequencies there was only an approximately linear increase. A large undulator, designed to radiate in the fundamental mode at 8 mm gave a half-watt power output. This is in general agreement with the theoretical radiation from electrons combined with the experimental power law. (Contractor's abstract)

2188

Oxford U. Inorganic Chemistry Lab. (Gt. Brit.).

THE REACTION OF ATOMS AND RADICALS WITH VARIOUS MOLECULES, by J. W. Linnett. Final technical rept. Feb. 1, 1957-Oct. 31, 1961. Nov. 26, 1961, 12p. (AFOSR-2029) (AF 61(514)1117) AD 272022 Unclassified

Emission spectra from flames of organic substances burning in active nitrogen at low pressures revealed a group of bands near 3290A only when the organic material contained H. Further analysis indicated that the emitter contained C and N and at least 3 atoms. From experiments with isotopic C, it was shown that the emitter was NCN. It was found that only the 4315A system of the CH emission is observed in flames supported by N atoms; when atomic O is used, the 3889A system is observed as well. Recombination of O and H atoms on the surfaces of catalysts, and the recombination of O atoms in the gas phase are discussed.



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.

2189

[Paris U.] France.

STUDIES OF DISLOCATIONS IN METALS BY X-RAY METHODS, by D. Taupin, C. Bousquet and others. Annual summary rept. Mar. 31, 1961, 17p. incl. illus. diagrs. (AFOSR-923) (AF 61(052)310) AD 262016 Unclassified

Summaries are presented of investigations on (1) the influence of a dislocation upon the reflecting power of a perfect crystal (the theoretical results are in satisfactory agreement with experimental measurements); and (2) the Berg-Barrett method used to study the structures of the domains in a $BaTiO_3$ crystal. The local distortion and the local value of the reticular spacing have been measured. (Contractor's abstract)

2190

[Paris U.] Association des Amis du Lab. de Physique de l'Ecole Normale Superieure (France).

RECOMBINATION RADIATION IN GERMANIUM AND SILICON, by C. Benoit a la Guillaume and O. Parodi. Aug. 1960 [9]p. incl. diagrs. tables, refs. [AF 61-(052)370] Unclassified

Presented at Internat'l. Conf. on Semiconductors, Prague (Czechoslovakia), Aug. 1960.

The variation with temperature of the relative intensities of the lines due to intrinsic recombination in Ge shows that the minimum of the conduction band is located at the edge of the Brillouin zone. The study of Zeeman effect on these lines proves that they are due to exciton annihilation. Recombination radiation through donors and acceptors has been studied at low temperature in Ge and Si. (Contractor's abstract)

2191

Paris U. Association des Amis du Lab. de Physique de l'Ecole Normale Superieure (France).

INVESTIGATION OF RECOMBINATION RADIATIONS FROM SEMICONDUCTORS, by C. Benoit a la Guillaume. May 15, 1961 [21]p. incl. diagrs. tables, refs. (AFOSR-1042) (AF 61(052)370) AD 262073 Unclassified

Recombination radiation from semi-conductors, mainly germanium have been studied at low temperatures (2°K to 20°K) with a resolving power of 1000 to 3000. A careful study of the intrinsic lines in Ge including magneto-optical effects proves that, at low temperature, they are due to exciton annihilation, and that the minimum of the conduction band is exactly at the edge of the Brillouin zone in the (111) direction. Lines due to shallow impurities in Ge have been studied. Two types of transition are observed: (1) recombination of a free carrier of opposite sign bounded to the impurity; (2) annihilation of an exciton from a 4 particles complex involving a neutral impurity plus an exciton. In both cases, first order and second order transitions are observed, and one can deduce the value of the $k = 0$ component of the wave function of the electron bounded to donors. Some results have been obtained in an attempt to visualize the dislocations in Ge by their own recombination radiation. (Contractor's abstract)

2192

Paris U. Lab. de Physique (France).

DOUBLE PHONON PROCESSES IN CADMIUM SULFIDE, by M. Balkanski and J. M. Besson. [1961] [6]p. incl. diagrs. tables, refs. (AFOSR-2107) [AF 61(052)572] Unclassified

Also published in Jour. Appl. Phys. Suppl., v. 32: 2292-2297, Oct. 1961.

Also published in Semiconducting Compounds; Proc. of the Conf., Schenectady, N. Y. (June 14-16, 1961), New York, W. A. Benjamin, Inc., 1961, p. 2292-2297. (AFOSR-955)

The bands of infrared absorption in hexagonal cadmium sulfide have been studied over a wide range of temperatures and are assigned to double-phonon processes. An analysis of these absorption peaks on the basis of four frequencies is proposed. The temperature-dependence of the location and intensity of these bands give indications upon the anharmonic parameter and Grüneisen constant of the crystal. Anharmonic forces are shown to be responsible for the coupling between normal vibrational modes. (Contractor's abstract)

2193

[Paris U. Lab. de Physique (France)]

ENERGY TRANSFER IN SEMICONDUCTORS, by M. Balkanski. [1958] [3]p. (AFOSR-4575) [AF 61(052)-572] AD 400843 Unclassified

Also published in Proc. 1958 Internat'l. Conf. on Semiconductors, Rochester, N. Y. (Aug. 18-22, 1958), New York, Pergamon Press, 1958, p. 179-181.

Also published in Jour. Phys. and Chem. Solids, v. 8: 179-181, Jan. 1959.

When an exciton produced in a semiconductor annihilates after propagation by returning in its fundamental state emitting a photon, this photon can be reabsorbed creating a new exciton if its frequency corresponds to the resonance energy. The processes can repeat

themselves as long as the photon emission takes place in the interior of the crystal at a few λ beneath the surface. The energy propagates by alternative creation and annihilation of excitons coupled by the radiation field until the excited state reaches the surface where the proton is emitted out of the system and detected. The mechanism proposed here to describe the energy transfer at great distances includes 2 successive steps repeated alternately. (1) Absorption of light and creation of an electron-hole pair strongly interacting between them whose zeroth order excited wave function can be constructed. (2) The excited electron returning to its ground state emits a photon. The emitted photon can be reabsorbed regenerating the excitation wave. The propagation of the excitation energy can be considered as exciton diffusion if the following conditions are satisfied: (1) The excitation wave conserves the wave vector over the whole process. (2) The multiple diffusion of the photon by the excitation waves is a coherent process. It is shown that in the solids where reabsorption of the emitted photon is possible one should find the apparent lifetime of the exciton greater than that given by simple estimation on one excited state. Because this multiple process is possible it is also natural to find great diffusion length. This explains the known experimental results.

2194

Paris U. Lab. de Physique (France).

ABAC CHART FOR FAST CALCULATION OF THE ABSORPTION AND REFLECTION COEFFICIENTS, by W. Nazarewicz, P. Rolland, and M. Balkanski. [1961] [2]p. incl. diagr. (AFOSR-J32) [AF 61(052)-572] AD 297143 Unclassified

Also published in Appl. Opt., v. 1: 369-370, May 1962.

Simultaneous transmission and reflection measurements on a thick absorbent layer permit 1 to obtain the absorption and reflection coefficients. A fast calculation is proposed by using a double coordinate system abac chart. The proposed abac chart permits 1 to obtain rapidly the transmission and the reflection coefficients of thick layers. Its usefulness is evident in the systematic study of the optical properties of such materials as semiconductors, which are neither perfectly transparent nor opaque, and which it is difficult to obtain in homogeneous volumes great enough to permit 1 to cut prisms in them, and for which the absorption coefficient is related to important properties such as the nature and the concentration of the impurities.

2195

Paris U. Lab. de Physique Théorique et Hautes Energies (France).

THE LOW ENERGY PION-PION INTERACTION I, by J. G. Taylor. Jan. 1961, 4p. (Technical note no. 23) (AFOSR-655) (Also bound with its AFOSR-1829; AD 272440) (AF 61(052)173) AD 258324 Unclassified

There has been a great deal of interest recently in the pion-pion interaction, both theoretically and practically. Here a derivation of the pion-pion amplitude from CAU (program of determining strong interactions by means of the properties of analyticity, unitarity, and crossing symmetry) which does not presuppose the resonance of Frazer-Fulco. The inverse amplitude is used to derive the most general form of pion-pion amplitude satisfying CAU. Results are obtained concerning the high energy behavior of the interaction, and a general discussion of possible resonances in the S and P waves is given. An account is given of the CAU properties in which some of the higher particle states are taken into account on the left hand cut (negative energy range), but only S and P waves are kept in all absorption parts. The high energy behavior of the S and P phase shifts can be determined unambiguously, showing that within the present approximation the I = 0 and 1 effective potentials are attractive at short distances and the I = 2 potential is repulsive. This result is used to discuss the possibility of resonances arising under the approximations.

2196

Paris U. Lab. de Physique Théorique et Hautes Energies (France).

THE PION-PION INTERACTION AND HIGH ENERGY p + d COLLISIONS, by J. G. Taylor. Jan. 1961, 5p. incl. refs. (Technical note no. 24) (AFOSR-656) (Also bound with its AFOSR-1829; AD 272440) (AF 61(052)173) AD 258448 Unclassified

Also published in Phys. Rev. Ltrs., v. 6: 237-238, Mar. 1, 1961.

A possible explanation of the anomaly found in meson production in proton-deuteron collisions is that put forward by Tubis and Uretsky (Phys. Rev. Ltrs., v. 5: 513, 1960). They suggest that if a final state P wave pion-pion interaction, described in the scattering length approximation, is added to the statistical model of Abashian et al (Ibid., v. 5: 258, 1960), a P wave scattering length of magnitude 2.5 pion Compton wavelengths explains the anomaly. Evidence is given that does not agree with such a large value for this scattering length. This evidence comes from equations relating the 3 scattering lengths as derived from crossing symmetry, and from the experimental evidence on the asymmetry of the pion momentum spectrum in tau decay. (Contractor's abstract)

2197

Paris U. Lab. de Physique Théorique et Hautes Energies (France).

SOME REMARKS ABOUT THE PHOTOPRODUCTION OF STRANGE PARTICLES, by M. Gourdin. Feb. 1961, 6p. incl. refs. (Technical note no. 25) (AFOSR-1567) (AF 61(052)173) AD 267241 Unclassified

Published in Nuovo Cimento, Series X, v. 20: 1035-1037, June 1, 1961.

An elementary description of strange particles photoproduction by adding to the Born terms some contributions due to resonances is presented. For Channel I (intermediate nucleons) and III (intermediate hyperons), the situation is exactly the same as for the associated production amplitude. For the Channel II (intermediate k-mesons) we have the possibility of an intermediate pi-K state. If we call k' the observed resonance, we replace the cut corresponding to the pi K intermediate state by a pole at the resonance energy.

2198

[Paris U.] Lab. de Physique Théorique et Hautes Energies (France).

CORRECTION TO INTRINSIC MAGNETIC MOMENTS BY CENTRAL AND TENSOR FORCES, by B. Bremond. June 1961, 17p. incl. tables. (Technical note no. 26) (AFOSR-1568) (Also bound with its AFOSR-1829; AD 272440) (AF 61(052)173) AD 266561 Unclassified

The magnetic moment correction by central and tensor interactions between a nucleon of specific momentum and spin and the Fermi sea are studied. The intrinsic magnetic moment operator is stated. The correction value is calculated by a second order perturbation method. The results are in qualitative agreement with the doubly-magic-plus-or-minus-one nuclei magnetic moments. (Contractor's abstract)

2199

[Paris U. Lab. de Physique Théorique et Hautes Energies] (France).

INELASTIC FORM FACTORS, by M. Gourdin. [1961] 7p. incl. diagrs. (Technical note no. 27) (AFOSR-1569) (Also bound with its AFOSR-1829; AD 272440) (AF 61(052)173) AD 266560 Unclassified

Also published in Nuovo Cimento, Series X, v. 21: 1094-1099, Sept. 16, 1961.

The inelastic scattering of electrons by nucleons or nuclei is treated. The process is related to the associated photonuclear reaction by using first order calculations of the electromagnetic coupling constant. (Contractor's abstract)

2200

Paris U. Lab. de Physique Théorique et Hautes Energies (France).

[BEHAVIOR OF NUCLEAR PARTICLES]. Final rept. Oct. 15, 1958-Oct. 14, 1961 [35]p. incl. refs. (AFOSR-1829) (AF 61(052)173) AD 272440 Unclassified

Work was conducted on unstable particles, K^4 - deuterium scattering, relativistic deuteron wave function, proton - antiproton interaction, weak interactions, theory of classical fluids, the structure of nuclear matter, pion - pion, and photo-production and electro-production of strange particles.

2201

Paris U. Lab. de Physique Theorique et Hautes Energies (France).

RELATIONS BETWEEN POLARIZATIONS DUE TO CHARGE INDEPENDENCE, by L. Michel. July 14, 1961, 7p. incl. diagrs. refs. (Technical note no. 1) (AFOSR-1511) (AF 61(052)474) AD 272294 Unclassified

Also published in Nuovo Cimento, Series X, v. 22: 203-207, Oct. 1, 1961.

The relation is studied that exists between the polarizations of corresponding particles in reactions identical from the point of view of charge independence. (Contractor's abstract)

2202

Paris U. Lab. de Physique Théorique et Hautes Energies (France).

FINAL STATE INTERACTION IN PROTON-ANTIPROTON ANNIHILATION AT REST, by C. Bouchiat and G. Flaman. July 30, 1961, 17p. incl. diagrs. refs. (Technical note no. 2) (AFOSR-1827) (AF 61-(052)474) AD 272029 Unclassified

Also published in Nuovo Cimento, Series X, v. 23: 13-21, Jan. 1, 1962.

The effects of the symmetrization of the wave function of final particles in proton-antiproton annihilation at rest leading to π-π and K-π resonant states are studied. The angular correlation between the decay products of the resonant states are quite different from those one would expect from the decay of an isolated particle. For instance, a forward-backward asymmetry appears in the decay of the K'; an angular distribution $\cos^2\theta$ in the disintegration of the π-π resonant state is transformed into a practically isotropic one. (Contractor's abstract)

2203

[Paris U.] Lab. de Physique Théorique et Hautes Energies (France).

THE LEFT-HAND CUT DISCONTINUITY AND EQUIVALENT POTENTIALS, by K. Chadan. Dec. 1961, 6p. (Technical note no. 1) (AFOSR-2223) (AF EOAR-62-10) Unclassified

Also published in Nuovo Cimento, Series X, v. 24: 379-384, May 1, 1962.

It was shown by Martin (Nuovo Cimento, Series X, v. 19: 1257-1265, 1961) that for a superposition of Yukawa potentials the left-hand discontinuity of the partial wave amplitude determines uniquely both the amplitude and the potential. The author extends the proof to the case when there is a bound state superimposed on the left-hand cut. It is also shown that the potential so obtained is one member of the family of phase-equivalent potentials obtained from the phase shifts. If there are no bound states on the left-hand cut, the potential obtained from the left-hand discontinuity is that particular member of the family which decreases fastest at infinity; no such statement can be made if there is a bound state below the left-hand branch point. (Math. Rev. abstract)

2204

Pennsylvania State U. Dept. of Aeronautical Engineering, University Park.

SHOCK WAVE STRUCTURE IN A FULLY IONIZED GAS BASED ON MULTI-COMPONENT FLUID THEORY, by H. Li and R. D. Mathieu. Sept. 1961 [54]p. incl. diagrs. refs. (Technical rept. no. 14) (AFOSR-1018) (AF 49(638)647) AD 266620 Unclassified

The multi-component continuous approach for the investigation of the gasdynamics of a plasma is presented. More information about the flow properties of a plasma can be obtained than from the classical magnetohydrodynamic approach. Also, the resulting equations appear to be more easily solved than the Boltzmann equation of classical kinetic theory. The basic macroscopic conservation equations for a non-reacting multi-component plasma are presented. The fluid properties of each component are referred to the mean velocity of that component. Therefore, no limitations are placed on the magnitude of the diffusion velocities. The effects of electric and magnetic fields are included. The equations for a 2-component mixture are used to study the structure of a shock wave in a fully-ionized hydrogen gas. It is assumed that the momentum exchange and energy exchange between the ions and electrons are important because of the strong Coulomb forces present. Thus, the effects of viscosity and thermal conductivity are neglected. The phenomenon of charge separation gives rise to an induced electric field within the plasma. For a Mach number of 1.12 and typical plasma conditions, the electric field is of the order of 12,000 v/cm. At this low Mach number, the fluid properties of the ions and electrons vary in an oscillatory manner through the shock wave. As the mean-free path between particles decreases, the oscillations damp out more rapidly and at the same time the oscillations become less frequent. (Contractor's abstract)

2205

Pennsylvania State U. [Dept. of Aeronautical Engineering] University Park.

GASDYNAMICS OF PLASMAS (Abstract), by H. Li and R. D. Mathieu. [1961] [1]p. (Bound with AFOSR-582; AD 257892) (AF 49(638)647) Unclassified

Presented at Fourth annual AFOSR Contractors' meeting on Ion and Plasma Acceleration, Beverly Hills, Calif., Apr. 20-21, 1961.

The multi-component continuum approach is used to investigate the fluid properties through the transition region of a shock wave in a fully ionized plasma. The plasma is considered to consist of electrons and one type of positive ions which are singly charged. A set of continuum equations is written for the ions and a set for the electrons. It is assumed that the ions and electrons are in a local thermodynamic equilibrium with themselves but not with each other. Only the effects of diffusion due to the self-induced electric field and to gradients in the pressure, density, and temperature are included. The effects of viscosity and thermal conductivity are neglected. The justification for this is the presence of the long range electrostatic Coulomb forces which become important when the Debye length is on the order of or greater than the mean free path. Uniform conditions for the electron and ion gas mixture are assumed far ahead and far behind the shock front. This implies that there is no current flow through the shock transition region if there is no external electric field. Thus, there is no dissipation to Joule heating. No assumptions are made concerning the difference in mass, number density, velocity, pressure, or temperature between the ions and electrons. Also, no assumption has been made concerning the magnitude of the diffusion velocities. The equations and expressions used are good for large diffusion velocities as well as for small diffusion velocities.

2206

Pennsylvania State U. [Dept. of Biology] University Park.

PHOTOOXIDASE ACTIVITY OF HEATED CHROMATOPHORES OF RHODOSPIRILLUM RUBRUM, by E. S. Lindstrom. [1961] [3]p. incl. diagr. tabl., refs. (AFOSR-J700) (Sponsored jointly by [Air Force Office of Scientific Research under AF AFOSR-61-42], Charles F. Kettering Foundation, and National Science Foundation) AD 413399 Unclassified

Also published in Plant Physiol., v. 37: 127-129, Mar. 1962.

Mild heat treatments of the chromatophore of Rhodospirillum rubrum (Esmarch) caused a more rapid decline in the rate of photooxidation of reduced indophenol than a destruction of the far-red absorption band of bacteriochlorophyll. This indicated that such photooxidations were not simply a passage of electrons from the reduced indophenol to the nascent photooxidized bacteriochlorophyll as other heat labile factors were also necessary for the photooxidation of the reduced indophenol. The rates of these photooxidations on a bacteriochlorophyll basis were comparable to the rates of the photoreduction of exogenous DPN. It is suggested that such photooxidations are valid measurements for the oxidant in bacterial photosynthesis. (Contractor's abstract)

2207

Pennsylvania State U. Dept. of Engineering Mechanics, University Park.

EFFECTS OF TRIAXIAL STRESSES ON MECHANICAL PROPERTIES OF METALS UNDER HIGH PRESSURE, by L. W. Hu, E. E. Headington and others. Final rept. Sept. 1961, 144p. incl. diagrs. tables, refs. (AFOSR-1716) (AF 49(638)676) AD 266887 Unclassified

The studies of the effects of triaxial stresses on the mechanical properties of metals under hydrostatic pressure conducted under this contract during the past 2 yr included 2 main parts. The results of the first part were negative and are not reported here. The second part consisted of the following 6 sections all of which are reviewed individually: (1) The influence of hydrostatic pressure on the fatigue life of an aluminum alloy 7075-T6 was investigated. It was found that the fatigue life of notched cantilever specimens increased with the intensity of superimposed hydrostatic pressure. (2) An experimental investigation was made to study the effect of tensile plastic deformation on the 3-dimensional yield surface of a mild steel. A significant conclusion which can be drawn from the test results was a local bulge produced on the yield surface by the loading program prescribed. (3) To determine the plastic stress-strain relations in tension for an aluminum alloy 2017-T4, an experimental program was conducted. The test results confirmed the previous findings that the hydrostatic stress state has no significant effect on the plastic behavior of aluminum alloys, although the area reduction at fracture was found to increase with the intensity of hydrostatic pressure. (4) A program to study the mechanical properties of wires drawn under hydrostatic pressure was initiated and it is not reported here. (5) Analytical studies were made on the inclusion of hydrostatic stress component in the formulation of the yield condition for metals. The implication of the inclusion of the hydrostatic stress component for plastic stress-strain relations was discussed. (6) One type of yield condition in particular was studied, and its application to the determination of the load carrying capacity of thick-walled spherical shells was made.

2208

Pennsylvania State U. Dept. of Engineering Mechanics, University Park.

EFFECT OF TENSILE PLASTIC DEFORMATION ON THREE DIMENSIONAL YIELD SURFACE, by L. W. Hu, H. E. Shull, and K. D. Pae. Sept. 1961 [26]p. incl. diagrs. tables. (Bound with its AFOSR-1716; AD 266887) (AF 49(638)676) Unclassified

The tensile yield stress of the cylindrical specimens prestressed in tension decreases when the intensity of the superimposed hydrostatic pressure increases. The experimental results disprove the assumption that hydrostatic pressure of moderate intensity has no effect on the plastic flow of metals. When the results of this investigation and the yield corner formation found in biaxial stress experiments are taken into consideration, straining plastically along the loading path appears to produce a local bulge on the initial yield surface.

2209

Pennsylvania State U. Dept. of Engineering Mechanics, University Park.

THE INCLUSION OF HYDROSTATIC STRESS COMPONENT IN YIELD CONDITION AND APPLICATION, by L. W. Hu and K. D. Pae. Sept. 1961 [2]p. incl. diagrs. (Bound with its AFOSR-1716; AD 266877) (AF 49(638)676) Unclassified

Also published in Jour. Franklin Inst., v. 275: 491-502, June 1963.

The inclusion of the hydrostatic stress component in the formulation of the yield condition for metals is discussed. Many experimental observations in combined stress experiments can be described satisfactorily by a yield condition of the form $J_2 = K^2 + \alpha J_1 + \beta J_1^2$. A further approximation of this yield condition can be used in biaxial stress problems for many materials and it depends on the relative magnitude of the material constants k, α and β. An application of the above yield condition to the determination of the load carrying capacity of thick-walled spherical shells was given.

2210

Pennsylvania State U. Dept. of Engineering Mechanics, University Park.

AN INVESTIGATION OF THE INFLUENCE OF HYDROSTATIC PRESSURE ON THE FATIGUE LIFE OF AN ALUMINUM ALLOY 7075-T6, by L. W. Hu, R. H. Hoffman, and J. Schreiber. Sept. 1961 [32]p. incl. diagrs. tables. (Bound with its AFOSR-1716; AD 266887) (AF 49(638)676) Unclassified

An investigation on the influence of hydrostatic pressure on the fatigue life of an aluminum alloy 7075-T6 was conducted by a specially designed fatigue testing unit of constant deflection type. It was found that the fatigue life increased significantly as the intensity of hydrostatic pressure increased but the scatter of experimental results appeared not to be affected by the superimposed pressure. In other words, it was found that in the formulation of a general theory of fatigue strength, it is incorrect to assume that the hydrostatic stress state has no effect on the fatigue strength of metals. The representation of the influence of hydrostatic pressure on the effect of the mean stress on fatigue strength of metals was discussed.

2211

Pennsylvania State U. Dept. of Engineering Mechanics, University Park.

A NOTE ON PLASTIC STRESS-STRAIN RELATIONS IN TENSION OF 2017-T4 ALUMINUM ALLOY UNDER HYDROSTATIC PRESSURE, by L. W. Hu and H. E. Shull. [Sept. 1961] 9p. incl. diagrs. (Bound with its AFOSR-1716; AD 266877) (AF 49(638)676) Unclassified

For the material 2017-T4 tested in tension under hydrostatic pressure up to 50,000 psi, the following conclusions can be made: (1) The tensile plastic stress-strain relations were not affected by the presence of hydrostatic pressure. (2) The necking of the specimen at fracture became more localized as the intensity of superimposed hydrostatic pressure increased. (3) The area reduction of fracture increased as the intensity of pressure increased.

2212

Pennsylvania State U. Dept. of Engineering Mechanics, University Park.

PLASTIC STRESS-STRAIN RELATIONS AND HYDROSTATIC STRESS, by L. W. Hu. Sept. 1961 [14]p. incl. diagrs. refs. (Bound with its AFOSR-1716; AD 266887) (AF 49(638)676) Unclassified

It has been shown that the plastic stress strain relations for metals can be formulated to include the effects of hydrostatic component of stress. If the plastic potential is assumed to be the same as the yield criterion, it is necessary to consider the volume change caused by plastic deformation. The uniqueness of solution for elastic-plastic bodies can be shown in the exact similar way as the proof of uniqueness theorem by Melan. The significance of the inclusion of the first stress invariant in yield criterion lies not only in the fact that it represents physical phenomena correctly, but also that it may lead to new view points in the stress analysis of elastic-plastic bodies.

2213

Pennsylvania State U. Dept. of Engineering Mechanics, University Park.

STRESS DISTRIBUTION IN A COMPOUND CYLINDER SUBJECTED TO TENSION, by L. W. Hu and E. E. Headington. Sept. 1961 [33]p. incl. diagrs. table, refs. (Bound with its AFOSR-1716; AD 266877) (AF 49(638)676) Unclassified

An elastic solution for a compound cylindrical bar subjected to tension was obtained by the stress function method. The numerical example for a bar with alt = 1000 appears to give a poor approximation to the solution. This poor approximation may be attributed to the fact that only the first 2 terms of the series solution were taken.

2214

Pennsylvania State U. Dept. of Engineering Mechanics, University Park.

COORDINATE SYSTEMS IN CONTINUUM MECHANICS, by W. Jaunzemis. Aug. 1961, 41p. incl. refs. (Technical rept. no. 3) (AFOSR-1867) (AF AFOSR-62-115) AD 270541 Unclassified

The use of space, body, and variable reference coordinate systems in problems of continuum mechanics is reviewed, and certain results regarding tensor fields are summarized. Specifically, the advantages of body coordinate systems for characterization of constitutive equations, and the description of permanent deformation with the aid of a variable reference system are discussed, with a view towards the study of thermal stresses and deformations in the high temperature range. The various forms of the equations of motion are discussed, and reference is made to certain conflicting statements in the recent literature.

2215

Pennsylvania State U. Field Emission Lab., University Park.

A SEARCH FOR POLARIZATION OF FIELD-EMITTED ELECTRONS, by W. T. Pimbley and E. W. Müller. [1961] [2]p. incl. diagrs. (AFOSR-3510) [AF 18(600)-672] AD 217686 Unclassified

Also published in Jour. Appl. Phys., v. 33. 238-239, Jan. 1962.

Experiments were performed to detect polarization using Mott scattering. The beam of field-emitted electrons is accelerated to relativistic speeds and scattered in a thin foil of a heavy metal. Diagrams of the apparatus used are given. No electron polarization was detected in either of the 2 experiments performed. The apparatus was unable to detect polarization less than about 3% in the most favorable case and up to 15% in the case of iron in a direction perpendicular to the electron beam.

2216

Pennsylvania State U. [Field Emission Lab.] University Park.

DIRECT OBSERVATION OF CRYSTAL IMPERFECTIONS BY FIELD ION MICROSCOPY, by E. W. Müller. [1961] [23]p. incl. illus. diagrs. table, refs. (AFOSR-43) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)504], Office of Naval Research, and Wright Air Development Division) Unclassified

Also published in Direct Observation of Imperfections in Crystals; Proc. of a Technical Conf., St. Louis, Mo. (Mar. 1-2, 1961), New York, Interscience Publishers, 1962, p. 77-99.

For abstract see item no. 2220, Vol. V.

2217

Pennsylvania State U. [Field Emission Lab.]
University Park.

PROGRESS IN FIELD EMISSION WORK-FUNCTION MEASUREMENTS OF ATOMICALLY PERFECT CRYSTAL PLANES, by R. D. Young and E. W. Müller. [1961] [5]p. incl. illus. diagrs. refs. (AFOSR-1096) (AF 49(638)504) Unclassified

Presented at Twenty-first annual M. I. T. Conf., on Physical Electronics, Mar. 1961.

Also published in Jour. Appl. Phys., v. 33: 91-95, Jan. 1962.

The field electron microscope has been used previously to measure the work function of thermally smoothed single-crystal tungsten planes. In this work the field ion microscope is used to create atomically perfect single-crystal planes by field evaporation and then to observe and preserve these clean surfaces. The slope of the field emission Fowler-Nordheim plot then gives the ratio of the three halves power of the work function to the field. Two techniques have been developed in order to obtain a second relationship between work function and field: (1) temperature dependence of field-emission current density and (2) energy distribution of field-emitted electrons. While investigating temperature dependence it was found that a reinterpretation of the Gel'berg et al data for the work function temperature dependence of molybdenum up to 1100°K revealed the following unexpected cubic temperature dependence: $\varphi_T = \varphi_0 + 0.44 \times 10^{-10} T^3$ ev. (Contractor's abstract)

2218

Pennsylvania State U. [Field Emission Lab.]
University Park.

FIELD EMISSION STUDIES OF METAL SURFACES, by E. W. Müller. Final rept. June 1, 1959-Nov. 30, 1961. Dec. 1961, 104p. incl. illus. diagrs. tables, refs. (AFOSR-1910) (AF 49(638)504) AD 270227 Unclassified

The results of most of the research performed under this contract have been or are being reported under published papers. This report contains additional results that are not contained in these publications. It consists of a compilation of several smaller research projects which have not yet led to sufficiently definite results to warrant publication in general journals. Each has been treated separately in this bibliography and can be identified under the contract as being bound within this overall final report.

2219

Pennsylvania State U. [Field Emission Lab.]
University Park.

DETERMINATION OF FIELD STRENGTH FOR FIELD EVAPORATION AND IONIZATION IN THE FIELD ION MICROSCOPE, by E. W. Müller and R. D. Young. [1961] [4]p. incl. diagrs. (AFOSR-3519) [AF 49(638)504] Unclassified

Also published in Jour. Appl. Phys., v. 32: 2425-2428, Nov. 1961.

The field strength required for field evaporation of tungsten and for best image conditions in the field ion microscope is measured by comparison with field electron emission of the same emitter. The evaporation field is independent of emitter radius except for radii below 150 A where the influence of free surface energy becomes noticeable. The field for the best conditions of a helium ion image of a typical emitter of 1000 A radius is 440 mv/cm. This field increases gradually with decreasing tip radius, so that the ratio of evaporation field to best image field for tungsten decreases from 1.27 at 1000 A radius to 1.0 at about 40 A radius. The radius dependence of this ratio can be calculated by assuming that the time a hopping atom spends in the critical ionization zone is a constant fraction of the ionization time. Practical implications are that large tip radii are preferable for easily evaporating emitter materials, and small radii may be useful when field evaporation is to be studied under best image conditions. (Contractor's abstract)

2220

Pennsylvania State U. [Field Emission Lab.]
University Park.

DIRECT OBSERVATION OF CRYSTAL IMPERFECTIONS BY FIELD ION MICROSCOPY, by E. W. Müller. [1961] [23]p. incl. illus. diagrs. table, refs. (AFOSR-J277) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)504], Office of Naval Research, and Wright Air Development Division) AD 408482 Unclassified

Also published in Direct Observation of Imperfections in Crystals; Proc. of a Technical Conf., St. Louis, Mo. (Mar. 1-2, 1961), New York, Interscience Publishers, 1962, p. 77-99.

The field ion microscope is a new version of the field electron microscope which depicts the evenly curved cap of a fine metal tip on a fluorescent screen with the help of electrons radially emitted under the influence of the high electric field at the tip. The magnification of this arrangement is essentially equal to the ratio of screen distance to tip radius. For tip radii below 10^{-5} cm the magnification can easily be made to exceed one million diameters. Resolution is determined by the field distribution on the atomically structured specimen surface itself, and by the fact that the ions originate in free space in a zone slightly above the surface. Individual defects of various crystal imperfections are presented showing the capabilities of the field ion microscope. Further research areas for future study are also outlined.

2221

Pennsylvania State U. [Field Emission Lab.] University Park.

BOMBARDMENT OF TUNGSTEN WITH 20 KEV HELIUM ATOMS IN A FIELD ION MICROSCOPE, by M. K. Sinha and E. W. Müller. Dec. 1961 [42]p. incl. illus. diagrs. refs. (Bound with its AFOSR-1910; AD 270227 (AF 49(638)504) Unclassified

Also published in Jour. Appl. Phys., v. 35: 1256-1261, Apr. 1964.

Fast helium atoms are shot into the emitter tip of a field ion microscope, and the resulting damage is shown to consist of vacancies, interstitials and their clusters. A large portion of defects created in the interior appears at the surface. This is due to the high field stress and the long range of interstitials by focusing collisions. Mobility of interstitials in tungsten was observed directly and occurs slowly at 21°K, and fast at 90°K.

2222

Pennsylvania State U. [Field Emission Lab.] University Park.

CORROSION OF TUNGSTEN BY WATER AND NITROGEN IN A FIELD ION MICROSCOPE, by J. F. Mulson and E. W. Müller. Dec. 1961 [27]p. incl. illus. diagrs. (Bound with its AFOSR-1910; AD 270227) (AF 49(638)504) Unclassified

Water vapor or nitrogen with a partial pressure of 10^{-6} mm etch tungsten tips in a field ion microscope in spite of the fact that the corroding molecules cannot approach the depicted tip region directly in the presence of the high field. The corrosion is a field induced chemical reaction, and the corrosion species migrate over the tungsten surface even at liquid hydrogen temperature.

2223

Pennsylvania State U. [Field Emission Lab.] University Park.

DETERMINATION OF WORK FUNCTIONS FROM FIELD EVAPORATION, DATA, by E. W. Müller. Dec. 1961 [7]p. incl. diagrs. (Bound with its AFOSR-1910; AD 270277) (AF 49(638)504) Unclassified

The formula for field evaporation contains 2 unknowns, the field strengths and the work function. By measuring field evaporation at 2 different temperatures 2 equations are obtained which can be solved for F and ϕ. Preliminary measurements indicate the usefulness of this method.

2224

Pennsylvania State U. [Field Emission Lab.] University Park.

AN IMPROVED METHOD FOR ELECTROPOLISHING FINE TIPS FOR FIELD ION MICROSCOPY, by Y. Yashiro and E. W. Müller. Dec. 1961 [3]p. incl. diagrs. (Bound with its AFOSR-1910; AD 270277) (AF 49(638)504) Unclassified

Presented at the Field Emission Symposium, Williamstown, Mass., Aug. 1961.

Improved electropolishing is obtained by using pulses from condensor discharges rather than d c. Desirable concave tapers can be made by having the electrolyte floating in a thin layer on an insulating liquid of greater density.

2225

Pennsylvania State U. [Field Emission Lab.] University Park.

MASS SPECTROSCOPY OF THE FIELD IONIZATION OF HYDROGEN, by T. C. Clements, E. W. Müller, and B. J. Waclawski. Dec. 1961 [21]p. incl. illus. diagrs. (Bound with its AFOSR-1910; AD 270227) (AF 49(638)504) Unclassified

H_1^+ and H_2^+ occur in the entire field range from 200 to 500 mv/cm. H_3^+ was found to be formed in a narrow field range near best image conditions. Relative H_3^+ production is independent upon pressure between 0.5 and 80 microns, and independent of temperature between 21°K and 200°K. Deuterium behaved the same way, and H_2-D_2 mixtures indicate that the triatomic ion is formed by the direct reaction of a proton or deuteron with a neutral molecule.

2226

Pennsylvania State U. Groth Inst., University Park.

A NEW CODE FOR REPRESENTATION OF ORGANIC STRUCTURAL FORMULAE ON PUNCHED CARDS AND MAGNETIC TAPE, FOR COMPUTER STORAGE AND PROCESSING, by V. Vand and R. Pepinsky. Jan. 15, 1961 [84]p. incl. diagrs. tables. (Rept. no. 75) (AFOSR-181) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)416 and Atomic Energy Commission under AT(30-1)1516) AD 279807 Unclassified

A new system has been developed for concise topological coding of organic structural formulae, using punched card input for small-machine processing or for transfer to magnetic tape for large machines. The code is specifically suited for storage and retrieval of structural formulae and all stereochemical features on standard small-scale machines. The small-machine print-outs are designed for IBM

Cardatypes with arithmetic units. Print-outs are in upper and lower case, with standard symbols for all chemical elements, chemical subscripts, etc. The Groth Institute upper-lower case control system for card- or tape-controlled typewriters is fundamental to the coding. This system can be transferred to an IBM 1401 printer with replaceable chains, or to the Pepinsky high-speed printer. The code does not involve numbering of atoms in the molecule and is only an intermediate step towards the Dyson Cipher and the logical chemical name. Conversion to the Dyson code is possible on large-scale machines. Small-scale machine systems suitable for this processing are discussed. (Contractor's abstract, modified)

2227

Pennsylvania State U. Groth Inst., University Park.

INDEX (11R-3RH) FOR NEW EDITION (NO. 43) OF HANDBOOK OF CHEMISTRY AND PHYSICS, by V. Vand and R. Pepinsky. Jan. 30, 1961 [59]p. incl. tables. (Rept no. 74) (AFOSR-182) (AF 49(638)416) Unclassified

An index for edition no. 43 of the Handbook of Chemistry and Physics has been produced entirely from IBM punched cards, using a Cardatype machine wired for upper-lower case GI case control system. Special symbols, such as Greek gamma, were inserted by hand. Their locations were indicated by special signs at the margin, which were subsequently erased. This was the only human intervention with the contents after punching the cards. Such print-outs can be produced on the IBM 1401 still more economically and at a very high speed. (Contractor's abstract, modified)

2228

Pennsylvania State U. Groth Inst., University Park.

A CONCISE TOPOLOGICAL CODE FOR ORGANIC STRUCTURAL FORMULAE, SUITABLE FOR SMALL-SCALE MACHINE RETRIEVAL, by R. Pepinsky and V. Vand. [1961] 3p. (AF 49(638)416) Unclassified

Presented at Symposium on New Machine Methods in Chemical Information Retrieval, St. Louis, Mo., Mar. 27, 1961.

A new system has been developed for concise topological coding of organic structural formulae, using punched card input for small-machine processing or for transfer to magnetic tape for large machines. The code is developed in stages of increasing conciseness, and complete linearization is possible. The code is specifically suited for storage of structural formulae and all stereochemical features on standard small-scale machines. The code, although completely topological, does not involve numbering of atoms in the molecules, and hence is only an intermediate toward a unique code such as the Dyson Cipher or Wiswesser code. The fact that retrieval centers, equipped with no more than a complement of small-scale machines which include a Cardatype and Sorter or Collator, can now process their own and outside-generated files, is of major importance. A system of automatic data exchange between centers of various sizes is proposed, in which the large centers also automatically convert the present topological coding to Dyson or other unique Ciphers and furnish the logical chemical name for each compound. The Groth Inst. code has been devised not only with the aim of simple topological representation of organic structures, but also to permit coding of inorganic and organic crystal structures, and to represent chemical reactions.

2229

Pennsylvania State U. Groth Inst., University Park.

DEVELOPMENTS IN INFORMATION RETRIEVAL METHODS FOR SMALL-SCALE AND LARGE-SCALE MACHINE SYSTEMS, by R. Pepinsky. [1961] [3]p. (AF 49(638)416) Unclassified

Presented at Symposium on New Machine Methods in Chemical Information Retrieval, St. Louis, Mo., Mar. 27, 1961.

Input data is coded for machine processing, and transferred to IBM cards. At least one card is used for each property where a property signifies any class of information: e.g., name, formula, molecular weight, crystal symmetry, density, cell dimensions, atomic coordinates (many cards), etc. Peek-a-boo cards are automatically produced for each property in sets of 500 crystalline species; and higher-order numbers identify sets of 500 species, sets of sets, etc. The Cardatypes are also programmed to rotate sentences, parts of chemical names and formulae, etc., to permit sorting on any of these components and to produce key-word-in-context entries for concordances and special searches. A complete, manageable retrieval system for mega-item files, using only small-scale machines is thus provided. Many large-machine programs have been developed, and include those for almost all calculations required in crystallography. The merged, variously-processed collection of data from all critical collations will be distributed to editors in other centers, to facilitate consideration of preparation of monographs on special subjects, suitable for later incorporation into an encyclopedia. Several special retrieval projects are in progress, the chief of which involves computation, storage and evaluation of powder diffraction data for identification purposes. Another program is concerned with consolidation of all information on polymorphism and crystal transitions. A third project involves processing and prepublication of a new edition of Donnay's Crystal Data.

2230

Pennsylvania State U. X-Ray and Crystal Analysis Lab., University Park.

RESEARCH ON THE CRYSTAL-STRUCTURAL BASES

FOR SOME PHYSICAL PROPERTIES OF CRYSTALLINE SOLIDS, by R. Pepinsky. Final rept. Jan. 31, 1961, 18p. incl. refs. (AFOSR-528) (AF 18(603)35) Unclassified

A summary of research activities concerning research on the crystal-structure bases for some physical properties of crystalline solids is presented along with instrumentation projects necessary for these research activities. Attention has been directed particularly to structures showing piezoelectric and ferroelectric properties, dielectric anomalies, and polymorphic transitions in the solid phase. Investigation techniques have involved development of new chemical and crystal-preparative methods, new methods for optical studies at low temperatures, new methods for dielectric observations, high-sensitivity piezoelectric measurements over wide temperature ranges, new x-ray structural methods, and extensive studies involving x-ray and neutron diffraction techniques.

2231

[Pennsylvania State U. X-Ray and Crystal Analysis Lab.] University Park.

A NEUTRON STRUCTURE ANALYSIS OF TETRAGONAL $NH_4H_2PO_4$, by L. Tenzer, B. C. Frazer, and R. Pepinsky. Jan. 25, 1958, 5p. (AFOSR-4917) (AF 18(603)35) AD 414931 Unclassified

Also published in Acta Crystallographica, v. 11: 505-509, July 1958.

For abstract see item no. PSU. 08:036, Vol. II.

2232

Pennsylvania U. [Dept. of Mathematics] Philadelphia.

CLASSES OF PERIODIC SEQUENCES, by N. J. Fine. [1957] [18]p. incl. tables. (AFOSR-5042) [AF 18-(603)65] AD 414025 Unclassified

Also published in Illinois Jour. Math., v. 2: 285-302, June 1958.

Let q symbols 1, 2, $\cdots$, q be given and consider all sequences of length n; place 2 sequences in the same equivalence class if they can be obtained from 1 another by merely renaming the symbols or by starting the 1 sequence at a different point. For example, if q = 3, n = 4, the sequences (1123), (3312), and (3123) are all equivalent. From these finite sequences, we may build up infinite sequences by repetition; the primitive period of such an infinite sequence is either n or a smaller integer. Thus, in the example, (1111) has primitive period 1. The author uses $F_q(n)$ to denote the number of equivalence classes with primitive period n and $F_q^*(n)$ to denote the total number of classes with period n (whether primitive or not). He then shows how to compute $F_q(n)$, but the formulae are too complicated to quote here. (Math. Rev. abstract)

2233

Pennsylvania U. [Dept. of Mathematics] Philadelphia.

POINT TRANSITIVE TRANSFORMATION GROUPS, by R. Ellis. [1961] [20]p. (AFOSR-517) (AF 49-(638)569) AD 258249 Unclassified

Also published in Trans. Amer. Math. Soc., v. 101: 384-395, Dec. 1961.

Let T be an abstract group, $(\beta T, T)$ the β-compactification of T regarded as a transformation group with phase group T. The collection of all point transitive transformation groups (X, T) with compact phase space X is studied by representing each such X as a set of homomorphisms of certain subalgebras of $C(\beta T)$ into $C(\beta T)$.

2234

Pennsylvania U. [Dept. of Metallurgical Engineering] Philadelphia.

A NEW THEORY OF WORKHARDENING, by D. Kuhlmann-Wilsdorf. Sept. 1961, 45p. incl. refs. (AFOSR-1956) (AF 49(638)435) AD 269940 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: 210, Mar. 26, 1962.

Also published in Trans. Metall. Soc. AIME, v. 224: 1047-1061, Oct. 1962.

The experimental evidence on mechanical behavior of fcc, bcc and hcp metals is briefly reviewed. Extended linear hardening, largely independent of temperature, strain rate and other testing conditions, is found not only in all fcc metals (stage II) and in Ge but also in polycrystalline Fe and simple steels. The average value of the shear modulus by work hardening coefficient in the linear range is about 300 in fcc metals and 500 in steels. The corresponding value for hcp metals is by far larger, and it is concluded that the linear hardening in them cannot be compared to that in fcc and bcc metals. A qualitative theory of easy glide is presented. Linear hardening in stage II is explained on the basis of 3 simple assumptions. The resultant theory is applicable to a great variety of materials, testing conditions and dislocation arrangements, and in particular also to the tangled dislocation structures which are believed to be due to interactions between point defects and dislocations.

2235

Pennsylvania U. [Dept. of Metallurgical Engineering] Philadelphia.

SOME THEORETICAL CONSIDERATIONS ON THE

GEOMETRY OF LOW-ANGLE DISLOCATION BOUNDARIES, by D. Kuhlmann-Wilsdorf. [1961] [7]p. incl. diagrs. (AFOSR-4006) (AF 49(638)435) Unclassified

Also published in Jour. Appl. Phys., v. 33: 648-654, Feb. 1962.

Frank's vector formula defining low-angle boundaries is rewritten into 6 independent scalar equations which can be represented in the form of 3 simple 2-dimensional vector diagrams. These diagrams facilitate the discussion and construction of low-angle boundaries, and in particular allow to construct four-grid boundaries due to glide dislocations on arbitrary planes. (Contractor's abstract)

2236

Pennsylvania U. Dept. of Metallurgical Engineering, Philadelphia.

NEUTRON AND X-RAY DIFFRACTION STUDIES ON THE STRUCTURE OF WC AND A COMPARISON OF IT WITH EARLIER ELECTRON DIFFRACTION DATA, by E. Parthe and V. Sadagopan. Technical status rept. Feb. 1-Sept. 30, 1961. Nov. 1961, 9p. incl. diagrs. table, refs. (AFOSR-1721) (AF 49(638)1027) AD 269689 Unclassified

A neutron diffraction study of WC reveals that WC crystallizes in a hexagonal form with 1 W atom in 000 and 1 C atom in 1/3 2/3 1/2. Neutron diffraction study in contradistinction to the electron and x-ray diffraction studies conclusively establishes that WC does not crystallize in the NiAs type structure.

2237

Pennsylvania U. Dept. of Metallurgical Engineering, Philadelphia.

[NEUTRON AND X-RAY DIFFRACTION INVESTIGATION OF THE STRUCTURE OF TUNGSTEN CARBIDES AND A COMPARISON OF ELECTRON DIFFRACTION DATA] Neutronen und Röntgenbeugungsuntersuchungen über die Struktur des Wolframcarbides WC und Vergleich mit älteren Elektronenbeugungsdaten, by E. Parthe and V. Sadagopan. [1961] [8]p. incl. diagrs. table, refs. (AFOSR-3558) (AF 49(638)1027) Unclassified

Also published in Monatsh. Chem., v. 93: 263-270, 1962.

A neutron diffraction investigation shows that tungsten carbide crystallizes in the hexagonal form. The tungsten atom lies at the lattice point 000 and the carbon atom at the lattice point 1/3 2/3 1/2. The neutron diffraction study proves, in contrast to the electron and x-ray diffraction investigation, that tungsten carbide does not crystallize in the nickel arsenide-type lattice.

2238

Pennsylvania U. [Dept. of Physics] Philadelphia.

SECOND-DIFFERENCE ANALYSIS OF BREMSSTRAHLUNG YIELD CURVES, by K. N. Geller. [1960] [3]p. incl. diagrs. table. (AFOSR-J632) (AF 49(638)454) AD 414209 Unclassified

Also published in Phys. Rev., v. 120: 2147-2149, Dec. 15, 1960.

For abstract see item no. 2086, Vol. IV.

2239

Pennsylvania U. Inst. for Cooperative Research, Philadelphia.

SOME SUGGESTED MECHANIZED INDEXING INVESTIGATIONS WHICH REQUIRE NO MACHINES, by J. O'Connor. [1960] 18p. (Sponsored jointly by Air Force Office of Scientific Research and Office of Naval Research under [Nonr-55135]) AD 240040 Unclassified

Published in Amer. Doc., v. 12: 198-203, July 1961.

This paper describes some investigations on mechanized indexing requiring no computers. Indexing here means an assignment to a document of a list of expressions to express its content for purposes of retrieval. The equipment required for the investigations suggested in this paper is a vocabulary of indexing terms, and a document collection to which they have been applied and are being used for retrieval. The process involves selecting a term from the indexing vocabulary of the retrieval to be used. Assume f to be T. A rule may be that this term is to be used when it appears in a document. Next, the degree of overassigning and underassigning must be calculated and a tolerance for both established. Thought must be given to the possibility of the term T appearing in a report as a reference, but which is only coincidently mentioned and whose relation to the paper as a whole is not important. A solution might be to assign T to the report only when it appears f number of times. If f is large enough overassigning can be eliminated but underassigning becomes a real problem. A solution then might be to assign T when the terms T and X appear in a report. Another solution may be to assign T when T-synonyms appear at least f times. Also T-indicators may be the appearing phases in a report which would best fit the indexing task to be completed. After consideration of these possibilities a check must be made to see if the application of any of these rules properly assigns the correct term to a report within the tolerance on overassigning and underassigning that has been excepted.

2240

Pennsylvania U. [Inst. for Cooperative Research] Philadelphia.

[REVIEW OF TWO REPORTS ON THE CRANFIELD

INDEXING EXPERIMENT], by J. O'Connor. [1961] [10]p. (AFOSR-887) (Sponsored jointly by Air Force Office of Scientific Research and Office of Naval Research under Nonr-55135) Unclassified

Also published in Jour. Doc., v. 17: 252-261, Dec. 1961.

All documents indexed were from the field of aeronautics and published since 1948. Eighteen thousand documents were collected. A set of one hundred of these documents constituted a 'document group'. In each group half were in the special field of high-speed aerodynamics, and the other half ranged over the rest of aeronautics. Further, in each group half the documents were journal articles and half were reports, and the documents were also divided equally between American papers and those of other countries. Presumably each group of one hundred documents was formed by random selection subject to the indicated restrictions, but this is not explicitly stated in the reports.

2241

Pennsylvania U. [Inst. for Cooperative Research] Philadelphia.

SOME REMARKS ON MECHANIZED INDEXING AND SOME SMALL-SCALE EMPIRICAL RESULTS, by J. O'Connor. [1961] [14]p. incl. tables. (Sponsored jointly by Air Force Office of Scientific Research and Office of Naval Research under Nonr-55135) Unclassified

Published in Machine Indexing: Progress and Problems; Proc. of Third Institute on Information Storage and Retrieval, American U., Washington, D. C. (Feb. 13-17, 1961), [Washington] American U. School of Government and Public Administration, 1961, p. 266-279.

The problems of indexing, especially in the face of an ever increasing volume of published literature, is discussed and the possibility of utilizing machine indexing as a means to combat this problem is presented. The rules that would have to be set up in order to assign applicable terms and the statistical percentage of reports that would be missed as a result of a particular set of indexing rules is also discussed. It seems evident that machine indexing can be a useful approach to the indexing problem

2242

Pennsylvania U. Office of Computer Research and Education, Philadelphia.

THE TREATMENT OF AMBIGUITY AND PARADOX IN MECHANICAL LANGUAGES, by S. Gorn. Apr. 1961 [33]p. incl. diagr. (AFOSR-603) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)951 and National Science Foundation) AD 259782 Unclassified

Also published in Recursive Function Theory; Proc. of Symposium in Pure Mathematics, New York (Apr. 5-7, 1961), Providence, R. I., Amer. Math. Soc., v. 5: 201-218, 1962.

A summary is given of the basic definitions of the theory of mechanical languages, and of the main processors for the prefix languages. A discussion is given of language extension with the examples of hierarchies of extensions in prefix languages. The relationship is established between language extension and increase in control ambiguity. A language of syntactic ambiguity descriptions is designed and the effective processor translating from this language to the derived-language naming language is specified. The concepts of recognition depth for both syntactic ambiguities and analyzability of mechanical languages are developed, and examples are given to show the existence of both types at all depths, including infinite depth. Examples of control ambiguity are developed ranging from the extremely useful to the paradoxical. Among the paradoxes analyzed in this way are the Epimenides paradox, the Lewis Carroll Tortoise and Achilles paradox, and the Russell paradox.

2243

Pennsylvania U. Office of Computer Research and Education, Philadelphia.

SPECIFICATION LANGUAGES FOR MECHANICAL LANGUAGES AND THEIR PROCESSORS - A BAKER'S DOZEN, by S. Gorn. Dec. 1961 [11]p. incl. diagrs. table, refs. (AFOSR-1537) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)-951 and National Science Foundation) Unclassified

Also published in Commun. Assoc. Computing Mach., v. 4: 532-542, Dec. 1961.

This paper describes several languages which can be used to specify the syntax for many mechanical languages. The paper shows to what extent these languages are capable of specifying such mechanical languages or their processors, and to what extent these specifying languages can be translated from one to another. A simple example is used in each case in order to specify these syntactical languages.

2244

Pennsylvania U. School of Medicine, Philadelphia.

PRODUCTION OF DIABETES INSIPIDUS IN HYPOPHYSECTOMIZED RATS BY HYPOTHALAMIC LESIONS, by C. C. Gale, S. Taleisnik, and S. M. McCann. [1961] [4]p. incl. diagr. tables, refs. (AFOSR-844) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)685 and National Institutes of Health) Unclassified

Also published in Amer. Jour. Physiol., v. 201: 811-814, Nov. 1961.

Lesions in the median eminence produced permanent diabetes insipidus (DI) in chronically hypophysectomized rats. Water turnover in these animals, however, was only about half of that observed when lesions were made in rats with intact pituitaries and was further characterized by absence of the normal interphase. Conversely, when hypophysectomy was performed in rats with DI, an immediate and sustained 50% reduction in water intake occurred. Administration of adrenocorticotropin to hypophysectomized rats with lesions caused significant augmentation of DI, but to levels with DI and intact pituitaries. Neither somatotrophic hormone (STH) nor triiodothyronine increased water turnover when given to hypophysectomized animals with DI. Lesions in the median eminence of hypophysectomized rats induced an immediate increase in urine volume in the absence of water intake, which indicates that primary polyuria was responsible at least in part for the development of DI in hypophysectomized rats with lesions. (Contractor's abstract)

2245

Pennsylvania U. School of Medicine, Philadelphia.

A HYPOTHALAMIC LUTEINIZING-HORMONE RELEASING FACTOR, by S. M. McCann. [1961] [8]p. incl. diagrs. refs. (AFOSR-1456) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)685 and National Institutes of Health) Unclassified

Presented at Forty-third meeting of the Endocrine Society, New York, 1961.

Also published in Amer. Jour. Physiol., v. 202: 395-400, Mar. 1962.

Crude acidic extracts of rat stalk-median eminence tissue evoked an ovarian ascorbic acid depletion on intravenous injection into immature rats pretreated with gonadotropins. Response was linearly related to logarithm of the dose. Various parts of the hypothalamus were extracted, and the major activity was found to reside in the stalk-median eminence region. Activity of this stalk-median eminence extract (SME) was relatively heat stable compared to luteinizing hormone (LH) activity of rat anterior pituitary extract. SME extract was partially inactivated by pepsin and completely inactivated by tryptic digestion. Intravenous SME did not elevate the already high plasma LH levels in untreated ovariectomized, estrogenized donors, whereas an extract of cerebral cortex was ineffective in this latter type of test animal. Pitressin also failed to influence LH titer of such donors. Increasing doses of estrogen or estrogen plus progesterone failed to block the effect of SME. SME also increased LH activity in plasma of ovariectomized rats in which release of LH had been blocked by lesions in the median eminence. It elevated LH activity in plasma of normal donors but had no significant effect on plasma LH activity of hypophysectomized animals. It was concluded that a hypophysial LH-releasing factor resides in stalk-median eminence tissue, and reasons were advanced for believing this to be a hormonal effect. (Contractor's abstract)

2246

Pennsylvania U. School of Medicine, Philadelphia.

EFFECT OF PROGESTERONE ON PLASMA LUTEINIZING HORMONE ACTIVITY, by S. M. McCann. [1961] [4]p. incl. diagrs. table, refs. (AFOSR-1713) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)685 and National Institutes of Health) Unclassified

Also published in Amer. Jour. Physiol., v. 202: 601-604, Apr. 1962.

The luteinizing hormone (LH) activity of ovariectomized rat plasma was estimated by the ovarian ascorbic acid depletion technique. A single subcutaneous injection of 25 mg of progesterone produced a slight decrease in this LH activity which was first demonstrable 2 days after injection of progesterone. If a second injection of 25 mg of progesterone was given 2 days after the first, a marked decrease in LH activity was found on testing a day later. Three daily subcutaneous injections of 5 mg of progesterone failed to significantly depress the LH activity in ovariectomized rat plasma. Pretreatment of these ovariectomized rats with estradiol benzoate rendered them more sensitive to the effects of progesterone in that 4 mg progesterone/day was then able to significantly depress the LH activity in their plasma. It was concluded that progesterone alone has a feeble inhibitory effect on the secretion of LH but that estrogen pretreatment sensitizes the animal to this inhibitory action of progesterone.

2247

Pennsylvania U. School of Medicine, Philadelphia.

ALTERATIONS IN FOOD AND WATER INTAKE AFTER HYPOTHALAMIC LESIONS IN THE RAT, by R. W. Smith and S. M. McCann. [1961] [5]p. incl. diagrs. refs. (AFOSR-1942) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)685 and National Institutes of Health) AD 453571 Unclassified

Also published in Amer. Jour. Physiol., v. 203: 366-370, Aug. 1962.

Electrolytic lesions in the lateral hypothalamus produced aphagia and adipsia. One rat remained adipsic until sacrifice 283 days after operation; 11 rats with lesions continued to drink water while refusing ground laboratory chow. This effect lasted until sacrifice, 8-13 days post-lesions, suggesting that areas regulating water and food intake are separable. Lesions designed to induce diabetes insipidus were produced in rats in which variable renal water loss had been eliminated by prior nephrectomy. Rats with lesions drank significantly more than nephrectomized controls during the 2-day observation period. The experiment was repeated, but food was withheld and controls were subjected to sham hypothalamic operation. In this group water intake was greater and weight loss less in rats with lesions than in sham-operated controls, though the difference was less than

that in the presence of food. Although the difference in water intake was small, the results suggest that destruction of an inhibitory drinking center may contribute to polydipsia in diabetes insipidus. Water intake may be stimulated by lateral and inhibited by medial areas in the hypothalamus. (Contractor's abstract)

2248

Pennsylvania U. School of Medicine, Philadelphia.

HORMONAL BASIS FOR IMPAIRMENTS IN MILK SYNTHESIS AND MILK EJECTION FOLLOWING HYPOTHALAMIC LESIONS, by C. C. Gale, S. Taleisnik and others. [1961] [14]p. incl. diagrs. table, refs. (AFOSR-2186) (Sponsored jcintly by Air Force Office of Scientific Research under AF 49(638)685 and Public Health Service) AD 453602 Unclassified

Also published in Jour. Endocrinol., v. 23: 303-316, 1961.

The placing of electrolytic lesions in the median eminence of the hypothalamic tuber cinereum induces severe impairment of lactation in rats by causing deficiencies in pituitary secretion of adrenocorticotrophic hormone (ACTH; essential for milk synthesis) and of oxytocin (necessary for milk ejection). Thus, in rats with lesions given oxytocin x 2/day to permit milk ejection, it was observed that: (1) the severity of impairment in lactation correlated significantly with the degree of atrophy of the dams' adrenal glands; (2) administration of luteotrophin (LTH) failed to repair this defect in lactation; (3) when cortisol was administered milk production was markedly improved—to about 70-80% of normal for days 5-10—(a further slight increase in milk yield resulted when oxytocin injections were given every 4 hr. 'around the clock' to rats receiving cortisol therapy); and (4) administration of regimens consisting of either LTH and cortisol, or LTH, growth hormone (GH), and cortisol failed to improve lactation beyond levels attained with cortisol therapy alone. In hypophysectomized rats replacement with cortisol and LTH, plus oxytocin x 2/day, permitted substantial synthesis which was not significantly improved further when GH was added to the regimen, and which promptly declined when LTH therapy was withdrawn. Since no deficiency in secretion of LTH could be demonstrated in lactating rats with lesions given hormonal replacement, these data provide evidence that elimination of hypothalamic regulatory mechanisms by hypothalamic lesions is compatible with secretion of large amounts of LTH. This demonstration that lesions in the median eminence block release of ACTH while permitting continued secretion of LTH indicates that the hypothalamic mechanisms regulating their release are not identical. (Contractor's abstract)

2249

Pennsylvania U. School of Medicine, Philadelphia.

APHAGIA, ADIPSIA AND POLYDIPSIA FOLLOWING HYPOTHALAMIC LESIONS IN THE RAT (Abstract), by R. W. Smith and S. M. McCann. [1961] [1]p. (AF 49(638)685) Unclassified

Presented at Forty-fifth annual meeting of the Fed. Amer. Soc. for Experimental Biol., Atlantic City, N. J., Apr. 10-14, 1961.

Published in Fed. Proc., v. 20: 333, Mar. 1961.

Electrolytic lesions in the lateral hypothalamus produced aphagia and adipsia. One rat remained adipsic until sacrifice 9 1/2 mo after operation. Seven rats with lesions in the lateral hypothalamus continued to drink water while refusing ground laboratory chow. This effect lasted until sacrifice, 8-13 days post-lesions, suggesting that areas regulating water intake and food intake are separable. To see if primary polydipsia is present in diabetes insipidus, lesions designed to induce diabetes insipidus were produced in rats in which variable renal water loss had been eliminated by prior nephrectomy. Rats with lesions drank significantly more than nephrectomized controls during the two day observation period. The experiment was repeated, but food was withheld and controls were subjected to sham hypothalamic operation (passing electrode into dorsal hypothalamus). In this group water intake was greater and weight loss less in rats with lesions than in sham operated controls, though the difference was less than that seen in presence of food. Although the difference in water intake was small, the results suggest that destruction of an inhibitory drinking center may contribute to polydipsia in diabetes insipidus. Water intake may be stimulated by medial areas in the hypothalamus.

2250

Pennsylvania U. School of Medicine, Philadelphia.

THE EFFECT OF OVARIAN HORMONES ON PLASMA LUTEINIZING HORMONE (LH) ACTIVITY IN THE OVARIECTOMIZED RAT (Abstract), by S. M. McCann. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)685 and Public Health Service) Unclassified

Published in Physiologist, v. 4: 72, Aug. 1961.

Using the ovarian ascorbic acid assay for LH, no LH could be detected in plasma from normal donor females, but detectable quantities were found in plasma of ovariectomized donors. This activity was decreased by single subcutaneous (sc) injections of estradiol benzoate (Eb). This effect was demonstrable within a day of injection of large doses and was maximal 3 days after injection, at which time the minimal effective dose to produce a decrease in LH activity was of the order of 0.1 μg. A slight decrease in LH activity was demonstrable within 1 hr of a massive intravenous dose of estradiol. Decreased LH activity was found in the absence of proestrous or estrous vaginal smears but was always found if the smear was in proestrous or estrous stage. A large dose (25 mg) of progesterone (P) sc produced a slight depression of LH activity in ovariectomized rat plasma on

assay 2-3 days later; a marked depression of activity resulted only if a second injection of 25 mg of P was given 2 days after the first with estimation of the activity on the third day. Five mg of P a day for 3 days had no significant effect. Large doses of Eb or Eb plus P failed to block the action of a hypothalamic extract with LH-releasing activity which suggests that the inhibitory effects of these steroids on LH secretion are mediated at some point proximal to the pituitary, presumably the hypothalamus.

2251

Pisa U. (Italy).

A TOPOLOGICAL PROPERTY OF RUNGE PAIRS, by A. Andreotti and R. Narasimhan. [1961] [11]p. incl. refs. (AFOSR-J442) (AF EOAR-62-35) AD 413771 Unclassified

Also published in Ann. Math., v. 76: 499-509, Nov. 1962.

Let X be a complex space and $\mathcal{H}(X)$ the ring of holomorphic functions on X equipped with the topology of compact convergence. Given an open subset Y of X, the pair (X, Y) is called a Runge pair if the image of $\mathcal{H}(X)$ under the restriction map is dense in $\mathcal{H}(Y)$. The main theorem of this paper is: Given a Runge pair (X, Y) of n-dimensional holomorphically convex spaces, where X is obtained from a holomorphically complete space with isolated singularities by blowing up a discrete set and where Y contains the blown-up set, it is proven that if $n = \dim_c X$, then $H_r(X \bmod Y, Z) = 0$ if $r > n$, and is torsion free if $r = n$. Moreover, if Y is relatively compact with smooth boundary, $H_n(X \bmod Y, Z)$ is even free. This theorem is applied to a certain class of holomorph-convex spaces in order to get information concerning their homology structure. The basic tool in the proof of the above theorem is the Morse theory.

2252

Pisa U. Inst. of Aeronautics (Italy).

[SOME PROBLEM IN THE AERODYNAMICS OF AIRFOILS IN NON-UNIFORM FLOW] Alcuni problemi dell'aerodinamica di profili in correnti non uniformi, by E. Pistolesi and M. Marini. [1960] [16]p. incl. diagrs. (AF 61(514)1051) Unclassified

Published in Aerotecnica, v. 40: 178-193, June 1960.

The characteristics are studied of an airfoil in a 2-dimensional flow of a compressible fluid at subsonic velocity, bordered by another 2-dimensional flow of a compressible fluid at supersonic velocity. The analysis considers the cases of (1) 2 adjacent semi-infinite flows; (2) a semi-infinite subsonic flow bordering a supersonic flow bounded by a rigid wall; and (3) an infinite subsonic flow with a transverse supersonic jet. Also studied are the characteristics of an airfoil in a 2-dimensional supersonic flow adjacent to another supersonic flow for the cases of (1) 2 adjacent semi-infinite flows; and (2) an infinite flow with a transverse supersonic jet. The effects of the nonuniformity of the flow on the values of the lift of an airfoil of zero thickness are determined, for the case in which the airfoil is placed at a small angle of incidence to the flow, as functions of the characteristic geometry of the flow and of the relation of velocities of the 2 flows.

2253

Pisa U. Inst. of Aeronautics (Italy).

LINEARIZED SUPERSONIC FLOW IN AN AXISYMMETRIC JET ISSUING IN AIR AT REST, by E. Pistolesi and M. Marini. Mar. 1961, 1v. incl. illus. (Technical rept. no. 1) (AFOSR-852) (AF 61-(052)209) AD 258232 Unclassified

Study concerns the aerodynamic characteristics of a wing disposed in a supersonic stream at some finite distance from the discharge of an axisymmetric supersonic jet. Such research requires that the flow field around an axisymmetric supersonic jet issuing from a nozzle in a supersonic stream be known. A new method was used to study the flow in the jet, based on the use of particular singularities, called pseudosources, disposed on the jet axis. The main aspects of this method are developed and the method itself is applied to the simple case of a supersonic axisymmetric jet issuing in air at rest. The jet shape was determined and some of the main characteristics of the flow in the jet are examined. Satisfactory results were obtained.

2254

Pisa U. Inst. of Physiology (Italy).

ELECTROENCEPHALOGRAM-SYNCHRONIZING STRUCTURES IN THE LOWER BRAIN STEM, by J. Magnes, G. Moruzzi, and O. Pompeiano. [1960] [29]p. incl. diagrs. refs. [AF 61(052)107] Unclassified

Published in Ciba Foundation Symposium on Nature of Sleep, London (Gt. Brit.) (June 27-29, 1960), Boston, Little, Brown, and Co. [1961] p. 57-85.

Electrical stimulation in the lower part of the medulla was carried out in acute encéphale isolé cats. Stimulation in the region of the nucleus of the solitary tract and of nucleus reticularis ventralis at low frequencies resulted in the appearance of large amplitude, slow waves on the surface of the cerebral cortex, bilaterally, in frontal, parietal, temporal and occipital leads. In most cases the repetition rate of the EEG waves was uninfluenced by changing the frequency of stimulation provided the pulse rate did not greatly exceed the inherent rhythm. Still higher rates produced EEG activity. Whereas in certain cases synchronization of the EEG ceased as soon as stimulation was over, in others it continued for varying periods of time subsequent to the end of

stimulation. These synchronizing effects were most easily elicited when the spontaneous background of the EEG was not fully activated. When intense activation was present spontaneously or was induced by sensory stimulation these effects could not be elicited or were abolished. It has been established that the results are not due to stimulation of the posterior column nuclei or fibers of the medial lemniscus. The relation of these findings to the possible functions of the brain stem synchronizing structures is discussed.

2255

Pisa U. Inst. of Physiology (Italy).

SYNCHRONIZATION OF THE EEG PRODUCED BY LOW-FREQUENCY ELECTRICAL STIMULATION OF THE REGION OF THE SOLITARY TRACT, by J. Magnes, G. Moruzzi, and O. Pompeiano. [1961] [35]p. incl. diagrs. refs. (AFOSR-353) (AF 61(052)-107) AD 258877 Unclassified

Also published in Arch. Ital. Biol., v. 99: 33-67, 1961.

In acute encéphale isolé cats, low frequency electrical stimulation (1-16/sec) in the region of the nucleus of the solitary tract and of nucleus reticularis ventralis, resulted in synchronization of the EEG. The resultant pattern of electrical activity was one of large amplitude slow waves distributed bilaterally in frontal, parietal, temporal and occipital leads. These effects were most easily elicited when the endogenous background of the EEG was not fully desynchronized. In most cases the repetition rate of the EEG waves was identical with that of the inherent EEG rhythm. However, when the frequency of stimulation exceeded the autogenous spindling rate, the frequency of the elicited waves was apt to follow the rate of stimulation. EEG activation ensued almost constantly when the pulse rate was higher than 30/sec. Low frequency stimulation (1-1/sec) of neighboring points in the same region of the medulla was found to produce EEG arousal. It has been established that the results with regard to synchronization of the EEG are not due to stimulation of the posterior column nuclei or fibers of the medial lemniscus, nor of fastigio-bulbar fibers running closely to the region of the solitary tract. Experiments performed on cats with acute or chronic lesions of the brain stem indicate that induced EEG synchronization may be obtained when only the medial part of the pons or of the mid-brain are spared by the lesion. (Contractor's abstract, in part)

2256

Pisa U. Inst. of Physiology (Italy).

[VISUAL PERCEPTION], by G. Moruzzi. Annual summary rept. June 15, 1960-June 14, 1961. July 5, 1961, 19p. incl. refs. (AFOSR-1196) (AF 61(052)-107) AD 262072 Unclassified

The habituation and the dishabituation of the visual responses to repetitive light flashes were investigated in the cerveau isole cat. The hypothesis of the habituation and of the release from dishabituation of the evoked visual potentials hinges upon the demonstration that the light striking the retina remains rigorously constant. The experiments on the relations between neurophysiology and animal behavior were concerned with the ocular manifestation of sleep in the owl placed in a dark, silent room. Experiments on the central influence of the retinal black-out on the central nervous system show that EEG synchronization increases following bilateral withdrawal of the retinal dark discharge in the cerveau isole cat, and following complete postcollicular transection, EEG activating structures, are still at work in the isolated cerebrum. The study of the effect of diffuse light and of the retinal black-out on the responses of the visual cortex elicited by lateral geniculate shocks led to the hypothesis that the effect of steady light is related with a decrease of the retinal dark discharge. Data suggest that steady light decreases the total retinal bombardment which was present in the dark adapted eye.

2257

Pisa U. Inst. of Physiology (Italy).

[ACTIVITY IN THE OPTIC NERVE AND IN THE LATERAL GENICULATE IN THE DARK AND DURING CONTINUOUS ILLUMINATION] Attivita' nel nervo ottico e nel genicolato laterale nell'oscurita'et durante l'illuminazione continua, by A. Arduini and L. Pinneo. [1961] [3]p. (AFOSR-1248) (AF 61(052)-107) AD 611469 Unclassified

Also published in Boll. Soc. Ital. Biol. Sper., v. 37: 430-432, 1961.

The results of electrical recording of activity in the central nervous system in relation to light stimulation are presented. The afferent optic impulses and lateral geniculate activity were recorded during dark and continuous light conditions. A mechanism for the observed phenomenon is presented.

2258

Pisa U. Inst. of Physiology (Italy).

[ASYMMETRY IN CLOSURE OF THE EYELIDS DURING SLEEP INDUCED BY UNILATERAL SUPPRESSION OF THE DARK DISCHARGE IN THE CIVET (ATHENE NOCTUA)] Asimmetria nella chiusura palpebrale durante l'addormentamento indotta dalla soppressione unilaterale della "dark discharge" nella civetta (athene noctua), by G. Berlucchi and P. Strata. [1961] [3]p. (AFOSR-1249) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)107 and Rockefeller Foundation) AD 455613 Unclassified

Also published in Boll. Soc. Ital. Biol. Sper., v. 37: 438-440, 1961.

The difference in behavior of the differentiated eyelid with respect to a healthy one is demonstrated. It is

verified that during sleep the tonic discharge is influenced by the corresponding tanus of the eyelid. Basically a partial lesion of the retina, and then an incomplete suppression of the dark discharge determines the effect od the described eyelid.

2259

Pisa U. Inst. of Physiology (Italy).

[TONIC ACTIVITY OF THE RETINA REGISTERED WITH SEMI-MICROELECTRODES] Attivita' tonica della retina registrata con semimicroelettrodi, by A. Arduini and A. Cavaggioni. [1961] [3]p. (AFOSR-2826) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)107 and Rockefeller Foundation) Unclassified

Presented at Thirtieth General Assembly of the Soc. Ital. Biol. Sper., Cagliari (Italy), Oct. 4-7, 1961.

Also published in Boll. Soc. Ital. Biol. Sper., v. 37: 1393-1395, 1961.

Light stimulation was used to determine the tonic activity of the retina. Semi-microelectrodes were used to measure the activity. The impulses measured varied from 4,000/min to 80,000/min. Results were confirmed with macroelectrode recordings at the optic chiasma. Results indicate the presence of a continuous electrical activity at the retina.

2260

Pisa U. Inst. of Physiology (Italy).

[EXISTENCE OF A TRUE CONSENSUAL PUPILLARY REFLEX IN BIRDS] Esistenza di un vero riflesso pupillare consensuale negli uccelli, by G. Berlucchi and P. Strata. [1961] [3]p. incl. refs. (AFOSR-2828) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)107 and Rockefeller Foundation) Unclassified

Also published in Boll. Soc. Ital. Biol. Sper., v. 37: 928-930, 1961.

Light stimulation was used to show the existence of a true consensual reflex at the pupil in birds. It is shown that the reflex is entirely involuntary and can be accompanied by a voluntary movement.

2261

Pisa U. Inst. of Physiology (Italy).

ENHANCEMENT OF CORTICAL RESPONSES TO SHOCKS DELIVERED TO LATERAL GENICULATE BODY. LOCALIZATION AND MECHANISM OF THE EFFECTS, by A. Arduini and M. H. Goldstein, Jr. [1961] [16]p. incl. diagrs. tables, refs. (AFOSR-2829) (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. 99: 397-412, Nov. 1961.

The experimental results are summarized: (1) Retinal conditions (deafferentation and illumination) which produce an enhancement of the responses led from the visual cortex following single shocks applied to the lateral geniculate body, do not significantly increase the responses of the auditory cortex to a medial geniculate volley. Thus, these effects are less generalized than the changes of EEG patterns which follow retinal deafferentation in the midpontine pretrigeminal preparation. (2) Even within the visual system, no enhancement is observed when the stimulating electrode is in the anterior quarter of the lateral geniculate nucleus. (3) If flickering light is used, at high rates of flicker (above 50/sec) results are the same as with steady illumination. As the flicker rate is decreased the amplitude of the shock evoked responses decreases until, at low rates of flicker, the responses are smaller than those obtained with the retinas dark-adapted. These findings support the hypothesis that enhancement effects obtained during steady retinal illumination or deafferentation result from a decrease in the neural traffic in the optic tracts. In control conditions (dark-adapted retinas) this neural traffic originates in the retinal dark discharge. A reduction or the complete temporary abolition of the retinal dark discharge may increase the shock evoked cortical response by releasing the geniculo-cortical system from a tonic inhibitory influence exerted by the dark discharge or by reducing or abolishing the occlusion phenomena produced by tonic activity. (Contractor's abstract)

2262

Pisa U. Inst. of Physiology (Italy).

EEG SYNCHRONIZATION FROM MEDULLARY STRUCTURES (Abstract), by J. Magnes, G. Moruzzi and O. Pompeiano. [1961] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under AF 61-(052)107 and Rockefeller Foundation) Unclassified

Presented at Forty-fifth annual meeting of the Fed. Amer. Soc. for Experimental Biol., Atlantic City, N. J., Apr. 10-14, 1961.

Published in Fed. Proc. v. 20: 336, Mar. 1961.

In the encéphale isolé cat low frequency electrical stimulation (1-16/sec) in the region of the nucleus of the solitary tract and of the nucleus reticularis ventralis results in synchronization of the EEG, frequently outlasting the period of stimulation. EEG activation occurs when pulse rate is higher than 30/sec. Low frequency stimulation of neighboring points is either ineffective or produces low voltage fast activity.

2263

Pittsburgh U. [Dept. of Chemistry] Pa.

THE POLYHEDRAL CLATHRATE HYDRATES. PART 2. STRUCTURE OF THE HYDRATE OF TETRA

ISO-AMYL AMMONIUM FLUORIDE, by D. Feil and G. A. Jeffrey. [1961] [11]p. incl. illus. diagrs. tables, refs. (AFOSR-534) (AF 49(638)456) AD 265853 Unclassified

Also published in Jour. Chem. Phys., v. 35: 1863-1873, Nov. 1961.

The hydrate $[i\text{-}C_5H_{11}]_4N^+ \cdot F^- \cdot 38H_2O$ belongs to a type of polyhedral clathrate structure in which the water molecules and the anions form the "host" structure and the cations are the "guests". The structural unit of the hydrogen-bonded clathrate cage is the $H_{40}O_{20}$ pentagonal dodecahedron. These dodecahedra are regularly associated in the crystal lattice by sharing faces, giving rise, therefore, to other polyhedra. In this hydrate, the other polyhedra are the tetrakaidecahedron and pentakaidecahedron, which form the cages enclosing the cations. A detailed 3-dimensional single crystal structure analysis has been completed. (Contractor's abstract)

2264

Pittsburgh U. [Dept. of Chemistry] Pa.

THE GEOMETRICAL APPROACH TO THE STRUCTURE OF WATER AND THE CLATHRATE HYDRATES, by G. A. Jeffrey. [1961] [16]p. incl. illus. diagrs. tables, refs. (AF 49(638)456) Unclassified

Published in Desalination Research Conf., Woods Hole, Mass. (June 19-July 14, 1961), Washington, D. C., National Academy of Sciences, 1963, p. 156-172.

The structural background is developed for the examination of a statement by L. Pauling in The Nature of the Chemical Bond, Cornell U. Press, 1960, p. 473: It seems not unreasonable to discuss the structure of liquid water in terms of the structure of methane hydrate. This will involve a discussion of the structures and the hydrogen bonding in the gas hydrates and the alkyl ammonium salt hydrates and of J. D. Bernal's recent work on the structure of liquids.

2265

Pittsburgh U. Dept. of Chemistry, Pa.

THE OXIDATION OF EPOXIDES BY DIMETHYL SULFOXIDE. A SIMPLE SYNTHESIS OF α-HYDROXY KETONES, by T. Cohen and T. Tsuji. [1961] [1]p. incl. refs. (AFOSR-249) (AF 49(638)788) Unclassified

Also published in Jour. Org. Chem., v. 26: 1691, May 1961.

A procedure is given for the oxidation of epoxides by dimethyl sulfoxide if catalytic quantities of boron trifluoride are present. In accord with the results obtained with halides and tosylates, the products are α-hydroxy ketones and dimethyl sulfide. Although the same reaction occurs in the absence of catalyst, much longer reaction periods are required and the yields are seriously reduced.

2266

Pittsburgh U. Dept. of Chemistry, Pa.

INTERMETALLIC COMPOUNDS BETWEEN LANTHANOUS AND TRANSITION METALS OF THE FIRST LONG PERIOD. II. FERRIMAGNETISM OF AB_5 COBALT COMPOUND, by K. Nassau, L. V. Cherry, and W. E. Wallace. [1959] [7]p. incl. diagrs. tables. [AF 49(638)979] Unclassified

Published in Jour. Phys. and Chem. Solids, v. 16: 131-137, Nov. 1960.

Magnetizations were determined at various temperatures for a series of substances represented by the type formula ACo_5 in which A is either Ce, Sm, Gd, Dy, Ho, Y or a mixture of Gd and Y. The purpose of the study was to ascertain whether the atomic moments are aligned, at sufficiently low temperatures, and if so to elucidate as far as possible the nature of the alignment. The magnetization-temperature curves for YCo_5 and $SmCo_5$ indicate them to be normal ferromagnetic compounds at least down to 80°K, with Curie points at 975° and 1015°K, respectively. Their saturation magnetic moments indicate that the cobalt moments are aligned ferromagnetically. The curves for the other compounds show well defined Curie temperatures ranging from 685° to 1125°K but are unusual in that below a certain temperature, ranging up to 575°K, magnetization shows an anomalous fall with diminishing temperature. Analysis of these results and the observed saturation magnetizations show that the moments are aligned, but not ferromagnetically. The compounds appear to be ferrimagnetic. A discussion of the possible modes of alignment is presented. Thermomagnetic analysis shows that in most instances the compounds decompose when heated to the point at which the alignment of the atomic moments is destroyed. (Contractor's abstract)

2267

Pittsburgh U. Dept. of Chemistry, Pa.

MAGNETIC STUDIES OF SOME INTERMETALLIC COMPOUNDS BETWEEN COBALT AND THE LANTHANIDE ELEMENTS, by L. V. Cherry and W. E. Wallace. [1961] [3]p. incl. diagr. (AFOSR-1391) (AF 49(638)979) Unclassified

Also published in Jour. Appl. Phys., v. 33: 1515-1517, Apr. 1962.

Thermomagnetic studies of intermetallic compounds having the stoichiometry ACo_5, in which A represents yttrium or a lanthanide element, have been extended to liquid helium temperatures. At applied magnetic

fields of 2600 and 7200 oe, anomalies not appearing at high fields have been observed in the behavior of $PrCo_5$ and $NdCo_5$. These anomalies are an apparent second (low-temperature) Curie point at about 126°K in $PrCo_5$ and a maximum in the thermomagnetic curve of $NdCo_5$ in the vicinity of 270°K. The data obtained for other ACo_5 compounds are consistent with those reported recently by Nesbitt et al. Results for $PrCo_5$ and $NdCo_5$ indicate ferromagnetic coupling of the cobalt moments on cooling below 910° and 925°K, respectively, while in each case at low fields, the lanthanide moments remain disordered. With $PrCo_5$ the data indicate ferromagnetic coupling of the Pr and Co moments below 126°K. Data for $NdCo_5$ suggest that on cooling, a similar type of coupling develops at about 270°K, but this is almost immediately superseded by antiferromagnetic coupling of the Nd moments with one another at lower temperatures. (Contractor's abstract)

2268

Pittsburgh U. Dept. of Chemistry, Pa.

ON INTERMEDIATE PHASES IN LANTHANON-MANGANESE SYSTEMS, by L. V. Cherry and W. E. Wallace. [1961] [2]p. incl. diagr. table. (AFOSR-1394) (AF 49(638)979) Unclassified

Also published in Jour. Appl. Phys., v. 33: 1619-1620, Apr. 1962.

Alloys involving 75 to 90 at. % Mn have been investigated. Both the x-ray and magnetic data obtained for these alloys suggest that the entity responsible for the observed behavior of $GdMn_5$ may actually be $GdMn_4$, and the former may be a mixture of the latter and either elemental Mn or some phase richer in Mn than $GdMn_5$. The chief x-ray evidence in favor of this possibility is the fact that 1 weak line, attributed to a trace of manganese in the $GdMn_5$ pattern, is absent in the $GdMn_4$ pattern, otherwise the 2 x-ray patterns are virtually the same.

2269

Pittsburgh U. Dept. of Chemistry, Pa.

INTERMETALLIC COMPOUNDS BETWEEN LANTHANONS AND TRANSITION METALS OF THE FIRST LONG PERIOD. I. PREPARATION, EXISTENCE AND STRUCTURAL STUDIES, by K. Nassau, L. V. Cherry, and W. E. Wallace. [1959] [7]p. incl. tables, refs. (AFOSR-J182) (AF 49(638)979) AD 400076 Unclassified

Also published in Jour. Phys. and Chem. Solids, v. 16: 123-130, Nov. 1960.

Alloys have been prepared with compositions corresponding to the formulas AB_5, AB_2, AB and A_3B, in which A is Y, La, Ce, Sm, Gd, Dy or Ho and B is Mn, Fe, Co, or Ni. Samples were prepared by the technique of levitation melting. Powder diffraction patterns were obtained to establish whether or not the various alloys existed in the form of intermetallic compounds. Extensive compound formation tendency was exhibited by all the lanthanons except La. All AB_2 type compounds were found to exist in the $MgCu_2$ structure. The AB_5 type compounds occurred either in the $CaCu_5$ structure or in an unsolved orthorhombic structure. Some AB and A_3B compounds may exist. Confirmation awaits interpretation of their diffraction patterns. Factors affecting the existence of these compounds and their structural parameters are discussed. (Contractor's abstract)

2270

Pittsburgh U. Dept. of Chemistry, Pa.

MAGNETIC CHARACTERISTICS OF SOME INTERMETALLIC COMPOUNDS BETWEEN MANGANESE AND THE LANTHANIDE METALS, by L. V. Cherry and W. E. Wallace. [1960] [2]p. incl. diagr. table. (AFOSR-J225) (AF 49(638)979) Unclassified

Presented at Sixth Conf. on Magnetism and Magnetic Materials, New York, Nov. 14-17, 1960.

Also published in Jour. Appl. Phys., v. 32: 340S-341S, Mar. 1961.

Two types of magnetic measurements have been made. First, saturation magnetizations were determined at room temperature (298°K) and liquid nitrogen temperature (80°K). Second, the magnetization-temperature behavior at constant fields of about 2500 and 7000 oe was ascertained from 80° to about 500°K. For the saturation measurements, extrapolation to infinite field strength was made with the use of data extending to 20 koe at 298°K, but to only 10 koe at 80°K. The Curie points, read from the magnetization temperature curves at low fields, and the saturation magnetizations are given.

2271

Pittsburgh U. [Dept. of Sociology] Pa.

ANTICIPATIONS AND BEHAVIOR: NOTES ON AN INTELLECTUAL TRADITION, by A. Frances. Dec. 15, 1961, 17p. incl. refs. (AFOSR-1712) (AF 49-(638)1116) AD 270729 Unclassified

The anticipatory systems of individuals and collectives as central instead of peripheral in the task of explaining and predicting social behavior are discussed. This definite orientation requires the re-conceptualization of terms which have been widely used in the fields of sociology, psychology and economics. The state of the art in anticipations and anticipation theory has as its primary objective the identification of this research with respect to parallel orientations.

2272

Pittsburgh U. [Sarah Mellon Scaife Radiation Lab.] Pa.

DIRECT FIELD EFFECTS IN ELECTRON PARAMAGNETIC RESONANCE HYPERFINE SPECTRA, by J. A. Weil and J. H. Anderson. [1961] [8]p. incl. diagrs. refs. (AFOSR-437) (Sponsored jointly by Air Force Office of Scientific Research and Atomic Energy Commission under AF 49(638)323) Unclassified

Also published in Jour. Chem. Phys., v. 35: 1410-1417, Oct. 1961.

The electron paramagnetic resonance spectrum exhibiting hyperfine effects from one nucleus is discussed for the case when the nuclear spin interacts appreciably not only with the electron magnetic moment but also directly with the applied magnetic field. The predicted hyperfine structure consists, in general, of $2S(2I + 1)^2$ lines. The angular dependence of the intensities and splittings is investigated; nodes in the splitting are found to be possible even when the eigenvalues of the hyperfine splitting tensor are nonzero. When the direct-field interaction is large, $2I + 1$ principal hyperfine lines occur, flanked by weaker "outrider" lines. Another mechanism for producing outrider lines in high direct fields, the nuclear quadrupole interaction with an electric field gradient, is discussed. Magnetic resonance studies of color centers in germanium-doped quartz demonstrate some of the predicted effects. (Contractor's abstract)

2273

Pittsburgh U. Sarah Mellon Scaife Radiation Lab., Pa.

PARAMAGNETIC CENTERS IN POTASSIUM AZIDE IRRADIATED AT LOW TEMPERATURE, by R. B. Horst, J. H. Anderson, and D. E. Milligan. [1961] [4]p. incl. diagr. table. (AFOSR-504) (AF 49(638)-323) Unclassified

Also published in Jour. Phys. and Chem. Solids, v. 23: 157-160, Jan.-Feb. 1962.

Electron spin resonance measurements have been made on single crystals of KN_3 which were irradiated and maintained at 77°K. Irradiations were made with unfiltered light from a G. E. H85-C3 lamp with a rated output of 0.49 W in the range 250-280 mμ. Irradiation times varied from 10 to 1080 min. Spin resonance measurements were made at frequencies of 9.33 and 23.9 kmc/s. Three types of paramagnetic centers were found. Two of these were identified from the hyperfine structure as consisting of an unpaired spin associated with nitrogen nuclei: the N_2 center and the N_4 center. The notation N_i denotes a paramagnetic center consisting of i nitrogen nuclei interacting with an unpaired spin. These centers form the main subject of this paper. The third center gives rise to a highly anisotropic resonance line which can be observed only when the magnetic field is nearly parallel to the c-axis (four-fold symmetry axis) of the crystal. This line appears to be composed of unresolved hyperfine lines.

2274

Pittsburgh U. [Sarah Mellon Scaife Radiation Lab.] Pa.

HALL EFFECT IN IMPURITY CONDUCTION, by T. Holstein. [1961] [19]p. incl. refs. (AFOSR-1052) [AF 49(638)323] Unclassified

Also published in Phys. Rev., v. 124: 1329-1347, Dec. 1, 1961.

The existence of a nonvanishing Hall effect in the impurity conduction regime of a semiconductor is demonstrated. In this regime (prevalent at low temperatures and at low impurity concentrations) the dominant electron transport mechanism is the phonon-induced hopping of charge carriers from occupied to unoccupied majority sites. The basic element of the theory is the existence of a (magnetic) field-dependent contribution to the jump probability between two sites. This contribution is computed and is shown to arise from the interference between the amplitude for a direct transition between the initial and final sites and the amplitude for an indirect, second-order transition, involving intermediate occupancy of a third site. The theory is applied to the case of an ac applied electric field. For values of the physical parameters representative of those occurring, for example in the ac measurements of Pollak and Geballe, the maximum Hall angle, though small ($\sim 10^{-6}$), is found to exceed the normal value $[(H/c)\mu_{drift}]$ by a factor $\sim 10^2$.

2275

Pittsburgh U. [Sarah Mellon Scaife Radiation Lab.] Pa.

PARAMAGNETIC RESONANCE IN POTASSIUM AZIDE IRRADIATED AT 77°K, by R. B. Horst, J. H. Anderson, and D. E. Milligan. [1961] 31p. incl. diagrs. table, refs. (AFOSR-1760) (AF 49(638)323) Unclassified

Single crystals of potassium azide have been irradiated at 77°K with ultraviolet light. Two new paramagnetic centers, N_2 and A, have been found. A third center, N_4, appears to be the same as that discovered by Shuskus, Young, Gilliam, and Levy in potassium azide irradiated at room temperature. The g tensor for the N_2 center has only orthorhombic symmetry. Its principal values are $g_x = 2.0008$, $g_y = 2.0027$, $g_z = 1.9832$. The x axis is parallel to the [001] crystal axis and the y and z axis are parallel to the [1$\bar{1}$0] and [110] axes respectively. The hyperfine tensor is approximately axially symmetric with $T_x = 3.8$G, $T_y = 12$G, $T_z = 4.0$G. The models N_2^- and N_2^+ for this center are discussed. Although they explain many features of the resonance, neither model can

account for the signs of the g shifts. It is concluded that the center probably consists of an unpaired spin trapped by 2 nitrogen atoms associated with a lattice defect. The paramagnetic center thus formed lacks a center of symmetry. (Contractor's abstract)

2276

Pittsburgh U. Sarah Mellon Scaife Radiation Lab., Pa.

THE MORIYA INTERACTION AND THE PROBLEM OF THE SPIN ARRANGEMENTS IN βMnS, by F. Keffer. [1961] [19]p. incl. diagrs. refs. (AFOSR-2536) (AF 49(638)323) Unclassified

Also published in Phys. Rev., v. 126: 896-900, May 1, 1962.

A study is made of the nature of the anisotropic superexchange interaction of the form $D_{ij} \cdot S_i \times S_j$ recently proposed by Moriya. This interaction is permitted in βMnS, with symmetry requiring that D_{ij} be normal to the plane defined by i, j, and the single intervening anion. It is conjectured that this interaction leads to a screw spin arrangement, with a 90° screw angle; in crystals considered heretofore the Moriya energy produces only a slight canting. The observed powder neutron diffraction pattern has been interpreted as indicating ordering of the 3rd kind with spins normal to the ordering axis; this arrangement, however, does not have minimum dipolar energy. The present proposed arrangement leads to the same diffraction pattern, and the Moriya energy probably overbalances the dipolar. (Contractor's abstract)

2277

Pittsburgh U. Sarah Mellon Scaife Radiation Lab., Pa.

THEORY OF EXCHANGE RESONANCE IN ANTIFERROMAGNETIC $CuCl_2 \cdot 2H_2O$, by R. J. Joenk. [1961] [8]p. incl. diagrs. table, refs. (AFOSR-2538) [AF 49(638)323] Unclassified

Also published in Phys. Rev., v. 126: 565-572, Apr. 15, 1962.

The low crystal symmetry of antiferromagnetic $CuCl_2 \cdot 2H_2O$ allows an antisymmetric, anisotropic, superexchange interaction (Moriya interaction) of the form $D_{12} \cdot [S_1 \times S_2]$ between corner and base-center copper ions. The classical magnetic-resonance frequencies and spin-wave frequencies have been derived for a 4-sublattice model from a spin Hamiltonian consisting of nearest-and next-nearest-neighbor isotropic superexchange interactions, the Moriya interaction, and orthorhombic anisotropy energy. A set of high-frequency exchange modes was obtained in addition to the usual antiferromagnetic resonance modes. The former are characterized by the beating in opposition of ferromagnetic sublattices which would be degenerate in the absence of the Moriya interaction. The exchange frequencies are proportional to the geometric average of the ferromagnetic and antiferromagnetic exchange fields and are an order of magnitude larger than the antiferromagnetic frequencies. A resonance absorption experiment is proposed to detect the exchange modes; zero field magnetic resonance is expected at about 0.7 mm. (Contractor's abstract)

2278

Pittsburgh U. Sarah Mellon Scaife Radiation Lab., Pa.

ANISOTROPIC SUPEREXCHANGE IN βMnS, by J. J. Pearson. [1961] 45p. incl. diagrs. table, refs. (AFOSR-2539) (AF 49(638)323) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 280, Apr. 24, 1961.

Also published in Phys. Rev., v. 126: 901-911, May 1, 1962.

The suggestion by Keffer (item no. 2276, Vol. V) of an anisotropic superexchange of the Moriya type in βMnS led to the present detailed calculation. Whereas Moriya's work was confined to ions with 1 electron in the 3d shell and to cases of low symmetry, this calculation was performed for a half-filled 3d shell and tetrahedral symmetry. The unperturbed state was taken to consist of 2 Mn^{++} ions together with their common S^{--} nearest neighbor, each in a tetrahedral crystal field. The perturbing Hamiltonian contained the electronic spin-orbit interaction and the Coulomb interaction between electrons on neighboring ions. The mechanism involved going from the ground state to an excited crystal field state on 1 Mn^{++} ion by the spin-orbit effect, then back to the ground state by superexchange between the Mn's. The direction of the D vector was found to be perpendicular to the plane of the 3 ions, and its magnitude of the order of a superexchange integral times the spin-orbit parameter over a crystal field splitting energy. The existence of the effect depends importantly upon π overlap between the Mn and S orbitals. (Contractor's abstract)

2279

Pittsburgh U. [Sarah Mellon Scaife Radiation Lab.] Pa.

PROPOSED SPIN ARRANGEMENT IN βMnS (Abstract), by F. Keffer. [1961] [1]p. [AF 49(638)323] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 280, Apr. 24, 1961.

In βMnS each anion is surrounded tetrahedrally by 4 magnetic cations. Any state with the 4 spins summing to zero will have lowest near-neighbor antiferromagnetic superexchange energy. Absence of inversion

symmetry allows a Moriya coupling of the form $D_{ij} \cdot S_i \times S_j$, with symmetry requiring D_{ij} normal to the plane defined by i, j, and the anion. The lowest energy arrangement consistent with translation symmetry is then $S_1 = -S_2$ and both orthogonal to $S_3 = -S_4$. (In crystals considered heretofore, the Moriya energy produces only a slight canting). The observed powder neutron diffraction pattern has been interpreted as indicating ordering of the 3rd kind with spins normal to the ordering axis; this arrangement however does not have minimum dipolar energy. The present proposed arrangement leads to the same diffraction pattern, and the Moriya energy easily overbalances the dipolar. Neutron diffraction in MnS_2 indicates an arrangement with minimum dipolar energy. This is not surprising since the pyrite structure allows no Moriya coupling. (Contractor's abstract)

2280

Pittsburgh U. [Sarah Mellon Scaife Radiation Lab.] Pa.

HALL MOBILITY OF THE SMALL POLARON (Abstract), by L. Friedman and T. Holstein. [1961] [2]p. [AF 49(638)323] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., v. 6: 302-303, Apr. 24, 1961.

In insulators of sufficiently narrow conduction-bandwidth, an excess electron tends to get trapped at atomic sites by self-induced lattice distortion. Thermal vibrations give rise to jumps between 2 such sites by causing momentary coincidences of electronic energies, thereby allowing the electronic-overlap jump mechanism to become operative. A modification of the elementary jump probability by an applied magnetic field occurs for those events in which the energies of 3 sites are simultaneously coincident. The effect arises from the interference between 2 sites and that for a second-order jump involving intermediate occupancy of the third site. For H = O, the 2 amplitudes are 90° out of phase and do not interfere; for H = O, the phase difference is altered by an amount proportional to the magnetic flux enclosed by the triangle defined by the site centroids. The resulting Hall mobility is found to be greater than or comparable to the normal value, according to whether or not the 3 sites are nearest neighbors.

2281

Plasmadyne Corp., Santa Ana, Calif.

IONIZATION IN AN ELECTRODELESS DISCHARGE, by R. P. Treat. Mar. 15, 1961, 62p. incl. diagrs. refs. (Rept. no. TN-031-655) (AFOSR-473) (AF 49-(638)655) AD 256216 Unclassified

An analytical study has been made of the ionization occurring in a weakly pre-ionized molecular hydrogen gas. The configuration studied consists of a long cylindrical gas column subjected to a strong, fast rising axial magnetic field which is initially zero. The investigation has shown that in practice it is possible to obtain a large number of ionization collisions in a time t_m during which the plasma mass motion and the magnetic field are negligible. For this time interval, if electron losses are neglected, the increase in ionization fraction depends only on the voltage induced around the discharge tube and on the ratio of the circumference of the tube to the electron free path. Quantitative order of magnitude results are given for this relation. For a fixed voltage around the discharge tube, maximum ionization during the mass motion time t_m occurs if the energy gained by an electron in a force path is about equal to the threshold energy for ionization. (Contractor's abstract)

2282

Plasmadyne Corp., Santa Ana, Calif.

IONIZATION PROCESSES IN GASES, by H. G. Loos. Final rept. Mar. 31, 1961 [14]p. incl. diagrs. (Rept. no. FR-031-655) (AFOSR-998) (AF 49(638)655) AD 261202 Unclassified

The ionization occurring during the initial phase of an axisymmetric electrodeless discharge has been investigated. In the axisymmetric electrodeless discharge considered, the electric field and the currents are in the azimuthal direction, while the magnetic field is axial. If the capacitor bank is switched on in a time small compared with the period of the discharge, the electric field rises to its full value in a time during which the magnetic field is still very small. Then, a model is appropriate in which at the time zero the electric field is instantly present at its full value, while the magnetic field is zero. Therefore, there must exist a time interval for which the magnetic field can be neglected. This time interval is called the initial phase; it ends at time, t_m, which is defined as the time for which the magnetic force on an electron is 1/10 of the electric force. Since it is shown that during t_m the plasma does not move much in the radial direction, t_m is called the mass motion time. The analytical investigation has been restricted to the initial phase; the magnetic field has been neglected, but the electric field induced by the change of magnetic field is accounted for.

2283

Plasmadyne Corp. [Giannini Research Lab.] Santa Ana, Calif.

AN EXPERIMENTAL INVESTIGATION OF THE BEHAVIOR OF AN ARC POSITIVE COLUMN IN THE PRESENCE OF FORCED CONVECTION, by P. G.

Thiene, J. E. Chambers, and W. Jaskovsky. Apr. 29, 1961, 94p. incl. illus. diagrs. refs. (Rept. no. T-4TN031-334) (AFOSR-682) (AF 49(638)334) AD 260648 Unclassified

An experimental investigation has been made of the behavior of low-current arc positive columns in the presence of subsonic, laminar forced convection. Columns in argon at atmospheric pressure were drawn between collinear electrodes and deflected by convection normal to the interelectrodes axis. Photographs of deflected columns over a current range 2 to 6 amp for various incident convection velocities up to approximately 200 cm/sec were taken and analyzed. The results are compared with theoretical predictions. In addition, a cursory investigation was conducted into the effect of a magnetic field applied transverse to the column so as to oppose the forced convection. (Contractor's abstract)

2284

Plasmadyne Corp. [Giannini Research Lab.] Santa Ana, Calif.

BASIC STUDY OF ENERGY EXCHANGE PROCESS BETWEEN AN ELECTRIC ARC AND A GAS FLOW, by P. G. Thiene. Final rept. Mar. 1, 1958 - Jan. 31, 1961. Feb. 23, 1961, 14p. incl. diagrs. (Rept. no. 1FR021-334) (AFOSR-1264) (AF 49(638)334) AD 263203 Unclassified

Three experimental studies were conducted. The first demonstrated photographically the stabilization of a spark by a gas vortex during the initial phase of the electrical breakdown. A relatively thorough investigation of the radial pressure distribution in the vortex was conducted. A photographic study was carried out to give data on the expansion of the spark channel with time and to note if instabilities develop in the spark. For the second study the plasma-flow facility has a flow of gas heated by a gas-stabilized arc capable of heating flow of argon to more than 10,000°K. An attempt was made to measure the average electrical conductivity of the plasma over the cross section of the tube. The conductivity was on the order of 1 mho/cm. Two simple experiments were performed which demonstrate the usefulness of the plasma-flow facility as a tool for studying magnetohydrodynamic interactions. During the third study it was found that when a planar zone of ohmic heating is subjected to a uniform normal flow, an asymmetrical temperature distribution develops with a shift of the peak downstream. It appeared that the resulting curvature of the zone would give rise to 2 local reactions.

2285

Plasmadyne Corp. [Giannini Research Lab.] Santa Ana, Calif.

STUDY OF HEATING AND ACCELERATION OF PLASMA BY MAGNETIC FIELDS, by M. C. Gourdine. Final rept. Feb. 1958-Feb. 1961. Mar. 1, 1961, 41p. incl. illus. diagrs. refs. (AFOSR-358) (AF 49-(638)335) AD 255738 Unclassified

Means of heating, accelerating, and channeling plasma jets by means of magnetic fields were investigated. The following investigations were performed: (1) Transient electrodeless discharge experiments; (2) Steady-state plasma channeling experiments; (3) Punch method of compressing, heating, and confining a plasma; (4) Relaxation heating of a plasma by surface interaction with a magnetic field; (5) Experiments on the punch method of heating; (6) Propulsion experiments with the asymmetric punch; (7) Magnetohydrodynamic shear heating; (8) Two-coil induction method of measuring conductivity; and (9) MHD channel flow of a rotating fluid. (Contractor's abstract)

2286

Plasmadyne Corp. [Giannini Research Lab.] Santa Ana, Calif.

MAGNETOHYDRODYNAMIC SHEAR HEATING, by M. C. Gourdine. Feb. 2, 1961, 17p. incl. illus. diagrs. (Rept. no. PLR-93) (AFOSR-497) (AF 49-(638)335) AD 255737 Unclassified

Also published in Engineering Aspects of Magnetohydrodynamics; Proc. Second Symposium, Philadelphia, Pa. (Mar. 9-10, 1961), New York, Columbia U. Press, 1962, p. 521-528.

The preliminary results of a theoretical and experimental investigation of MHD shear heating in mercury are presented. Mercury is a convenient working fluid because its properties are well known, and it is relatively simple to use. A preliminary theory based on a crude model is presented which checks quite well with experiments.

2287

Plasmadyne Corp. [Giannini Research Lab.] Santa Ana, Calif.

MHD FLOW CONSTRUCTIONS WITH FUNDAMENTAL SOLUTIONS (Abstract), by M. C. Gourdine. [1961] [1]p. [AF 49(638)33?] Unclassified

Presented at meeting of the Amer. Phys. Soc., Mexico City (Mexico), June 22-24, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 340, June 22, 1961.

In this paper steady flows of an incompressible, viscous, electrically conducting fluid are constructed from fundamental solutions of magnetohydrodynamics – the applied magnetic field is parallel to the velocity at infinity. The flat plate and the sphere are considered as examples, and approximate solutions are presented for the limiting cases of large and small Reynolds and magnetic Reynolds numbers. The effects of currents in the body are also considered,

and it is found that unless the magnetic Prandtl number is larger than unity, currents in the body have negligible effect on the flow.

2288

Plasmadyne Corp. [Giannini Research Lab.] Santa Ana, Calif.

EFFECTS OF A BODY FORCE ON GAS-DYNAMIC DISCONTINUITIES (Abstract), by M. C. Gourdine. [1961] [1]p. [AF 49(638)335] Unclassified

Presented at meeting of the Amer. Phys. Soc., Berkeley, Calif., Nov. 20-22, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 373, Apr. 23, 1962.

A simple theory which describes the effects of a body force on the jump conditions across gas-dynamic discontinuities—such as shock, detonation, or deflagration waves—is presented. The equations for the model are algebraic, and semigraphical methods are used to illustrate the physical implications of the solutions. The results of this theory agree qualitatively and quantitatively with experimental results on the effects of electrostatic fields on the propagation velocity of detonations in carbon monoxide and oxygen. An electric field of 5500 v/cm reduces the Mach number of the detonation from $M_1 = 6$ to $M_1 = 3$. A body force F, assumed to exist uniformly throughout the burning front of thickness l, has an appreciable effect on the propagation velocity whenever the parameter Fl/p_1 is of order one or larger, where p_1 is the pressure in front of the discontinuity. The theory also predicts the existence of subsonic detonations and stable detonations that violate the Chapman-Jouget condition.

2289

Plasmadyne Corp. [Giannini Research Lab.] Santa Ana, Calif.

[RESEARCH ON HIGH INTENSITY PLASMA JETS]. Apr. 30, 1961, 107p. incl. illus. diagrs. tables. (AFOSR-1011) (AF 49(638)766) Unclassified

The experimental results of this investigation cover the period from October 1, 1959 to April 30, 1961. General descriptions of the thrust measuring facility are given and include illustrations and diagrams of all apparatus used in testing of the gases hydrogen, helium and ammonia. Tabulated results of all tests are given with the inclusion of (1) efficiency and losses (2) losses in conversion from electrical to thermal energy (3) losses to obtain uniformity of heating and (4) losses to obtain uniformity of direction.

2290

Plasmadyne Corp. [Giannini Research Lab.] Santa Ana, Calif.

HIGH INTENSITY IONIC JETS (Abstract), by A. C. Ducati. [1961] [1]p. (Bound with AFOSR-582; AD 257892) (AF 49(638)766) Unclassified

Presented at Fourth annual AFOSR Contractors' meeting on Ion and Plasma Acceleration, Beverly Hills, Calif., Apr. 20-21, 1961.

The operation of plasma jets using helium, hydrogen or hydrogen compounds as propellants has been studied at Plasmadyne during past years and the results obtained have been described. During the last year, work has been mainly concentrated on the systematic experimental study of various propellants, particularly hydrogen. Electrode configurations have been studied with special emphasis to conditions favorable to long life. An evaluation of the relative overall performance of mixing chambers and nozzles in function of the maximum specific impulse obtainable was experimentally conducted and preliminary data obtained. Measurements were improved to give 1% accuracy for any one parameter and with overall accuracy of 5%. Representative experimental data obtained are presented.

2291

Plasmadyne Corp. [Giannini Research Lab.] Santa Ana, Calif.

STUDY OF SOME OF THE PROPERTIES OF AN rf-GENERATED PLASMA (Abstract), by D. D. Hollister. [1961] [1]p. [AF 49(638)766] Unclassified

Presented at meeting of the Amer. Phys. Soc., Berkeley, Calif., Nov. 20-22, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 373, Apr. 23, 1962.

In order to investigate the properties of the ring discharge, a series of Langmuir probe measurements of electron temperature and concentration were carried out. The discharge was produced by a Hartley oscillator whose ringing frequency is dependent on the conductivity of the plasma. A method of determining plasma conductivity and power adsorption from the ringing frequency is considered, and the basic theory of the electrodeless ring discharge is discussed.

2292

Politecnico di Milano. Laboratorio di Elettrochimica, Chimica Fisica e Metallurgia (Italy).

[INVESTIGATION OF THE PHENOMENON OF OVERVOLTAGE IN MOLTEN SALTS] Recherches sur les phénomènes de surtension en de sels fondus, by R. Piontelli, G. Sternheim and others. [1961] 15p. incl. diagrs. refs. (AF 61(514)733-C) Unclassified

Published in Soviet Eletrochem.; Proc. Fourth Conf. on Electrochem., Moscow (USSR) (Oct. 1-6, 1956), New York, Consultants Bureau, v. 1: 90-94, 1961.

Experimental techniques for measuring the individual overloads on the electrodes of an electrolytic cell with salt solutions are presented and the significance of the results (apparent voltage overloads) is discussed. Experimental results are presented to include the excess voltage due to ion transfer in a chlorine suspension at a sufficiently elevated temperature even for intermediate metals and for aluminum in a cryolitic medium. The cathode deposit of aluminum in industrial cells is the direct result of an electrochemical reaction. Also among dissolved salts, phenomena rendering the metal inactive are due to the presence or formation of overlapping layers (occasionally oscillatory). This inactivation characteristic is eliminated by the fusion of the metal.

2293

Politecnico di Torino. [Laboratorio di Meccanica Applicata] (Italy).

SIMULTANEOUS TRANSFER OF MOMENTUM, HEAT AND MASS. PART II. GAS-VAPOUR MIXTURES, by G. Jarre. Feb. 1961, 15p. incl. diagrs. (Technical note no. 19) (AFOSR-16) (AF 61(052)208) AD 258111 Unclassified

Study was made of the analogy between the velocity, temperature and concentration fields and the analogy between the momentum, heat and mass transfers, in high speed streams of moist gases over surface where evaporation or condensation can occur. The deduced transfer analogy is an extension of the classical Colburn analogy (Ind. Eng. Chem., v. 22: 967, 1930). The following factors were considered: (1) high speed, (2) high vapor concentration, (3) different gas and vapor specific heats, and (4) full range of flow regimes from the laminar Couette flow to the fully turbulent boundary layer flow. (Contractor'sabstract)

2294

Politecnico di Torino. [Laboratorio di Meccanica Applicata] (Italy).

SIMULTANEOUS TRANSFER OF MOMENTUM, HEAT AND MASS. PART III. EVAPORATIVE COOLING AT HIGH SPEED, by G. Jarre. Apr. 1961, 1v. incl. diagrs. tables. (Technical note no. 20) (AFOSR-1161) (AF 61(052)208) AD 262068 Unclassified

The opposite effects of evaporative cooling and of aerodynamic heating at high speed are investigated. The evaporative cooling is a very effective process to strongly reduce the friction heating produced by high speeds. The wet bulb of a psychrometer describes the adiabatic case of evaporative cooling. The field of low vapor concentration is thoroughly analyzed and simple graphical methods are derived. Numerical examples illustrate the obtained results. The stability of laminar flow under evaporative cooling is eventually discussed. (Contractor's abstract)

2295

Politecnico di Torino. [Laboratorio di Meccanica Applicata] (Italy).

RESEARCH PERFORMED AT THE INSTITUTE OF APPLIED MECHANICS OF THE POLITECNICO (TORINO) ON MOMENTUM, HEAT AND MASS TRANSFER AND ON FREE MOLECULAR FLOW, by C. Ferrari. Apr. 1961, 16p. (Technical rept.) (AFOSR-1162) (AF 61(052)208) AD 262067 Unclassified

Research performed during 1960 is summarized as follows. Work on momentum, heat, and mass transfer at high speed concerns homogeneous gases, gas-vapor mixtures, and evaporative cooling; work on free molecular flow concerns energy exchanges, momentum exchanges, and the relations between interaction coefficients and sitting time of the molecules on the surface. (Contractor's abstract)

2296

Polytechnic Inst. of Brooklyn, N. Y.

INFRARED STIMULATION AND QUENCHING OF PHOTOCONDUCTION IN SINGLE CRYSTAL ZnS:Cu (Abstract), by F. G. Ullman and J. J. Dropkin. [1958] 3p. [AF 18(600)692] Unclassified

Presented at meeting of the Electrochem. Soc., New York, Apr. 1958.

The crystals studied were grown from the vapor phase and are colorless, transparent, and non-luminescent. Photoconduction measurements were made in a vacuum at pressures of about 10^{-4} mm of mercury and with silver paste electrodes. The UV and IR photocurrents obey Ohm's law for both polarities up to 1000 v. Slight deviations from Ohm's law are found below 10 v. Measurements were made at 440 v where these effects are negligible. Space charge polarization effects are also observed but are small. The UV photocurrent (2537A or 2650A) rises slowly (~30 sec) to a steady value and decays in about the same time when excitation ceases. The rise and decay of the IR photocurrent is somewhat faster but shows the same behavior. The IR and UV photocurrents vary linearly with light intensity except for 2537A excitation where square root dependence is found. This implies the existence of large numbers of empty recombination centers other than luminescent centers as would be expected for a non-luminescent crystal. Two types of crystals have been studied, those in which the UV photocurrent is decreased by IR and those in which it is increased. It is concluded that IR quenching phenomena in ZnS:Cu arises from the same excitation mechanism as the IR phenomena. This mechanism must be hole excitation since the UV photocurrent which has been shown to be carried by conduction band electrons is quenched by the IR photocurrent.

2297

Polytechnic Inst. of Brooklyn, N. Y.

A PROCEDURE FOR PARAMETER REFINEMENT IN SIMPLE STRUCTURES, by A. Batt and B. Post. Dec. 1961 [3]p. (AFOSR-2161) (AF 18(600)1193)
AD 438551 Unclassified

Also published in Acta Cryst., v. 15: 1268-1270, Dec. 10, 1962.

A procedure for the refinement of atomic position parameters in suitable simple structures is described. The method has been applied to the refinement of published position parameters of the oxygen atom in yttrium iron garnet. The new values are: x = -0.0269 ± 0.0001, y = 0.0581 ± 0.0003, and z = 0.1495 ± 0.0001. (Contractor's abstract)

2298

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

ON TURBULENT FREE MIXING OF PARALLEL STREAMS OF TWO DIFFERENT GASES, by S. Uchida. June 1961, 59p. incl. illus. tables. (PIBAL rept. no. 635) (AFOSR-966) (AF 49(638)217)
AD 260302 Unclassified

A theoretical investigation of the turbulent mixing of 2 different nonreacting gases is presented. Four different equations for predicting the mixing are derived by considering combinations of 2 different formulations of the turbulent transport currents of mass, momentum and energy, and 2 different formulations of the eddy kinematic viscosity coefficient in compressible flow. All equations can be solved numerically to yield similar type solutions. The results of a numerical calculation comparing the solutions given by the 4 equations is presented. (Contractor's abstract)

2299

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

VELOCITIES IN TWO-DIMENSIONAL ASYMMETRIC WAKES, by M. H. Steiger and M. H. Bloom. July 1961, 15p. incl. illus. (PIBAL rept. no. 707) (AFOSR-1085) (AF 49(638)217) AD 261480
Unclassified

The fluid mechanics of asymmetric free mixing regions are investigated by an integral method analysis, with emphasis on non-similar behavior stemming from the form of the initial profiles. Velocity distributions are calculated and presented for a steady, laminar, compressible, 2-dimensional wake for various values of the inviscid velocity ratio u1/u2, where u is the axial velocity component evaluated at the outer edge of the viscous layer and 1 and 2 refer to the (x1, y) and x2, y) coordinate systems, respectively. (Contractor's abstract)

2300

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

VELOCITIES IN TWO-DIMENSIONAL ASYMMETRIC WAKES (ADDENDUM), by M. H. Steiger and M. H. Bloom. July 1961, 3p. (Addendum to PIBAL rept. no. 707) (AFOSR-1085A) (AF 49(638)217)
AD 263206 Unclassified

The purpose of this addendum is to discuss and present a method for calculating the mixing of two streams subject to arbitrarily different inviscid velocities with arbitrary values of the initial thickness of each stream. (Contractor's abstract)

2301

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

CHEMICAL EFFECTS IN EXTERNAL HYPERSONIC FLOWS, by R. Vaglio-Laurin and M. H. Bloom. Aug. 1961, 134p. incl. diagrs. tables, refs. (PIBAL rept. no. 640) (AFOSR-1273) (AF 49(638)217)
AD 263207 Unclassified

Presented at ARS Internat'l. Hypersonic Conf., Cambridge, Mass., Aug. 16-18, 1961.

Also published in Prog. in Astronaut. and Rocketry, v. 7: 205-254, 1962.

The report gives an account of advances and problems in the area of chemically reacting continua. Emphasis is placed on external flows about axisymmetric hypersonic vehicles at zero incidence. The analysis and correlation of observables in complete inviscid flows assuming either chemical equilibrium or composition frozen at post-shock equilibrium conditions is presented. An assessment of rate processes in these flows is performed by means of 1-dimensional rate calculations along streamlines. It is shown that the latter calculations and the frozen model may be used in tandem to obtain estimates of observables in practical situations. The behavior of non-equilibrium boundary layer flows over bodies is discussed with emphasis on the quenching effect of a cold non-catalytic wall. A quantitative study of wakes behind the vehicles is presented, the influence of shock induced vorticity and of inner core is considered for both laminar and turbulent flows. (Contractor's abstract)

2302

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

HYPERSONIC APPROXIMATION FOR THE INVISCID FLOW OVER CONICAL BODIES WITHOUT AXIAL SYMMETRY AND COMPARISON WITH TESTS AT MACH 8, by C. R. Ortloff. Jan. 1961, 50p. incl. illus. tables, refs. (PIBAL rept. no. 728) (AFOSR-1634) (AF 49(638)217) AD 270609 Unclassified

A successive approximation method, based on assumptions valid for hypersonic free stream Mach numbers, is developed for analysis of the inviscid perfect gas flow in the shock layer of non-axisymmetric conical bodies at angles of attack and/or yaw. First and second order analyses for determining shock geometry, and the resulting body pressure distribution, are based upon satisfying the flow tangency condition at the body surface by series expansions about first and second approximation shock waves, respectively; small differences added by superimposed second order corrections indicate rapid convergence of the method, so that first approximation shock geometry and pressure distribution results are sufficient to represent the flow field. First order hypersonic approximation results for an elliptic cone (a/b = 1.78), over a large range of angles of attack and yaw, at M1 = 8.00, indicate accuracy comparable to more complex theoretical methods, and in good agreement with experimental data for lower values of these angles. (Contractor's abstract)

2303

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

A NOTE ON THE APPLICATION OF THE HEAT BALANCE INTEGRAL TO PROBLEMS ON NON-PLANAR GEOMETRY, by T. J. Lardner and F. V. Pohle. Jan. 1961 [14]p. incl. diagrs. refs. (PIBAL rept. no. 585) (AFOSR-57) (AF 49(638)302) AD 250719 Unclassified

The temperature distribution in the region exterior to a cylindrical hole in the infinite space whose boundary is exposed to a constant heat flux is determined using the integral method with a parabolic profile. The results indicate that the use of the parabolic spatial temperature distribution leads to poor agreement with the exact solution. A modified profile is found to lead to better agreement. The analogous problem for the spherical cavity is treated. (Contractor's abstract)

2304

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

CREEP ANALYSIS OF ANNULAR PLATES, by B. Venkatraman and S. A. Patel. Mar. 1961, 1v. incl. diagrs. tables. (PIBAL rept. no. 588) (AFOSR-518) (AF 49(638)302) AD 255156 Unclassified

Also published in Jour. Franklin Inst., v. 275: 13-23, Jan. 1963.

The paper presents analyses of creep in annular plates subjected to uniform lateral pressures. These analyses are based upon creep flow laws associated with the maximum shearing stress criterion. It is assumed that the creep rate is a power function of moment multiplied by a function of time. Annular plates with four specific edge conditions are considered. These are: free inner edge and simply supported, or clamped outer edge; free outer edge and simply supported, or clamped inner edge. In all cases expressions for moments and deformations are obtained in closed form.

2305

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

CREEP BENDING OF COMPRESSIBLE PLATES, by S. A. Patel and B. Venkatraman. [1961] [17]p. incl. diagrs. (PIBAL rept. no. 590) (AFOSR-848) (AF 49(638)302) AD 259355 Unclassified

Also published in Internat'l. Jour. Mech. Sci., v. 4: 137-[illegible], 1962.

A nonlinear moment-curvature relation is developed for the creep-bending analysis of thin-plates made of compressible materials. This relation is used to analyze 2 specific annular plates: an annular plate simply supported along the outer edge and free at the inner edge, with uniform radial moments applied along the supported circumference; an annular plate clamped along the inner edge and free at the outer edge, with uniform radial moments applied along the free circumference. Solutions for moment distributions and deflections are presented for both problems. (Contractor's abstract)

2306

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

APPLICATION OF BIOT'S VARIATIONAL PRINCIPLE IN HEAT CONDUCTION, by T. J. Lardner and F. V. Pohle. May 1961, 100p. incl. illus. tables, refs. (PIBAL rept. no. 587) (AFOSR-932) (AF 49(638)302) AD 259696 Unclassified

Biot's variational principle for heat conduction is applied to the solution of a number of 1-dimensional problems. These problems illustrate the applicability of the principle to problems involving prescribed heat flux boundary conditions and to problems with temperature-dependent material properties. (Contractor's abstract)

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Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

BIOT'S VARIATIONAL PRINCIPLE IN HEAT CONDUCTION, by T. J. Lardner and F. V. Pohle. July 1961, 61p. incl. illus. refs. (PIBAL rept. no. 595) (AFOSR-1275) (AF 49(638)302) AD 263835 Unclassified

The literature on Biot's variational principle for heat conduction and the thermodynamic foundations of the

principle are reviewed. An additional example treats the heating of slabs exposed to time-dependent heat fluxes. A specific example of a triangular heat pulse is presented in detail. (Contractor's abstract)

2308

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

A METHOD OF REDUCING THE HEAT TRANSFER TO ANNULAR SHOCK GENERATORS (Unclassified title), by G. Alello and V. Zakkay. Jan. 1961 [18]p. incl. diagrs. (PIBAL rept. no. 612) (AFOSR-59) (AF 49(638)445) AD 321652 Confidential

2309

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

OPTIMUM ORBITAL TRANSFER BY HIGH THRUST ROCKETS, by L. Ting. Feb. 1961, 1v. incl. diagrs. (PIBAL rept. no. 633) (AFOSR-163) (AF 49(638)-445) AD 253306 Unclassified

For a high thrust rocket, the specific impulse is of the order of or larger than the local circular orbital velocity, and the fuel consumption rate is so large that the dimensionless parameter, ϵ, defined as the ratio of the product of initial weight and specific impulse to that of the fuel consumption rate and a reference radial distance to the earth's center of the common focus, is much less than unity. The solution of transfer by a single impulse is shown to be equivalent to the true optimum transfer by a high thrust rocket when terms of the order of ϵ are neglected. With the aid of the approximate theory for variational problems, developed in a previous paper, the solution of transfer by a single impulse is improved so that the result will differ from the true optimum by the order of ϵ squared only. Explicit formulas for the improvements in the total burning time and in the thrust angle program are obtained. With application of these formulas to each impulse transfer, it is shown that an optimum solution of transfer by N-impulse can be improved. (Contractor's abstract)

2310

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

PRELIMINARY EXPERIMENTAL INVESTIGATION OF FLOW ABOUT A BLUNT BODY WITH FLOW-SEPARATION SPIKES AT $M_\infty = 7.9$, by V. Zakkay. Feb. 1961 [23]p. incl. diagrs. (PIBAL rept. no. 631) (AFOSR-219) (AF 49(638)445) AD 253200; PB 155480 Unclassified

The pressure and heat transfer distribution about a hemispherically-capped cone having a cone half angle of 50° and a bluntness ratio of 0.667, equipped with flow-separation spikes, is presented. The measurements were made at $M = 7.9$ and a Reynolds number from 0.3 million to 0.5 million. Two different configurations were chosen for this investigation. The over-all reduction of drag and heat transfer with the spike to that without the spike is compared to the recent results obtained for a spiked-nose hemisphere cylinder. For both configurations the results with the spikes indicate a reduction in drag. The heat transfer over the spherical portion of the model was reduced by the addition of the spike; however, heat transfer coefficients as much as 3 times the stagnation point value were reached at the backward portion of the cone. The heat transfer to the cylindrical portion of the model was increased for both configurations. (Contractor's abstract)

2311

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

AXIALLY SYMMETRIC LAMINAR FREE MIXING WITH LARGE SWIRL, by M. H. Steiger and M. H. Bloom. [1961] 22p. incl. diagrs. (PIBAL rept. no. 636) (AFOSR-400) (AF 49(638)445) AD 254528; PB 155803 Unclassified

Presented at Winter annual meeting of the Amer. Soc. Mech. Engineers, New York, Nov. 26-Dec. 1, 1961.

Also published in Jour. Heat Transfer, v. 84: 370-374, Nov. 1962.

Viscous laminar axially-symmetric free mixing with large swirl is investigated by a boundary layer type of analysis with integral methods. Large swirl generates axial pressure gradients as well as large radial pressure gradients, and therefore alters the streamwise flow. Examples calculated for both incompressible and compressible flow show that the wake may be significantly lengthened by large swirl. However, this effect is shown to be diminished in the compressible case where higher freestream Mach numbers lead to decreased densities, and to decreased centrifugal effects, decreased radial pressure gradients, and decreased axial pressure gradients. In the limiting special case of small or moderate swirl the results agree with those previously obtained by Steiger and Bloom in an analysis wherein the induced pressure gradients were neglected a priori. (Contractor's abstract)

2312

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

APPROXIMATE SOLUTIONS FOR REENTRY TRAJECTORIES WITH AERODYNAMIC FORCES, by K. Wang and L. Ting. May 1961 [29]p. incl. diagrs. refs. (PIBAL rept. no. 647) (AFOSR-684) (AF 49-(638)445) AD 257618 Unclassified

Also published in Astronaut. Acta, v. 8: 28-41, 1962.

When the motion of the reentry vehicle is expressed in 2 equations for the components in the instantaneous trajectory plane, and 1 for the component normal to the plane, the former equations are uncoupled from the latter. Thus, the problem of a nonplanar trajectory is reduced to an equivalent planar trajectory. Approximate analytic solutions for planar trajectories with constant lift and drag coefficients are obtained by improving and extending existing analytic solutions. The present solutions are not subjected to the restrictions which are valid for drag-only vehicles at large entry angle, nor for lifting vehicle entering the atmosphere at near circular orbit velocity and shallow angles. They are derived in a closed form of simple functions expressing the relations between the velocity, the angle of inclination and the density, or elevation. Using these relations, the acceleration experienced by the pilot can be calculated and the peak value determined. The numerical results calculated for these cases, where the above restrictions are violated, show good agreement with the machine results by direct integration of the equations of motion. (Contractor's abstract)

2313

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

ON LINEARIZED SWIRLING WAKES, by M. H. Steiger and M. H. Bloom. July 1961, 17p. incl. diagr. (PIBAL rept. no. 706) (AFOSR-1054) (AF 49-(638)445) AD 261547 Unclassified

Mathematically exact solutions for axisymmetric wakes with small swirl in a constant-property medium are derived by 2 methods. The first depicts the eigenvalue problem associated with the method of separation of variables and includes the so-called similar solution. The second technique utilizes Fourier methods and Hankel transforms, and solutions are given for both the axial and circumferential velocities in terms of arbitrary initial conditions. The solution produces an infinite continuous set of eigenvalues and 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. The question of what type of flow can be produced physically at an initial station arises and also is discussed, and their importance to experimental observations noted. (Contractor's abstract)

2314

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

PRACTICAL ASPECTS OF REENTRY PROBLEMS, by A. Ferri and L. Ting. July 1961 [39]p. incl. diagrs. refs. (PIBAL rept. no. 705) (AFOSR-1178) (AF 49(638)445) AD 262452 Unclassified

Presented at Internat'l. Symposium on Space Flight and Re-entry Trajectories, Louveciennes, June 19-21, 1961.

Also published in Astronaut. Acta, v. 8: 63-81, 1962.

Entry trajectories for vehicles without and with lift are investigated. The existence and the significance of the second peak deceleration in reentry trajectories are presented. The second peak may be greater than the first one. For a given entry velocity, the first peak deceleration can be a discontinuous function of entry angle. With proper lift modulation of the body-type vehicle, i. e. by changing the angle of attack of the vehicle, the range of the entry angle for non-skip trajectories can be increased significantly, while the first peak deceleration remains less than 5 times the gravitational acceleration. A constant elevation maneuver is presented and its effectiveness in reducing the second peak deceleration is explained. This maneuver, followed by a constant lift modulation, permits the control of the point of landing over a wide range. The practical application of the rate of change of deceleration in deciding the proper lift modulation is demonstrated. (Contractor's abstract)

2315

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

THREE-DIMENSIONAL VISCOUS WAKES, by M. H. Steiger and M. H. Bloom. Oct. 1961, 9p. incl. diagr. (PIBAL rept. no. 710) (AFOSR-1580) (AF 49-(638)445) AD 266617 Unclassified

The velocity fields of 3-dimensional viscous wakes are examined with the use of the boundary layer approximations, Oseen's linearization of the convective terms, and the assumption of constant fluid properties. Transform methods yield solutions for general types of initial conditions. As an illustration, the axial velocity distribution of a wake whose initial isovels (lines of constant velocity) are of elliptic shape and their decay to axial symmetry are demonstrated. (Contractor's abstract)

2316

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

REVIEW OF ELECTROMAGNETIC EFFECTS ON SPACE VEHICLES, by K. P. Chopra. Mar. 17, 1961, 8p. incl. refs. (PIBAL rept. no. 716) (AFOSR-1635) (AF 49(638)445) Unclassified

Presented at the Amer. Astronaut. Soc. Symposium on Interactions of Space Vehicles with Ionized Atmosphere, Washington, D. C., Mar. 17, 1961.

Published in Jour. Astronaut. Sci., v. 9: 10-17, 1962.

The various electromagnetic effects on space vehicles moving in an ionized atmosphere pervaded by a magnetic field are reviewed. These effects may be divided into 2 broad categories according to whether the electric currents are induced inside the space vehicle or in the surrounding medium. The effects falling in the second category may be analyzed from the point of

view of the atmosphere being treated either as a continuum or as a noncontinuum. The nature of the ionized medium in the immediate neighborhood of the space vehicle is of great significance. A physical model is proposed in which the ionized cloud is composed of a spherical ion belt surrounding a negatively charged space vehicle and an ionized column in its front. The characteristic features of this model are high drag and large radar cross sections of the space vehicles, the acceleration of electrons in the initial frontal column to high energies before impact, and the excitation of plasma waves. These features have a certain bearing on the interpretation of the observations on artificial earth satellites.

2317

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

THEORETICAL AND EXPERIMENTAL INVESTIGATION OF THE LAMINAR HEAT TRANSFER DOWNSTREAM OF A SHARP CORNER, by V. Zakkay and T. Tani. Oct. 1961 [39]p. incl. illus. (PIBAL rept. no. 708) (AFOSR-1640) (AF 49(638)445) AD 266621 Unclassified

An experimental and theoretical investigation of the laminar heat transfer downstream of a sharp convex corner is presented. The flow field in the region of the discontinuity is divided into 2 parts: the flow field upstream of the discontinuity, obtained from standard viscous and inviscid techniques, and the flow immediately downstream of the sharp discontinuity, obtained by expanding both the supersonic and subsonic flow fields upstream of the discontinuity inviscidly around the corner. Downstream of the discontinuity the flow is represented by a viscous non-similar sublayer which starts at the discontinuity, and by a viscous shear layer at the outer edge which has the inviscid profiles immediately downstream of the discontinuity as initial conditions. The boundary conditions for the viscous sublayer at the outer edge are defined by the shear viscous layer.

2318

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

ON VISCOUS WAKES OF YAWED INFINITE CYLINDERS AND ANALOGOUS JETS, by M. H. Bloom. Nov. 1961, 4p. (PIBAL rept. no. 730) (AFOSR-1731) (AF 49(638)445) AD 268352 Unclassified

Also published in Jour. Aerospace Sci., v. 29: 492, Apr. 1962.

Boundary layers over yawed infinite cylinders whose inviscid properties are spanwise-invariant, and whose surface conditions are uniform, have received considerable attention. Analogous treatment may be accorded the viscous wakes of such cylinders, which are of interest, for instance, in connection with flame holders or observables of high speed bodies at angle-of-attack.

2319

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

ON THE NUMERICAL SOLUTION OF THE BLASIUS PROBLEM WITH THREE-POINT BOUNDARY CONDITIONS, by K. Toba. [1961] [2]p. [PIBAL rept. no. 734] (AFOSR-1745) (AF 49(638)445) Unclassified

Also published in Jour. Aerospace Sci., v. 29: 480-481, Apr. 1962.

A technique for the approximate determination of the initial parameters to be used in the numerical solution of the Blasius problem with three-point boundary conditions is presented and the parameters mathematically derived.

2320

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

APPROXIMATE SOLUTIONS FOR AERODYNAMIC HEATING OF REENTRY VEHICLES, by C. J. Ruger. Nov. 1961, 18p. (PIBAL rept. no. 729) (AFOSR-1761) (AF 49(638)445) AD 268826 Unclassified

Aerodynamic heating of space vehicles during reentry with constant aerodynamic coefficients is considered. General relations for the conditions at the maximum heating rate, and for the total heat input at the stagnation point from entry to any point in the trajectory, are developed. The relations are not subject to the restrictions of skip or exit trajectories with entry velocity greater than the circular speed. The relation presented for the heat input has 2 parts. The first, which is the most significant part of the heat input, is of closed form. The second part is left in terms of an integral and evaluated by Simpson's rule. Only a small number of steps are required in the numerical evaluation of this integral, thus making this solution much shorter than direct numerical integration. The numerical results calculated from this solution show good agreement with those from the direct numerical integration. (Contractor's abstract)

2321

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

LINEARIZED DIFFUSION IN A RELAXING GAS, by P. M. Sforza and M. H. Bloom. Nov. 1961 [42]p. incl. illus. (PIBAL rept. no. 736) (AFOSR-1769) (AF 49(638)445) AD 268827 Unclassified

The linearized model of a gas with diffusion processes and rate reaction is applied to 1-dimensional unsteady motion generated by initial non-uniformities of state and velocity. The time-dependent system resembles that of steady free mixing of jet or wake type, with 2 space coordinates. The time-wise character of the profiles of flow variables is studied analytically under 2 sets of conditions: (1) Zero mass-motion with

state non-uniformity in slab-like, cylindrical and spherical configurations; this corresponds to steady flow with a non-dissipating step-function velocity profile. (2) Mass-motion with uniform temperature in slab-like configuration; this corresponds to 2-dimensional viscous isothermal free mixing with the variations of concentration and enthalpy.

2322

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

LINEARIZED SWIRLING WAKES, by M. H. Steiger and M. H. Bloom. [196-] [6]p. incl. diagr. refs. (AFOSR-J55) (AF 49(638)445) AD 400392 Unclassified

Also published in Phys. Fluids, v. 5: 1027-1032, Sept. 1962.

Exact similar and nonsimilar solutions for axisymmetric wakes with small swirl in a constant-property medium are derived. Emphasis is placed on the similar solutions, particularly those associated with the swirl. A unique similar solution for the axial velocity is distinguished from a possible infinite set by invoking the auxiliary condition of invariance of the axial momentum defect. Likewise, for the circumferential velocity only 1 of the large number of possible similar solutions is shown to satisfy the conditions that the circumferential mass flow, momentum flux, and higher moments are bounded. (Contractor's abstract)

2323

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

THEORETICAL AND EXPERIMENTAL INVESTIGATION OF THE LAMINAR HEAT TRANSFER DOWNSTREAM OF A SHARP CORNER, by V. Zakkay and T. Tani. [1960] [13]p. incl. diagrs. refs. (AFOSR-J429) (AF 49(638)445) AD 407277 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: 1455-1467, 1962.

An experimental and theoretical investigation of the laminar heat transfer downstream of a sharp convex corner is presented. The flow field in the region of the discontinuity is divided into two parts: the flow field upstream of the discontinuity, which is obtained from standard viscous and inviscid techniques, and the flow immediately downstream of the sharp discontinuity, which is obtained by expanding both the supersonic and subsonic flow fields upstream of the discontinuity inviscidly around the corner. Downstream of the discontinuity the flow is represented by a viscous nonsimilar sublayer which starts at the discontinuity and by a viscous shear layer at the outer edge which has the inviscid profiles immediately downstream of the discontinuity as initial conditions. The boundary conditions for the viscous sublayer at the outer edge are defined by the shear viscous layer. Experimental results are presented for two different configurations at a free stream Mach number of 8. The experimental results agree well with the analysis presented. (Contractor's abstract)

2324

Polytechnic Inst. of Brooklyn. Dept. of Chemical Engineering, N. Y.

FREQUENCY RESPONSE OF ADSORPTION ON SOLID CATALYSTS, by L. M. Naphtali. Final rept. July 31, 1961. (AFOSR-1216) (AF 49(638)337) Unclassified

This work was undertaken to apply control engineering techniques for characterizing system dynamics to problems in adsorption on catalysts. The theoretical methods were advanced to develop techniques of numerically converting transient data to frequency response data; to interpret frequency response data; to compute frequency response from convenient experiments, and to analyze data to determine distribution functions of number versus rate constant. The apparatus for measuring frequency response was developed. It was used to study the effects of oxygen and reduction temperature on the H_2-Ni system.

2325

Polytechnic Inst. of Brooklyn. Dept. of Chemistry, N. Y.

MODIFICATION OF SPECTRAL AND SEMICONDUCTING PROPERTIES OF POLYVINYLIDENE CHLORIDE BY ULTRAVIOLET LIGHT OF SPECIFIC WAVELENGTHS, by G. Oster, G. K. Oster and M. Kryszewski. [1961] [9]p. incl. diagrs. refs. (AF 49-(638)293) Unclassified

Published in Jour. Polymer Sci., v. 57: 937-947, Mar. 1962.

Polyvinylidenechloride-polyvinylchloride copolymer (saran) when irradiated with 254 mμ light produces a species which absorbs maximally at 285 mμ and has a tail in the spectrum which extends into the visible region. Irradiated samples show a further increase in absorption when heated at 100°C, while unirradiated samples are unaffected by such heating. Irradiation at 254 mμ results in crosslinking which is further increased on heating. On the other hand, heating destroys the Carr-Price reaction exhibited by irradiated material. Heating also destroys the electron spin resonance signal of the irradiated material. Irradiated films are photoconducting but this property is destroyed by heating. The compound produced by irradiation at 254 mμ is destroyed by irradiation at 310 and 365 mμ, but the products are different in the 2 cases and depend on the presence of oxygen.

2326

Polytechnic Inst. of Brooklyn. Dept. of Mechanical Engineering, N. Y.

A SPRAY COMBUSTION MODEL WITH DROPLET BREAKUP INCLUDING GAS DYNAMIC COUPLING, by S. Z. Burstein, S. S. Hammer, and V. D. Agosta. June 1961, 35p. incl. diagrs. refs. (AFOSR-433) (AF 49(638)165) AD 258231 Unclassified

Presented at the ARS Propellants Combustion and Liquid Rockets Conf., Palm Beach, Fla., Apr. 26-28, 1961.

Also published in Prog. in Astronaut. and Rocketry, v. 6: 243-267, 1962. (Title varies)

A simplified model is proposed for the combustion of a bi-propellant spray. The model considers 2 subsystems, the spray, and the combusted gases. These subsystems are coupled together by heat transfer, mass transfer and momentum transfer. The solution of the problem relies upon the integration of a system of 7 nonlinear differential equations. Under the given boundary conditions a co-operative evaporation process occurs, in which increased velocity gradients cause increased evaporation which increases the velocity gradient. Tests were made on a 2-in. diam, variable length rocket motor, using JP-5A and liquid oxygen. A simple converging diverging nozzle is employed to give high chamber exit Mach numbers (.4 to .5). For a given set of injection parameters, under stable operating conditions, the results indicate that the steepest portion of the gradient, which corresponds to evaporation of the major portion of the fuel, is always found in a fixed region of the chamber, independent of the absolute length of the chamber. Results appear to be in agreement with theory.

2327

Polytechnic Inst. of Brooklyn. [Dept. of Mechanical Engineering] N. Y.

HIGH FREQUENCY OSCILLATING COMBUSTION IN ROCKET MOTORS (Abstract), by V. D. Agosta. [1961] [1]p. [AF 49(638)165] Unclassified

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

A simplified steady state mathematical model is proposed for the combustion of a monopropellant spray in a rocket chamber. The solution of the problem relies upon the integration of a system of 7 nonlinear total differential equations. The integration is performed using the IBM 704 digital computer. The data generated from this program are the initial conditions for the non-steady analysis. The time dependent conservation laws of the combustion gases and liquid droplets are coupled together and solved. The method of characteristics is used as the technique of solution since the partial differential equations by appropriate transformations, are reduced to first order ordinary differential equations along the bicharacteristics, gas particle path, and liquid particle path. The bicharacteristic equations are solved by the Runge-Kutta-Gill technique. Arbitrary pressure pulses are introduced into the combustion chamber and the amplification or attenuation of these pulses and their interaction with the combustion zone is ascertained. An analysis has been made of shock wave propagation in a rocket engine having the above physical characteristics. The shock wave equations contain terms to account for the drag, evaporation and subsequent combustion of the liquid fuel drops. These equations have been coded for the IBM 650 computer and the program is currently being debugged. An experimental wave generator has been developed that introduces a predetermined shape pulse into the rocket chamber. At present a half sine wave of 1 μsec duration is being employed. The shape and size of the pulse can be varied by modifying the ports in the generator and size of the explosive actuator.

2328

Polytechnic Inst. of Brooklyn. [Dept. of Mechanical Engineering] N. Y.

PLANE-STRESS BENDING OF SANDWICH PLATES, by J. E. Koch. May 1961, 26p. incl. diagrs. table. (Technical note no. 11) (AFOSR-837) (AF 49(638)453) AD 265545 Unclassified

Also published in Developments in Mechanics, Proc. of the Seventh Midwestern Mechanics Conf., Michigan State U. (Sept. 6-8, 1961), New York, Plenum Press, v. 1: 307-324, 1961.

The plane-strain bending of a symmetrically arranged 3-layered plate is studied on the basis of a recent flexural theory. Solutions are found for 3 common types of support under arbitrary transverse surface loading conditions. On the basis of these solutions, the importance of the various effects included in the theory is assessed. (Contractor's abstract)

2329

Polytechnic Inst. of Brooklyn. Dept. of Mechanical Engineering, N. Y.

DAMPING OF FLEXURAL VIBRATIONS OF SANDWICH PLATES, by Y.-Y. Yu. May 1961, 36p. incl. diagrs. (Technical note no. 10) (AFOSR-838) (AF 49(638)453) Unclassified

Also published in Jour. Aerospace Sci., v. 29: 790-803, July 1962.

For the analysis of the effect of structural damping on the flexural vibrations of infinite and simply supported rectangular sandwich plates, the general 2-dimensional equations of a sandwich-plate theory are first presented. As in the 1-dimensional case (item no. PIB. 15:001, Vol. II), the theory takes into account the thickness-shear deformation and imposes no limitations upon the ratios between the densities, elastic moduli, and thicknesses of the core and face

layers of the sandwich. The unrestricted nature of the theory makes a thorough analysis of damping possible, and the results obtained are in fact applicable to any symmetrically constructed 3-layered composite plate. (Contractor's abstract)

2330

Polytechnic Inst. of Brooklyn. Dept. of Mechanical Engineering, N. Y.

THE EFFECT OF THICKNESS DEFORMATION ON VIBRATIONS OF SANDWICH PLATES, by Y.-Y. Yu. [1961] [2]p. (AFOSR-2255) (AF 49(638)453) Unclassified

Also published in Jour. Aerospace Sci., v. 29: 491-492, Apr. 1962. (Title varies)

United States Air Force - supported extension of previous analyses of the flexural vibrations of elastic sandwich plates, to cover the extensional vibrations of such plates. The effects of thickness-stretch deformation are studied.

2331

Polytechnic Inst. of Brooklyn. Dept. of Mechanical Engineering, N. Y.

COMMENT ON INFLUENCE OF TRANSVERSE SHEAR ON NONLINEAR VIBRATIONS OF SANDWICH BEAMS WITH HONEYCOMB CORES, by Y.-Y. Yu. [1961] [2]p. incl. table. [AF 49(638)453] Unclassified

Also published in Jour. Aerospace Sci., v. 29: 886-887, July 1962.

It is shown that, contrary to a previous conclusion, the influence of a transverse shear may be of importance in the nonlinear vibration analysis of honeycomb-sandwich flight structures.

2332

Polytechnic Inst. of Brooklyn. [Dept. of Physics] N. Y.

RARE EARTH DISILICIDES, by I. P. Mayer, E. Banks, and B. Post. [1961] [4]p. incl. tables. (AFOSR-2160) (AF 49(638)827) AD 295881 Unclassified

Also published in Jour. Phys. Chem., v. 66: 693-696, Apr. 1962.

Disilicides of yttrium and of a number of the heavier rare earth metals were prepared. X-ray diffraction analysis indicates that the yttrium compound is dimorphic, crystallizing in the hexagonal system (AlB_2 type) at low temperatures and in the orthorhombic system (distorted form of the tetragonal $ThSi_2$ structure) at higher temperatures. Tb and Ho disilicides are orthorhombic while the disilicides of Er, Tm, Yb, and Lu are hexagonal. The composition of the $YbSi_2$ phase was investigated by x-ray diffraction methods; within the limits of experimental error, the unit cell contains 2 silicon atoms for each ytterbium atom, as indicated by the formula. (Contractor's abstract)

2333

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

PROPOSED PROGRAM FOR STUDYING THE MECHANISMS OF ELECTRIC BREAKDOWN OF LIQUIDS (Abstract), by H. Farber. Mar. 15, 1960, 3p. (Rept. no. 815) (Bound with its AFOSR-5249) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under AF 18(600)1505) Unclassified

A program for further study of the mechanism of electric breakdown of liquids is proposed after a review of available theory and some of the observed phenomena for a variety of pure liquids.

2334

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

SIZE EFFECT IN THE MEASUREMENT OF MICROWAVE PERMEABILITY OF FERRITES, by B. Maher and L. [M.] Silber. [1960] [1]p. incl. diagrs. [AF 18-(600)1505] Unclassified

Published in I. R. E. Trans. on Microwave Theory and Techniques, v. MTT-9: 96, Jan. 1961.

Measurements were made on spheres of 2 typical polycrystalline ferrites R-1, a magnesium manganese ferrite and yttrium iron garnet. The measurements were made by mounting the sample in the center of an X-band TE_{102} rectangular cavity; and the change in the insertion loss as a function of the applied magnetic field was measured. The quantity obtained is u'', the imaginary part of the diagonal element of the permeability tensor. The values of u'' were calculated from the equation: $u'' = \left(\frac{V_o}{V} - 1\right) \frac{V_c}{4Q_u V_s - \left[1 - \left(\frac{\lambda_o}{2a}\right)^2\right]}$ where V_o/V_1 is determined from the ratio of the insertion loss of the cavity at very large static field to the insertion loss at a particular field; Q_u is the unloaded Q of the cavity; V_c and V_s are volume of the cavity and the sample, respectively. The formula gave values of U''_{max} and line width which were independent of size, within experimental uncertainty, for all the samples.

2335

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

CONDITIONS ON MODEL-REFERENCE ADAPTIVE SYSTEM INPUT SIGNALS FOR STABLE PERFORMANCE, by J. J. Bongiorno, Jr. Jan. 17, 1961 [27]p. incl. diagrs. refs. (Research rept. no. PIBMRI-886-60) (AFOSR-571) (AF 18(600)1505) AD 258581 Unclassified

An approach to adaptive control system design which does not involve a direct measurement or identification of the variable process parameters is investigated. Convergence-time relationships and sufficient conditions for system stability are developed when the process is characterized by a variable gain or variable time-constant, and fixed dynamics of any order. The adaptive capability is achieved by employing a model as a reference element and by means of appropriate adaptive circuitry. The adaptive circuitry is simple, easily instrumented, and does not require successive differentiations; the primary function of the adaptive circuitry is one of integration. (Contractor's abstract)

2336

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

AN INVESTIGATION OF THE JUNGLE GYM PERIODIC STRUCTURE, by B. Mohr. May 9, 1961, 65p. incl. diagrs. refs. (Research rept. no. PIBMRI-892-61) (AFOSR-792) (AF 18(600)1505) AD 258702 Unclassified

A jungle gym periodic structure, an array of square bars contained within a square waveguide is discussed; it is suitable for use, both, as a linear accelerator, and for high power traveling wave tubes, since heat can be conducted directly to the walls of the guide. Characteristics of the jungle gym, determined experimentally, are the propagation characteristics, internal Q, and coupling impedance. Resonance frequency measurement tangent method, and the perturbation technique, necessary in order to obtain the above-mentioned characteristics, are given. In addition, a structure, the wire loaded cylindrical guide structure, closely related to the jungle gym, is described. Both structures exhibit a slow backward fundamental space harmonic and large bandwidth. Bandwidths obtained for the jungle gym structure, dependent on its periodic length, range from about 2000 to 3600 mc, with an approximate midband frequency of 4700 mc.

2337

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

A REPRESENTATION OF MICROWAVE ONE-PORT CAVITIES, by G. Persky. May 4, 1961, 65p. incl. diagrs. (Research rept. no. PIBMRI-912-61) (AFOSR-797) (AF 18(600)1505) AD 258949 Unclassified

The theoretical basis for representing 1-port cavities by means of a modified Wheeler representation, i.e., a representation which includes transformers, transmission lines, and ideal attenuators, and which more closely resembles a physical cavity, is given. Formulas and techniques for abstracting the pertinent parameters from experimental data are also presented. Two configurations are considered: a simple (empty) cavity and one which is partially loaded with a dielectric material. It is shown that in practical cases both of these cavities, and by inference more complicated ones, can be represented by the same simple network. Experimental results substantiating the theory have been offered. In contrast to the usual RLC representation, the present representation makes it possible to obtain the network parameters, when necessary, from a knowledge of the physical cavity components. In addition, because of the direct relationship which the network parameters bear to the cavity components, the effect on cavity behavior which results when the values of individual components are changed can be readily determined. (Contractor's abstract)

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Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

THE DIRECTIONAL COUPLER CORE OF AN ARBITRARY LOSSLESS, RECIPROCAL 4-PORT, by W. [K.] Kahn and R. L. Kyhl. [1961] [2]p. incl. diagrs. (Research rept. no. PIBMRI-918-61) (AFOSR-996) (In cooperation with Massachusetts Inst. of Tech., Research Lab. of Electronics) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under AF 18(600)-1505 and DA 36-039-sc-78108) Unclassified

Also published in Proc. Inst. Radio Engineers, v. 49: 1699-1700, Nov. 1961.

The ideal directional coupler which might work within a particular 4-port has appeared somewhat reluctant in the sense that no formula was available which would yield the characteristics of this coupler in terms of the conventional parameters of the given 4-port. This report presents the necessary formulas and, in addition, noted the generalizations of the original result which become apparent in the deviation.

2339

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

THE FOURTH SYMPOSIUM ON TEMPERATURE, ITS MEASUREMENT AND CONTROL IN SCIENCE AND INDUSTRY, by H. Farber. May 9, 1961, 6p. (Research rept. no. PIBMRI-915-61) (AFOSR-1078)

(Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under AF 18(600)1505) Unclassified

This is a report on the activities at the Fourth Symposium on Temperature, Its measurement and Control held in Columbus, Ohio, Mar. 27-Mar. 31, 1961. The sessions were divided into 5 categories: (1) Plenary sessions during which background and tutorial type papers were presented, (2) Definitions of temperature and the establishment of temperature scales, (3) Principles and applications of instruments, (4) Applications of measurements in various fields, and (5) Temperature and heat considerations in biophysics. This report gives a sampling of papers presented which dealt with temperatures below 90°K and with some of the basic concepts of temperature and thermometry.

2340

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

EIGENWAVES ON A LATTICE OF SMALL SCATTERERS, by H. Kurss. July 17, 1961, 21p. (Research rept. no. PIBMRI-936-61) (AFOSR-1140) (AF 18(600)1505) AD 261387 Unclassified

Previously, the quantum mechanical Bloch waves in a cubic crystal were analyzed by a cavity or structure constant approach by J. Korringa, W. Kohn (Physica, v. 13: 392, 1947) and N. Rostoker, et al (Phys. Rev., v. 94: 1111, 1954). In the present report, the above method is reformulated to permit the analysis of electromagnetic Bloch waves in artificial dielectrics as well as electromagnetic surface waves on open periodic structures. The analysis, which is particularly appropriate for small scatterers, proceeds as follows. It is shown that a lossless scatterer embedded in a lossless medium can be characterized by a Hermitian matrix R. The lattice structure is then characterized by a structure constant matrix Γ which, in the eigenwave region, is also Hermitian. A dispersion relation for eigenwaves is then obtained as the condition that the determinant of $R-\Gamma$ vanishes. (Contractor's abstract)

2341

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

THE MEASUREMENT OF ARBITRARY LINEAR MICROWAVE TWO-PORTS, by H. M. Altshuler. July 27, 1961, 32p. incl. illus. tables. (Research rept. no. PIBMRI-935-61) (AFOSR-1169) (AF 18(600)1505) AD 264042 Unclassified

Presented at Conf. on Microwave Measurement Techniques, London (Gt. Brit.), Sept. 1961.

Also published in Proc. Inst. Elec. Engineers (London), v. 109B, Suppl. 23: 704-712, 1962.

The measurement of the scattering parameters of linear, but otherwise arbitrary, 2-ports (active, lossless or dissipative and reciprocal or non-reciprocal) by means of an interference bridge is described. Since the measured data form circular loci from which the parameters are then derived, known precision curve fitting techniques are applicable. The various loci which may occur and their characteristics are discussed together with the methods available for distinguishing the proper locus from its inverse. Various methods of balancing the bridge and many of the errors associated with bridge balancing are given. Finally, the deliberate use of bridge imbalance for increasing measurement accuracy is considered.

2342

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

DESIGN STUDY OF A LINEAR ELECTRON ACCELERATOR, by D. Menaker. Aug. 18, 1961, 40p. incl. diagrs. refs. (Research rept. no. PIBMRI-931-61) (AFOSR-1473) (AF 18(600)1505) AD 268734 Unclassified

A linear accelerator incorporating a bar loading structure and utilizing microwave feedback is described. The characteristics of the bar structure required for the design are the attenuation length and the coupling impedance. Methods for obtaining these parameters are discussed and the pertinent measurement techniques are described. The design of the feedback loop is presented and the over-all characteristics of the accelerator with feedback is presented. Beam loading losses are introduced and the resultant output energy is calculated for different values of beam loading. These results are presented in the form of a curve which depicts the output energy as a function of accelerator length with beam loading as a parameter. The over-all system is described with particular mention of the auxiliary equipment needed for operation. (Contractor's abstract)

2343

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

ABSTRACT OPERATOR METHODS IN ELECTROMAGNETIC DIFFRACTION, by N. Marcuvitz. Aug. 22, 1961, 19p. (Research rept. no. PIBMRI-939-61) (AFOSR-1838) (AF 18(600)1505) AD 273025 Unclassified

The essence of a diffraction problem lies in the determination of a far scattered field from a prescribed incident field. In abstract terms, this relation is provided by a transformation operator, the explicit evaluation of which is the central problem of the abstract operator theory. Solution of this problem requires the inversion of an operator characterizing both the scattering region and the scatterer. For general classes of scattering problems it is possible to exhibit certain abstract features of the relevant operators and to derive abstractly therefrom the information corresponding to these features. Examples of such abstract procedures are discussed.

2344

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

BANDWIDTH LIMITING EFFECTS OF FREQUENCY SELECTIVE FADING OVER TROPOSPHERIC SCATTER PATHS, by P. D. Shaft. June 1961, 105p. incl. diagrs. tables, refs. (Research rept. no. PIBMRI-979-61) (AFOSR-1570) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and [Signal Corps] under AF 18(600)1505) AD 282967 Unclassified

A set of design curves of intermodulation distortion due to frequency selective fading was derived for tropospheric scatter systems. These curves are applicable to systems frequency modulated with frequency division multiplexed telephone and telegraph channels. The reduction in distortion due to the use of diversity reception was not calculated, but a general discussion of some of the problems involved in determining the reduction is given. A 2-ray model was selected to derive general results. This, however, restricts the use of the design curves to the region where the information bandwidth is less than the propagation bandwidth. Equations for intermodulation distortion are evaluated using the parameter normally encountered in tropospheric scatter systems. A method of obtaining a probability distribution of distortion is indicated, and an example is worked out in detail. The design curves are compared to experimental measurements of intermodulation distortion due to propagation and agree to a first order approximation. The principal result is the development of design curves which can be used to predict the intermodulation distortion introduced by the tropospheric scatter medium. The intermodulation distortion will exceed thermal noise in many systems. (Contractor's abstract)

2345

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

EFFECTS OF IMPULSE NOISE ON DIGITAL DATA TRANSMISSION, by A. B. Bodonyi. Dec. 11, 1961 [30]p. incl. diagrs. refs. (Research rept. no. PIBMRI-975-61) (AFOSR-1989) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research and [Signal Corps] under AF 18(600)-1505) AD 285511 Unclassified

Represented are the basic characteristics of impulse noise and effects of impulse noise on various types of binary data transmission systems. The sources and properties of such impulse noise, in contrast with gaussian noise are discussed. A method is described for the experimental comparative evaluation of bit error rates in presence of additive impulsive noise. The method is shown to permit unique comparison between the 3 modulation schemes tested, namely on/off carrier, frequency shift and diphase (phase several keying, with coherent detection). The major conclusions drawn for these experiments are: (1) The choice of modulation scheme has a greater effect on the overall error rates in presence of impulse noise than it does for the gaussian case. (2) The simple error-detecting and error-correcting systems, designed to combat the effects of gaussian noise, can be utilized only to a fraction of their theoretical advantage in case of impulse noise. (3) The best results can be obtained from the coherent PSK system at high signal-to-noise ratios. (Contractor's abstract)

2346

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

DIGITAL COMPUTER SIMULATION OF IMPULSE NOISE, by R. V. D'Aiello. Oct. 31, 1961, 81p. incl. diagrs. tables, refs. (Research rept. no. PIBMRI-967-61) (AFOSR-1990) (AF 18(600)1505) AD 283104 Unclassified

A method of using a digital computer to generate probability distributions is described. These distributions can then be used to simulate the effects of impulse noise on the transmission of digital data. The statistics of impulse noise is discussed, and 2 probability distributions are proposed in order to describe these phenomena. (Contractor's abstract)

2347

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

PROCEEDINGS OF THE SYMPOSIUM ON ELECTROMAGNETICS AND FLUID DYNAMICS OF GASEOUS PLASMA, New York, (Apr. 4-6, 1961), Vol. XI, ed. by J. Fox and M. Crowell. Brooklyn, Polytechnic Press, 1962, 468p. incl. illus. diagrs. tables, refs. (AFOSR-3388) (In cooperation with Inst. of Radio Engineers and the Inst. of Aerospace Sciences) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)1505, Office of Naval Research, and Signal Corps) Unclassified

Various aspects of plasma research are covered. Topics discussed include micropic and macroscopic theory, wave phenomena, and shocks and flows.

2348

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

A DUALITY BETWEEN PASSIVE AND REACTIVE SYSTEMS, by H. Kurss. Jan. 1, 1961, 13p. (Research rept. no. PIBMRI-984-61) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under AF 18(600)-1505) Unclassified

Published in Proc. Inst. Elec. and Electronics Engineers, v. 51: 376, Feb. 1963.

The dissipated power of passive components is shown to be dual to the stored energy of reactive components in that both are additive and non-negative. Dual lemmas on a mapping property of passive and reactive 2-port networks are then proved. With the aid of these lemmas some dual theorems are proved in a dual manner.

2349

Polytechnic Inst. of Brooklyn. [Microwave Research Inst.] N. Y.

MOTION OF A CHARGED PARTICLE IN AN AXIALLY SYMMETRIC MAGNETOSTATIC FIELD, by E. Mishkin and C. Rader. [1961] [1]p. [AF 18(600)1505] Unclassified

Published in Phys. Fluids, v. 4: 783, June 1961.

Motion of a particle of mass m and charge q in an axially symmetric magnetostatic field is considered. The magnetic field is defined by a single component vector potential and it is assumed that the field variations over a Larmor radius are small. The motion of the particle consists of the cyclotron rotation around a guiding center, the trajectory of which is derivable from a scalar potential V. The Lagrangian of this magnetic field leads to 3 equations of motion.

2350

Polytechnic Inst. of Brooklyn. [Microwave Research Inst.] N. Y.

SOME MODELS FOR PULSE-INTERVAL MODULATION SYSTEMS, by H. J. Hunt. [1961] [3]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under AF 18(600)1505) Unclassified

Published in Biological Prototypes and Synthetic Systems; Proc. Second Annual Bionics Symposium, Cornell U., Ithaca, N. Y. (Aug. 30-Sept. 1, 1961), New York, Plenum Press, v. 1: 291-293, 1962.

One of the common approaches taken by researchers in bionics interested in translating biological functions into electronic systems is the development of models which simulate various types of biological phenomena. The present work describes the development and operation of a model of a "neuromime". The approach used is that of simulating some of the functions of sensory receptors as closely as possible with an electronic device. The model consists of a pulse generator, a sweep-generator feedback element which is triggered from output pulses, and a summer. To simulate a spontaneously operating neuron or receptor, all that is required is to apply a single constant dc input sufficient to raise the output of the summer above the threshold. To simulate an adapting type of receptor, decaying exponentials are used as inputs. Multiple pulse inputs are used to simulate neural functions. In general, to simulate almost any neural output pattern that has been observed, it is usually sufficient to calculate beforehand the required input that will give rise to the desired response.

2351

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

A NOTE ON THE THEORY OF THE DIRECTIONAL COUPLER (Abstract), by W. [K.] Kahn. Sept. 25, 1961, 2p. (Rept. no. 952) (Bound with its AFOSR-5249) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under AF 18(600)1505) Unclassified

A connection is exhibited between the directional coupler core of an arbitrary, non-degenerate lossless, reciprocal 4-port and the theory of the cross-ratio.

2352

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

THE REACTANCE THEOREM FOR N-PORT NETWORKS, by H. Kurss. Oct. 9, 1961, 9p. (Research rept. no. PIBMRI-954-61) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under AF 18(600)1505) Unclassified

The reactance theorem is stated for an N-Port network in a form which treats the external parameters symmetrically and which makes no reference as to the manner in which the frequency parameter ω occurs. This is then specialized to various matrix representations of an N-port. Finally, some properties of reactance matrices are discussed.

2353

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

DISSIPATION IN UNIFORM (DIELECTRIC FILLED) WAVEGUIDES, by G. Persky. Oct. 17, 1961, 9p. (Research rept. no. PIBMRI-946-61) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under AF 18(600)1505) Unclassified

Standing waves in a waveguide with dielectric and/or metal wall losses generally give rise to expressions for power dissipation per unit length containing a term which is a sinusoidal function of the distance along the waveguide. In the present memorandum this phenomenon is explained and expressions of the dissipation are derived. The development is carried out for TE and TM modes in a uniform dielectric filled waveguide or arbitrary cross section, and then again from the standpoint of transmission line theory. The practical implications of the results are discussed.

2354

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

VISIT TO LABORATORIES IN ENGLAND, by H. M. Altschuler. Oct. 23, 1961, 29p. (Research rept. no. PIBMRI-961-61) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under AF 18(600)1505) Unclassified

In September 1961, the author paid a day's visit to each of 7 laboratories in England to gain information in the field of microwaves; in particular, microwave measurement techniques and masers. Consequently, the projects seen are not necessarily representative of all the work being carried out at these installations. Depending on circumstances, the information gathered ranges from the sketchy to the more or less complete.

2355

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

DC EFFECTS IN FERROMAGNETIC RESONANCE IN THIN FERRITE FILMS, by W. Heinz and L. [M.] Silber. Oct. 30, 1961 [7]p. incl. diagrs. table. [Research rept. no. PIBMRI-966-61] (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under AF 18(600)1505) Unclassified

Published in Jour. Appl. Phys. Suppl., v. 33: 1306-1307, Mar. 1962.

The dc voltage which accompanies ferromagnetic resonance has been observed in thin films of magnetite. The dependence of this voltage on microwave power and static magnetic field is in qualitative agreement with theory, but larger by a factor of 3. (Contractor's abstract)

2356

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

THE UNIQUENESS OF THE LOSSLESS FEED NETWORK FOR A MULTIBEAM ARRAY, by W. K. Kahn and H. Kurss. [1961] [2]p. incl. diagr. (Rept. no. 942) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)1505, Office of Naval Research, and [Signal Corps]) Unclassified

Published in I. R. E. Trans. on Antennas and Propagation, v. AP-10: 100-101, Jan. 1962.

This note demonstrates that the particular lossless multibeam antenna feed network is essentially unique. A multibeam antenna produces a number of similar beams disposed to cover an angular sector. A feed network ideally suited to such an antenna array would certainly be lossless, provide good isolation among input channels, and efficiently utilize the available aperture. (Contractor's abstract)

2357

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

STABILITY AND CONVERGENCE PROPERTIES OF MODEL-REFERENCE ADAPTIVE CONTROL SYSTEMS, by J. J. Bongiorno, Jr. [1961] [12]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under AF 18(600)1505) Unclassified

Published in I. R. E. Trans. on Automatic Control, v. AC-7: 36-41, Apr. 1962.

An approach to adaptive control system design which does not involve a direct measurement or identification of the variable process parameters is investigated. Convergence-time relationships and sufficient conditions for system stability are developed when the process is characterized by a variable gain or variable time-constant, and fixed dynamics of any order. The adaptive capability is achieved by employing a model as a reference element and by means of appropriate adaptive circuitry. The adaptive circuitry is simple, easily instrumented, and does not require successive differentiations; the primary function of the adaptive circuitry is one of integration. (Contractor's abstract)

2358

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

NETWORK THEORY OF SEMICONDUCTOR HALL PLATE CIRCUITS, by J. M. Garg. June 1961, 110p. incl. diagrs. tables, refs. (Research rept. no. PIBMRI-868-61) (AFOSR-693) (AF 18(603)105) AD 257934 Unclassified

Investigation was concerned with the study of properties and synthesis of passive electrical networks which contain Hall plates as nonreciprocal elements. Network representations of these elements which are dissipative and linear and exhibit nonreciprocity, and the optimum performance of these elements when used in a suitable connection with other conventional network elements are the major topics of interest.

2359

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

SHORT-TIME STABILITY IN LINEAR TIME-VARYING SYSTEMS, by P. Dorato. May 9, 1961, 61p. incl. diagrs. (Research rept. no. PIBMRI-908-61) (AFOSR-748) (AF 18(603)105) AD 258397 Unclassified

Presented at I. R. E. Internat'l. Convention, New York, N. Y., Mar. 20-23, 1961.

Also published in I. R. E. Internat'l, Convention Record, Pt. 4: 83-87, 1961.

Short-time stability is investigated in linear time-varying systems. Elements of linear time-varying analysis required are reviewed and special emphasis is placed on the impulse response w(t, τ) and the representation of undriven systems in the matrix differential form: $\dot{y} = \underset{\sim}{A}(t)\,\underset{\sim}{y}$. Undriven systems are discussed as an extension of Chzhan-sy-in's work in linear time varying systems. Sufficient conditions for short-time stability are expressed in terms of the coefficient matrix $\underset{\sim}{A}(t)$. Necessary and sufficient conditions for short-time stability are stated in terms of the impulse response, w(t, τ) for driven systems. The concept of short-time C-equivalence, essentially a structural stability concept, is introduced and conditions for the C-equivalence of 2 systems are given in terms of their impulse responses. Examples are included to illustrate the various theorems and indicate the range of applicability of the concept of short-time stability. Proofs of theorems used are given and an analysis of the results obtained along with suggestions for additional study are presented.

2360

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

STABILITY ANALYSIS OF TWO-PARAMETER CONTROL SYSTEMS, by M. L. Shooman. June 1961, 96p. incl. diagrs. tables, refs. (Research rept. no. PIBMRI-920-61) (AFOSR-997) (AF 18(600)1505 and AF 18(603)105) AD 260044 Unclassified

This dissertation treats the problem of stability in 2 parameter control systems. The 2 parameters may be loop-gains, time constants, natural frequencies, damping constants, or describing function gains representing system nonlinearities. The limitations of single parameter analysis techniques are discussed and parameter plane analysis introduced. The 2 system parameters are plotted along the coordinate axes in the parameter plane. The left-half-plane and the j omega axis of the s-plane are mapped into a stable region and a stability boundary respectively, in the parameter plane. The parameter plane plot delineates the ranges of the 2 system parameters that yield stable operation. The Routh Table or other similar stability criteria are used to obtain the stability boundary in the parameter plane. Using appropriate mapping transforms, performance boundaries may be obtained. These transformations allow a mapping of lines of constant sigma in the left-half plane into the parameter plane. Analog computer methods are discussed that allow experimental location of stability and performance boundaries in complex problems. The parameter plane method of analysis was applied to a system with 2 nonlinearities. Three means of analyzing 3 and more parameter systems are also discussed.

2361

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

ON THE OPTIMUM DESIGN OF PREDICTOR CONTROL SYSTEMS, by S. Horing. Aug. 24, 1961, 79p. incl. diagrs. refs. (Research rept. no. PIBMRI-945-61) (AFOSR-1412) (AF 18(603)105) AD 265275 Unclassified

The basic optimization problem of Predictor Control Systems is viewed, in very general terms, as a problem in decision theory. Based on available information. the decision must be made as to which of the allowable control signals should be applied to the plant in order to achieve the optimum performance. A sum of squared error criterion is used to define the optimum in order to reduce the problem to a problem in linear decision theory. A piecewise-linear Control Boundary is found which can be used to generate the desired control signal. The realization of this Control Boundary is shown to be straight-forward and inexpensive. This technique can be applied to fixed linear plants of arbitrary order. A linear approximation to the optimum Control Boundary is discussed. The practical advantages of such an approximation are shown to be considerable.

2362

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

STABILIZATION OF MULTILOOP SYSTEMS VIA THE SENSITIVITY FUNCTION, by R. Haddad. Aug. 30, 1961, 120p. incl. diagrs. tables. (Research rept. no. PIBMRI-944-61) (AFOSR-1420) (AF 18(603)105) AD 265276 Unclassified

The stabilization of multiloop systems against individual variations in 1 or more of the system parameters is studied. A correlation between the stability of a multiloop configuration and the real-frequency behavior of the sensitivity function is derived. From this relationship, a set of stability margins is developed which provide a quantitative measure of the destabilizing effects of variations in each parameter. The margins, referred to as parameter gain and phase margins are shown to be generalizations of the familiar gain and phase margins of the single-loop, servo system. The design objective is the realization of a set of specified stability margins; the relationship between these margins and the real-frequency behavior of the associated sensitivity functions gives rise to specification of the sinusoidal response of compensation networks at a set of discrete frequencies. (Contractor's abstract)

2363

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

THE SIGNIFICANCE OF SENSITIVITY IN FEEDBACK

SYSTEM STUDIES, by W. A. Lynch and J. G. Truxal. June 1, 1961, 107p. incl. diagrs. (Research rept. no. PIBMRI-866-60) (AFOSR-1540) (AF 18(603)105) AD 273024 Unclassified

The sensitivity function is the fundamental measure of the effectiveness of feedback, in controlling the effects of both parameter variations and unwanted noise signals. After a preliminary discussion of the significance of the sensitivity function, methods for the simple calculation of the sensitivity are presented: methods valid whenever the over-all transmission is a bilinear function of the varying parameter (thus, whenever the parameter is a circuit element or the transmittance of a controlled source). The sensitivity function yields simple evaluations of the parameter margins, the amount by which specific parameters must be varied to cause system instability. The parameter margins can be evaluated directly from the frequency-domain plots utilized in normal system design. This interpretation of the sensitivity function is of importance not only in the logical design for simultaneous control of several sensitivity functions, but also in the identification problem. Extensions to the study of nonlinear systems can be effected if a frequency-independent describing function can be defined. (Contractor's abstract)

2364

Polytechnic Inst. of Brooklyn. [Microwave Research Inst.] N. Y.

CASCADE SYNTHESIS OF NONRECIPROCAL LOSSLESS 2-PORTS, by W. L. Rubin and H. J. Carlin. [1961] [8]p. incl. diagrs. (AFOSR-4211) (AF 18(603)-105) Unclassified

Also published in I. R. E. Trans. on Circuit Theory, v. CT-9: 48-55, Mar. 1962.

Necessary and sufficient conditions for the synthesis of nonreciprocal lossless n-ports are shown also to be necessary and sufficient for the realization of a nonreciprocal lossless 2-port as a cascade of reciprocal and nonreciprocal lossless 2-ports. Nonreciprocal transmission zeros are realized by 4 canonic nonreciprocal 2-ports, which are analogous to the Darlington A, B, C, D networks that are required for realization of reciprocal transmission zeros. (Contractor's abstract)

2365

Pomona Coll. Dept. of Physics, Claremont, Calif.

ULTRASOFT X-RAY MICROSCOPY, by B. L. Henke. May 1961, 20p. incl. illus. diagrs. table, refs. (Technical rept. no. 4) (AFOSR-970) (AF 49(638)-394) AD 258678 Unclassified

Also published in Encyclopedia of Microscopy, New York, Reinhold Publishing Corp., 1961, p. 675-693.

The resolution of projection and contact x-ray microscopy is comparable to that of light microscopy. Nevertheless both forms of x-ray microscopy have had the traditional advantages: (1) capability for measurement of structural detail within optically opaque materials, (2) capability for measurement of thickness and depth of microscopic structure through stereographic analysis by virtue of a very great depth of field; and (3) capability for quantitative measurement of mass and elementary chemistry of microscopic systems through microabsorption techniques. These advantages are gained for micron-sized systems and for the lighter element materials through the use of x-radiations in the 10 to 50A region. With the ultra-soft x-rays the necessary absorption signal is obtained along with a greatly simplified relationship between sample transmission and the sample mass and chemistry. Methods and instruments which have been developed for quantitative contact microradiographic analysis are described here.

2366

Pomona Coll. [Dept. of Physics] Claremont, Calif.

MEASUREMENT IN THE 10 TO 100 ANGSTROM X-RAY REGION, by B. L. Henke. July 1961 [36]p. incl. illus. diagrs. refs. (Technical rept. no. 5) (AFOSR-1219) (AF 49(638)394) AD 262302 Unclassified

Also published in Advances in X-Ray Analysis, v. 4: 244-279, 1961.

The results of recent work of the Millikan Laboratory of Physics on the physics and application of ultrasoft x-radiations are summarized. These investigations include (1) the compilation of ultrasoft x-ray interaction coefficients, (2) the development of high-intensity, low-voltage x-ray tubes (100 to 1000 v), (3) the application of pulse-height analysis in flow proportional counter measurement of 10 to 100A radiations, (4) a detailed study of the photographic action of the ultrasoft x-radiations, and (5) the application of these long wavelength x-radiations to micromass and microchemical analysis by microradiographic and total-reflection techniques. (Contractor's abstract)

2367

Pontifical Catholic U. of Rio de Janeiro (Brazil).

EULER'S CONTINUOUS FRACTION EXPANSION AND ITS APPLICATION IN ELECTRICAL CIRCUIT THEORY, by E. P. Braga and T. Oniga. 1961 [31]p. incl. diagrs. tables. (AFOSR-1225) (AF 49(638)648) AD 271922 Unclassified

The use of continued fraction expansions in network theory is well known. An infinite continued fraction expansion, like an infinite series, can be calculated only by means of approximations. The convenience, for practical purposes, of a given expansion, depends on the degree of successive approximations. This problem is discussed for the case of Euler's infinite fraction expansion for the exponential expression

exp(1/z) which provides a particularly interesting example for the analytic and circuit representation of highly singular systems. (Contractor's abstract)

2368

Pontifical Catholic U. of Rio de Janeiro (Brazil).

GAMMA IRRADIATION EFFECTS ON ELECTRETS, by B. Gross and R. J. De Moraes. [1961] [3]p. incl. diagrs. (AFOSR-3210) (AF AFOSR-60-6) Unclassified

Also published in Phys. Rev., v. 126: 930-932, May 1, 1962.

Carnauba wax electrets were irradiated with gamma rays from a Co^{60} source. Doses varied between 0 and 5 megaroentgen (Mr). After irradiation the polarization of the electrets was determined by reheating them in short circuit and measuring the released charge. This charge was found to decrease roughly exponentially with dose, with a decay constant of the order of 1 Mr. A background effect due to Compton polarization is described. (Contractor's abstract)

2369

Pontifical Catholic U. of Rio de Janeiro (Brazil).

ELECTRICAL IRRADIATION EFFECTS IN SOLID DIELECTRICS, by B. Gross and P. V. Murphy. [1960] [7]p. incl. illus. diagrs. refs. (AFOSR-3466) (AF AFOSR-60-6) Unclassified

Also published in Nukleonik, v. 2: 279-285, Dec. 1960.

A review of work, mainly by the authors, of electrical breakdown and space charge storage effects induced by electrical bombardment in polymers (Plexiglas) and borosilicate is presented. Related topics discussed include differential range distributions of electrons, β-particle transmission currents in solid dielectrics, the thermovoltaic effect and Compton current in γ-irradiated dielectrics, γ-powered detectors and power sources, and current production by neutrons and neutron dosimetry.

2370

Pontifical Catholic U. of Rio de Janeiro (Brazil).

[CHARGE STORAGE AND IRRADIATION EFFECTS IN SOLID DIELECTRICS] by B. Gross. Final rept. Dec. 21, 1961, 16p. incl. diagrs. tables. (AF AFOSR-60-6) Unclassified

Measurements on the volume polarization of the electret clearly indicate that all sections of a polarized sample, when reheated under identical conditions, release the same amount of charge as the corresponding non-sectioned sample; therefore, their polarizations must all have been identical. It follows that the electret possesses a uniform volume polarization. The present measurements have brought out this fact for the first time. Depolarization of electrets by gamma radiation was accomplished and physical measurements indicate that irradiation depolarizes the electret according to an exponential law. A dose of 1 megaroentgen reduces the original polarization roughly to a fraction 1/e.

2371

Princeton U. [Chemical Engineering Lab.] N. J.

STABILIZATION OF ENERGY-RICH MOLECULES. II. ENERGY TRANSFER WITH PARAFFIN HYDROCARBONS, by B. Stevens and M. Boudart. Jan. 1961 [24]p. incl. diagrs. refs. (AFOSR-158) (AF 49(638)-32 and AF 33(038)23976) AD 255157 Unclassified

The energy transfer between vibrationally excited β-naphthylamine vapor and paraffin hydrocarbons (CH_4 to C_6H_{14}) was studied by measuring the enhancement of fluorescence of the aromatic molecule due to stabilizing collisions. The accomodation coefficient characterizing the efficiency of energy transfer in this type of collision increases linearly with the molecular weight when the vibrational modes of the stabilizing gas participate significantly in the exchange of energy. This result was previously found in the case of thermal accommodation of paraffins at nickel surfaces. The parallelism between the two phenomena is emphasized. (Contractor's abstract)

2372

Princeton U. Chemical Engineering Lab., N. J.

RATES OF EVAPORATION OF LIQUIDS, by M. Boudart. Mar. 1961, 12p. (AFOSR-464) (AF 49(638)-32) AD 255155 Unclassified

The rate of evaporation of a pure liquid at temperature T into a vacuum is shown to be equal to $\alpha \cdot c \cdot n_s$ where α is a coefficient depending on equilibrium molecular properties, c is 1/4 the gas-kinetic mean velocity of the molecules at temperature T, and n_s is the number density of the vapor molecules in equilibrium with the liquid at T. This result is not new. Its derivation and underlying assumptions are of considerable theoretical interest. Previous derivations which have led to similar or slightly different results are discussed. (Contractor's abstract)

2373

Princeton U. [Chemical Engineering Lab.] N. J.

MOLECULAR PROBLEMS IN HEAT AND MASS TRANSFER, by M. Boudart. Final rept. Oct. 30, 1956 - June 30, 1961, 2p. (AFOSR-2383) (AF 49-(638)32) Unclassified

This final report lists some of the accomplishments achieved as a result of the support given under this contract. It lists the degrees granted during the

contract's duration. The papers published and technical notes are also listed. The main accomplishments include a definitive study of the Kantrowitz impact tube method of studying relaxation times, the confirmation of interfacial resistance at liquid surfaces, and a new theory of surface diffusion and its importance in catalysis.

2374

Princeton U. [Dept. of Aeronautical Engineering] N. J.

HIGH SPEED AERODYNAMICS AND JET PROPULSION. VOLUME IV. THEORY OF LAMINAR FLOW, ed. by F. K. Moore. Princeton U. Press, 1964 [1960] 869p. incl. illus. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research Office of Naval Research, and Office of Ordnance Research under Nonr-03201) Unclassified

The present volume is concerned with fluid motions which are influenced in an important way by viscosity and heat conductivity of the flowing substance. The fluid is regarded as a continuum in which the resistance to shearing motion and the conduction of heat arise by exchange processes occurring on a molecular scale. When viscous and conductive effects arise from this cause, the motion is said to be laminar, as distinct from turbulent motion, in which macroscopic eddies are responsible for high rates of transfer of momentum and energy. These turbulent motions are treated in Volume V of the High Speed Aerodynamics and Jet Propulsion series. (Item no. 2375, Vol. V).

2375

Princeton U. [Dept. of Aeronautical Engineering] N. J.

HIGH SPEED AERODYNAMICS AND JET PROPULSION. VOLUME V. TURBULENT FLOWS AND HEAT TRANSFER, ed. by C. C. Lin. Princeton U. Press, 1959, 549p. incl. illus. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Office of Ordnance Research under Nonr-03201) Unclassified

This volume deals with the interrelated problems of turbulent flow and heat transfer. It begins with an article on transition from laminar to turbulent flow. This is followed by a discussion of the problem of shear flow from the experimental and semi-empirical points of view and of the statistical theory of turbulence from a deductive point of view. Future developments in knowledge should result in the merging of these 2 approaches into a comprehensive and unified treatment. The 3 modes of heat transfer - conduction, convection, and radiation - are presented in the remaining part of this volume. These articles are especially oriented toward high speed flows with high temperature differences. Free convection due to gravitational forces is considered in this portion of the volume only in connection with boiling heat transfer. In the sections on the physical basis of radiation and on the method of engineering calculations in radiant heat exchange, it is an interesting reflection on the current status of the knowledge in this important field that these phases of the problem are presented from somewhat different points of view.

2376

Princeton U. [Dept. of Aeronautical Engineering] N. J.

HIGH SPEED AERODYNAMICS AND JET PROPULSION. VOLUME VIII. HIGH SPEED PROBLEMS OF AIRCRAFT AND EXPERIMENTAL METHODS, ed. by A. F. Donovan, H. R. Lawrence and others. Princeton U. Press, 1961, 976p. incl. illus. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Office of Ordnance Research under Nonr-03201) Unclassified

This volume of the Princeton series has as its intention the completion of the present discussion of the aerodynamics of high speed aircraft and missiles which starts in Volume VI (item no. PRL 12:001, Vol. I) and is carried further in Volume VII (item no. PRL 12:005, Vol. II). The first portion is concerned with aircraft design problems that are particularly associated with high speeds. An introductory discussion of the type of performance calculation peculiar to high speed aircraft is followed by a section devoted to the problems of stability and control at high speeds. The final section of this portion is a rather complete treatise on the problems of aeroelasticity which are encountered with high speed aircraft. The second portion of the volume is concerned with the techniques of aerodynamic testing in wind tunnels and shock tubes. Consideration is given not only to testing techniques in the 3 speed ranges - transonic, supersonic, and hypersonic - but also to facilities for testing in the regime of rarefied gas dynamics. The final portion of the volume is devoted to a discussion of free flight techniques. A discussion of the basic techniques of instrumented rocketry is followed by a section on the testing of piloted aircraft. The final section is a treatise on free flight range techniques.

2377

Princeton U. [Dept. of Aeronautical Engineering] N. J.

HIGH SPEED AERODYNAMICS AND JET PROPULSION. VOLUME X. AERODYNAMICS OF TURBINES AND COMPRESSORS, ed. by W. R. Hawthorne. Princeton U. Press, 1964 [1960] 616p. incl. illus. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Office of Ordnance Research under Nonr-03201) Unclassified

This volume deals with the problems of the flows in gas turbines and compressors. Such flows are complex, and there is an obvious difficulty in any attempt to describe comprehensively the flow in say, a compressor or a turbine in an exact and rigorous fashion. The choice of topics for the Sections and each author's treatment of any one topic reflect this difficulty. Originally, the application of aerodynamic theory to flow through axial compressors and turbines followed

the blade element theory of propellers. Sections B, E, G, and K which discuss sub- and supersonic flow and unsteady flow in cascades develop this approach. The next step, that of describing the 3-dimensional aspects of the flow, is exemplified in the ideal flow theory developed in Section C. In Sections F and H the attempt is made to describe more completely the flow in axial compressor and turbine stages. With each step toward the final goal the approximations required increase and the unsatisfactory gaps in exact knowledge become more obvious.

2378

Princeton U. [Dept. of Aeronautical Engineering] N. J.

HIGH SPEED AERODYNAMICS AND JET PROPULSION. VOLUME XI. DESIGN AND PERFORMANCE OF GAS TURBINE POWER PLANTS, ed. by W. R. Hawthorne and W. T. Olson. Princeton, Princeton U. Press, 1960, 563p. incl. illus. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Office of Ordnance Research under Nonr-03201) Unclassified

This volume, XI, and its companion, Volume X (item no. 2377, Vol. V) comprise a treatment of the aircraft gas turbine power plant. In particular, the 2 volumes discuss the major engine components - compressor, combustor, turbine, and controls - with a view toward describing, explaining, and interpreting the basic phenomena influencing their design and operation. The main subjects in Volume XI are combustion, mechanical and metallurgical aspects, and performance and control.

2379

Princeton U. [Dept. of Aeronautical Engineering] N. J.

HIGH SPEED AERODYNAMICS AND JET PROPULSION. VOLUME XII. JET PROPULSION ENGINES, ed. by O. E. Lancaster. Princeton U. Press, 1959, 799p. incl. illus. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Office of Ordnance Research under Nonr-03201) Unclassified

This volume considers those principles and problems encountered in combining components to form a complete engine. It relies heavily upon the other volumes which deal with basic principles or principles and problems related to components of an engine. Section A gives a concise history of the development of rockets and air flow jet engines. Section B gives definitions of thrust and various efficiencies and derives relationships for the performance of the different jet propulsion systems. Section C gives the performance analysis of turbojets based on the internal solution of matching the compressor, combustor, turbine, and nozzle. It includes a discussion of off-design performance and describes the problems of control and testing which are unique to a complete unit. Section D treats the turboprop in a somewhat similar manner. It gives the logic for interest in a turboprop and discusses the additional complications. Section E is devoted to the ramjet, its performance, controls, and methods of testing. Section F discusses the wave engines in general, and in particular the pulse jet and the comprex. Section G treats the liquid rocket engine, from the consideration of appropriate fuels to the designing and testing of the motor. Section H gives a similar treatment for solid propelled rockets, with special stress on the stability and characteristics of burning. The possibility of a variety of hybrid engines, part rocket, part turbine, or more generally, part jet and part rotating machinery, is introduced in Section I and J which treat 2 such cases - the ramjet and the jet rotor. Each section derives the possible performance and outlines the possible use of these engines. Section K deals with the problems in making a nuclear jet power plant suitable for aircraft. It gives the theory related to the shielding, heat transfer, and the production and control of a small lightweight reactor. The final section does not quite give a peek into the future, but it gives a systematic procedure for exploring the many possibilities of the types of jet engines.

2380

Princeton U. [Dept. of Aeronautical Engineering] N. J.

THEORETICAL SOLUTIONS TO SOME NEARLY FREE MOLECULAR PROBLEMS, by D. R. Willis. [1960] [12]p. incl. table. (AFOSR-3417) (AF 18(600)498) Unclassified

Also published in Rarefied Gas Dynamics; Proc. First Symposium, Nice (France) (July 1960), New York, Pergamon Press, v. 3: 246-257, 1961.

In this paper, the problem of Couette flow is solved using integral methods and a general method of attacking problems in the nearly free molecular regime is proposed. This method is based on a limited collision model. It appears equivalent to a first approximation to the integral type of solution, valid for nearly free molecular conditions.

2381

Princeton U. Dept. of Aeronautical Engineering, N. J.

ANALYSIS OF LONGITUDINAL HIGH FREQUENCY COMBUSTION INSTABILITY IN A GAS FUELED ROCKET MOTOR, by H. G. Bortzmeyer and L. Crocco. Dec. 5, 1961 [44]p. incl. diagrs. refs. (Rept. no. 587) (AFOSR-1957) (AF 18(600)1527) AD 270745 Unclassified

A theoretical investigation of the stability boundary for longitudinal high frequency oscillations in a gas fueled rocket motor has been carried out. It was based on the following assumptions: (1) the mechanism responsible for combustion instability involves oscillatory heat transfer to the injector plate; and (2) the rates of chemical reactions in homogeneous gas phase are high enough to enable the chemical system to respond without phase lag to periodic variations of the conditions

in the chamber. Under these assumptions the equations governing the propagation of small pressure perturbations in the combustion chamber were derived, and oscillatory solutions of the type were found. By applying proper boundary conditions to these solutions a so-called characteristic equation for the unknown complex quantity s has been derived. Numerical solutions have been carried out for the relatively simple case of moderate frequency oscillations taking place in a chamber ended by a short nozzle.

2382

Princeton U. Dept. of Aeronautical Engineering, N. J.

COMBUSTION PROCESSES IN LIQUID PROPELLANT ROCKET MOTORS, by I. Glassman. Final rept. Sept. 1, 1955 - Aug. 31, 1960. Dec. 20, 1961, 5p. incl. refs. (AFOSR-2059) (AF 18(600)1527) AD 272924 Unclassified

The high pressure combustion process of liquid sprays, the light scattering technique for the measurement of droplet spray characteristics, the chemical reaction rate data of fundamental reactions, and the use of gaseous propellants to determine chemical influences on combustion instability were studied. An apparatus was developed that permits the investigation of the combustion of droplet sprays under a wide range of pressure and temperature conditions. In order to follow the history of the burning droplets a light scattering technique was developed which permits the determination of a mean droplet size and concentration. In the course of the light scattering work significant contributions were made to the field of photographic photometry. A new type flow reactor was developed for the measurement of high temperature reaction kinetics. Thorough experimental and analytical investigations of ethylene oxide decomposition were carried out. Similarly high temperature hydrogen-oxygen kinetic rates were determined. The range of temperature covered was the same as that of interest to those working in the field of supersonic combustion. Although the handling of gaseous hydrazine proved very difficult and no experimental results could be obtained within the period of the subject contract, concern with this subject led to a complete theoretical investigation of hydrazine that has proved of great interest to those working in the propellant field. It became evident during the course of the investigation on chemical influences in combustion instability that chemical kinetics could not be a controlling influence, but that some physical phenomenon like heat transfer to the injector was the important factor. Some recirculation effects were investigated as well.

2383

Princeton U. Dept. of Aeronautical Engineering, N. J.

THE IGNITION MECHANISM OF COMPOSITE SOLID PROPELLANTS, by R. F. McAlevy, III. June 1, 1961 [139]p. incl. illus. diagrs. tables, refs. (Rept. no. 557) (AFOSR-1220) (AF 49(638)411) AD 263440 Unclassified

Evidence points to gas phase heat evolution as the controlling mechanism for the steady-state deflagration process of solid propellants. Generally, this takes the form of a measured decrease of the ignition time lag with increasing oxygen concentration of the ignition gas. The study of this effect in the ignition of NH_4ClO_4 composite propellants is discussed. The shock tube was selected as the basic tool for this research. All of the quantitative experiments, designed to verify the gas phase ignition theory were executed by exposing small specimens of propellants to an instantaneous, controlled, heat input. This was accomplished by reflecting impinging shock waves from their exposed, flat, surfaces. As the igniting gas composition was vitiated with N the measured ignition time lags increased from a few hundred microseconds in a mixture of 100% O2, 0% N2, to 5 milliseconds in a mixture of 40% O2, 60% N2. This evidence led to an ignition mechanism based on a gas phase heat release due to the reaction between the vaporized fuel component of the propellant and the oxygen component of the ignition gas. (Contractor's abstract)

2384

Princeton U. Dept. of Aeronautical Engineering, N. J.

RESEARCH ON THE IGNITION OF SOLID PROPELLANTS, by C. E. Hermance, J. Wenograd, and K. P. Hall. Final technical rept. May 15, 1958 - Sept. 30, 1961. Dec. 1961, 8p. (Rept. no. 588) (AFOSR-1960) (AF 49(638)411) AD 270112 Unclassified

Studies of the mechanism of solid propellant ignition have been in progress at Princeton for four and one-half yr. The most significant achievement has been the development of a theory which postulates that the site of a runaway exothermic reaction which constitutes ignition is in the gas phase. Previous theories have assumed that ignition occurs as a consequence of self heating within the solid phase. During the course of the contract a body of data has been acquired which strongly supports this gas phase ignition theory.

2385

Princeton U. [Dept. of Aeronautical Engineering] N. J.

FUNDAMENTAL STUDIES OF SOLID PROPELLANT IGNITION (Abstract), by M. Summerfield, R. F. McAlevy, III and others. [1961] [2]p. incl. table. [AF 49(638)411] Unclassified

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

The mechanism of ignition of solid propellants has been under investigation at Princeton since 1957. To date, the energy source for ignition has been hot gas generated in a shock tube. The authors feel that the discrepancies in magnitude between the predicted and observed exponents of Z_o (effect of oxygen weight fraction) and p probably are indications that the assumption of second order gas phase kinetics is too

simplified. It is felt that the data lend powerful support to the gas phase ignition theory. Conductive heating ignition experiments have also been performed on a typical double base propellant. For this case, τ (ignition time) is dependent upon Z_o suggesting that double base ignition also involves a gas phase mechanism. In an effort to extend experiments into a regime of higher heat input, so that the gas phase ignition concept may be tested under conditions more closely resembling those in a practical rocket motor, a new experiment configuration is being developed in which a sting-mounted round-nose propellant model will be exposed to convective heating by a supersonic gas downstream of the nozzle of a shock tunnel.

2386

Princeton U. [Dept. of Aeronautical Engineering] N. J.

PROPELLANT IGNITION AND IGNITER CHARACTERISTICS (Abstract), by M. Summerfield, R. W. Lancaster and others. [1961] [2]p. incl. diagr. [AF 49(638)411] Unclassified

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

The objective being pursued under this contract is to study in a well-controlled fashion the ignition of small solid propellant grains in a configuration which resembles that in a practical solid rocket motor. A gaseous ignition system was selected as the ignition stimulus for the first phase of this research. Appropriate mixtures of methane, oxygen, and nitrogen are injected into a small gas rocket and ignited by a spark. The combustion products emerging from the nozzle of the gas motor then will flow through the inner perforation of a small case-bonded internal burning solid propellant grain, and will ignite it by convective heating. By selection of appropriate values of the mass flow rate of gas, the gas composition, the throat area of the exhaust nozzle downstream of the solid propellant grain, and the port diameter of the grain itself, the following parameters can be independently and readily controlled: (1) the chemical reactivity of the igniting gases, (2) the dummy chamber pressure, (3) the temperature of the igniting gas, and (4) the gas velocity over the propellant surface. An apparatus utilizing such an ignition system has been constructed, test propellant grains have been fabricated successfully, and testing will begin shortly.

2387

Princeton U. [Dept. of Aeronautical Engineering] N. J.

SOLID PROPELLANT ROCKET INSTABILITY AND RELATED FUNDAMENTAL EXPERIMENTS (Abstract), by M. Summerfield and R. H. W. Waesche. [1961] [1]p. [AF 49(638)411] Unclassified

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

The instability observed in the past in solid propellant rocket motors can be conveniently divided into 3 classes, according to the frequencies observed. The high frequency class spans the range from 500 to 30,000 cps and more, and has been associated with transverse acoustic modes. The intermediate range runs from 50 to 1500 cps and is associated with the longitudinal modes. The low frequency class is usually less than 100 cps and is much lower than an identifiable acoustic frequency. To understand the basic process that leads to unstable burning and the mechanism of action of the various suppressants, a number of important experiments have been performed. One shows that the region of interaction between the acoustic field and the combustion process lies in the reaction zone near the burning propellant surface. Another shows that the pressure inaction is much more powerful for building up the oscillations than a velocity interaction. A third shows that the contribution to the acoustic energy from combustion interactions in the burned gas in the chamber port is probably negligible. All this evidence points to the necessity of determining the nature of the interaction between the burning process at the surface and the acoustic field in the chamber in a quantitative manner. The pertinent property is the acoustic impedance of the flame zone, or what has been termed the response ratio. The present indications are that quantitative measurements above 1000 cps will be extremely difficult to achieve.

2388

Princeton U. [Dept of Aeronautical Engineering] N. J.

IGNITION OF DOUBLE BASE SOLID ROCKET PROPELLANTS, by R. F. McAlevy, III, and M. Summerfield. [1961] [4]p. incl. diagrs. refs. (AF 49-(638)411) Unclassified

Published in ARS Jour., v. 32: 270-273, Feb. 1962.

The results of ignition tests of 3 different double base propellants performed by means of a shock tube technique are presented. The measured ignition delay of these propellants decreased with increasing chemical reactivity and with increasing pressure level of the surrounding gaseous environment. This behavior is strikingly similar to that previously observed when a series of composite propellants were so tested. Recently, it was demonstrated that the ignition of composite propellants takes place via a gas phase, vis-a-vis solid phase, heat release mechanism. The present results constitute strong evidence that double base propellants also ignite via a gas phase mechanism and that oxygen in the igniting gas participates in this mechanism.

2389

Princeton U. [Dept. of Aeronautical Engineering] N. J.

A STUDY OF THE LEADING EDGE OF A SHOCK INDUCED BOUNDARY LAYER, by M. Sichel. Mar. 1961 [115]p. incl. diagrs. tables, refs. (Rept. no. 540) (AFOSR-628) (AF 49(638)465) AD 260911 Unclassified

An investigation of the flow at the leading edge of the boundary layer generated by a weak shock wave moving past a flat plate is presented. It is postulated that the leading edge flow can be divided into a shear layer near the wall dominated by the transverse viscous shear and into a free stream or shock region outside the shear layer which is dominated by the longitudinal viscous stress. By expending flow parameters in the shock strength parameter and by stretching coordinates, simplified equations for the shear layer and the shock region were derived from the Navier-Stokes or continuum equations. Such a shock strength expansion was also applied to the normal shock in the free stream and the results were found to be excellent agreement with exact analytical solutions of the Navier-Stokes equations. The vertical velocity generated within the shear layer is of sufficient magnitude to affect the shock region flow; therefore, the two regions interact. Outside the shear layer there is a region of non-Hugoniot flow where the shock is not normal or oblique but where the shock structure is 2-dimensional. An approximate solution of the leading edge interaction was obtained by replacing the shock region with an oblique shock, which is approximately matched to the shear layer. (Contractor's abstract)

2390

Princeton U. Dept. of Aeronautical Engineering, N. J.

VARIATIONAL PRINCIPLES IN PLASMA DYNAMICS, by C.-H. Su. [1961] [3]p. (AFOSR-942) [AF 49-(638)465] Unclassified

Also published in Phys. Fluids, v. 4: 1376-1378, Nov. 1961.

A Lagrangian density is constructed for a multifluid system. Maxwell's equations and flow equations for inviscid, barotropic, and infinitely electrical conducting fluid are obtained from the Lagrangian density through the use of the well-known Lagrange-Euler equations. Flow equations for plasma consisting of electrons and ions are derived from the equations of different species. In this way, in addition to the usual equations of momentum and continuity, a generalized Ohm's law is also obtained. (Contractor's abstract)

2391

Princeton U. Dept. of Aeronautical Engineering, N. J.

A STUDY OF THE EQUATION $\varphi_{xxx}-\varphi_x\varphi_{xx}+\varphi_{yy}=0$ WHICH DESCRIBES THE STRUCTURE OF WEAK NON-HUGONIOT SHOCK WAVES, by M. Sichel. Mar. 1961, 105p. incl. refs. (Rept. no. 541) (AFOSR-1166) (AF 49(638)465) Unclassified

This is a study of a previously derived "viscous transonic" equation. The equation is used to derive an equation for the perturbation to the structure of a weak normal shock wave caused by a small disturbance within the shock wave. Proofs of uniqueness, for a finite domain, are developed for both equations. By the introduction of a certain variable, an exact similarity solution of the "viscous transonic" equation is obtained. A similarity solution which is closely related to the solution of Tomotika and Tamada for the transonic flow near the throat of a Laval nozzle is also obtained.

2392

Princeton U. Dept. of Aeronautical Engineering, N. J.

ON A BOUNDARY VALUE PROBLEM IN THE KINETIC THEORY OF BROWNIAN MOTION, by I. M. Cohen. July 1961, 14p. (Rept. no. 568) (AFOSR-1454) (AF 49(638)465) AD 267517 Unclassified

The proposed boundary value problem in the kinetic theory of Brownian movement has been solved. It is, in principle, possible to calculate the velocity distribution of the Brownian particles as a function of distance from 1 of the 2 walls. In particular, if 1 wall is an absorbing barrier (for example, at $\xi = 0$, $f_1 = 0$ for $\eta > 0$), one may calculate how the distribution in velocities is skewed as the absorbing wall is approached. This particular solution may have some relevance to the theory of plasma probes. (Contractor's abstract)

2393

Princeton U. Dept. of Aeronautical Engineering, N. J.

THE MEASUREMENT AND COMPARISON WITH THEORY OF HEAT TRANSFER FROM SIMILAR LAMINAR BOUNDARY LAYERS TO AERODYNAMIC BODIES IN SUPERSONIC AND HYPERSONIC GAS STREAMS, by W. G. Reinecke. [1961] [169]p. incl. illus. diagrs. tables, refs. (Rept. no. 569) (AFOSR-1521) (AF 49(638)465) AD 273311 Unclassified

This analysis describes the experimental measurement of small rates of heat transfer to wind tunnel models from laminar compressible similar boundary layers at supersonic and hypersonic free stream Mach numbers. Wind tunnel models were developed having surface Mach number distributions corresponding to those required by the similar boundary layer solutions of Cohen and Reshotko. Then a method, using fairly simple equipment, was tested for measuring isothermal heat transfer to cold wind tunnel models with good accuracy and repeatability. Measurements were made of the recovery temperature and heat transfer rates on cold models with similar boundary layers in both favorable and adverse pressure gradients at a free stream Mach number of 2. Tests were also conducted at a free stream Mach number of 11 on a hot body having a favorable surface pressure gradient compatible with the similarity requirement. The assumptions of the similarity analysis were fulfilled in varying degrees by the different test configurations.

2394

Princeton U. Dept. of Aeronautical Engineering, N. J.

ON THE VISCOUS FLOW NEAR THE STAGNATION

POINT ON AN INTERFACE, by W. J. Prosnak. June 1961 [49]p. incl. diagrs. tables. (Rept. no. 563) (AFOSR-1592) (AF 49(638)465) AD 269684 Unclassified

The viscous flow near the stagnation point on an interface between 2 liquids with different densities is studied. The use of a model allows some fairly general results to be readily obtained as a result of a mathematical analysis. Moreover, although the model is obviously not in full accordance with re-entry phenomena, it is believed that it is not oversimplified, and that solutions of real problems obtained on the basis of the results of the present study will be at least qualitatively correct. Equations governing the stated problem can be transformed to those describing the stagnation point flow at a rigid wall, but the boundary conditions are different. Results concerning the velocity and temperature fields based on a numerical integration of these equations are given. Also presented are approximate formulas for heat transfer, displacement thickness, momentum thickness, boundary layer thickness, and temperature layer thickness.

2395

Princeton U. Dept. of Aeronautical Engineering, N. J.

EXPLORATORY STUDIES OF A LOW GAMMA, HIGH MACH NUMBER WIND TUNNEL USING FREON 14 AS THE WORKING FLUID, by A. R. George. Dec. 1961, 33p. incl. refs. (Rept. no. 591) (AFOSR-1876) (AF 49(638)465) AD 272140 Unclassified

The design of a low gamma, high Mach number wind tunnel was studied as a possible facility in which to obtain knowledge of gamma effects on hypersonic flow fields. The impetus for this study stems from an interest in low gamma effects for the extrapolation of helium wind tunnel data and because of the fundamental gamma influences in hypersonic flow theory. The inherent problems in designing such a wind tunnel were investigated and a particular practical design outline presented for a system using heated Freon 14. It would operate with gamma near 1.1, maximum Mach numbers from 7 to 9, at low Reynolds numbers, and with mean free paths from 0.002 to 1.2 in. at the design point. The feasibility of the unorthodox design features has been demonstrated in exploratory experiments but substantial engineering development is still required. (Contractor's abstract)

2396

Princeton U. Dept. of Aeronautical Engineering, N. J.

A GRAPHITE RESISTANCE HEATER FOR A HYPERSONIC WIND TUNNEL USING NITROGEN. I. DESCRIPTION OF TUNNEL AND HEATER, by R. P. Shreeve, W. T. Lord, and others. [June 1961] [13]p. incl. diagrs. table, refs. (AFOSR-1028a) (AF 49-(638)709) Unclassified

Also published in Internat'l. Jour. Heat and Mass Transfer, v. 5: 1081-1093, Nov. 1962.

A heater system has been developed for a hypersonic wind tunnel which uses nitrogen as the test gas, and operates continuously at Mach numbers up to 20. The system uses a small electrically heated graphite element containing a spiral gas passage. The tunnel is designed to operate ultimately at a gas stagnation pressure of 10,000 lbf/in^2, although the work described here refers to operation up to 1,000 lbf/in^2. The stagnation temperature required to avoid condensation of the nitrogen in the test section at a Mach number of 20 is about 5000°R. The major problem encountered in achieving such a temperature are given.

2397

Princeton U. Dept. of Aeronautical Engineering, N. J.

A GRAPHITE RESISTANCE HEATER FOR A HYPERSONIC WIND TUNNEL USING NITROGEN. II. ANALYSIS OF HEATER PERFORMANCE, by W. T. Lord, R. P. Shreeve, and S. J. Boersen. [June 1961] [10]p. incl. diagrs. (AFOSR-1028b) (AF 49-(638)709) Unclassified

Also published in Internat'l. Jour. Heat and Mass Transfer, v. 5: 1095-1104, Nov. 1962.

A formula is derived for the rise in total temperature of nitrogen flowing through an electric resistance element made of graphite. The derivation of the formula involves the consideration of an idealized heating system based on a simple graphite tube and the assumption that the solution of the internal heat transfer problem possesses certain properties. The formula provides a useful basis for the analysis of experimental results from practical heating systems which resemble the idealized system. Such a practical system is exemplified by the graphite heater in the pilot hypersonic nitrogen tunnel at Princeton University (as described in Part I), and the results obtained with this heater are shown to be well represented by the formula. (Contractor's abstract)

2398

Princeton U. Dept. of Aeronautical Engineering, N. J.

ABSTRACTS OF PAPERS. FOURTEENTH AFOSR CONTRACTORS' MEETING ON LIQUID ROCKET COMBUSTION RESEARCH. Sept. 25-26, 1961 [30]p. incl. refs. (AFOSR-1768) [AF 49(638)933] AD 267915 Unclassified

This report includes abstracts of several papers presented at the Air Force Office of Scientific Research Contractors' Conference on Liquid Rocket Combustion Research. These abstracts on aerospace propulsion which resulted from AFOSR contracts are all reviewed separately in this volume.

2399

Princeton U. [Dept. of Aeronautical Engineering] N. J.

COMBUSTION INSTABILITY IN LIQUID PROPELLANT ROCKET MOTORS (Abstract), by L. Crocco and D. T. Harrje. [1961] [2]p. [AF 49(638)938] Unclassified

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

Two research programs in combustion instability in liquid propellant rocket motors are currently being carried out at Princeton. One, the linear program deals with spontaneously originating instability. Theoretical and experimental influences on the unstable operation of various liquid rocket motors are presented. The importance of barriers to the velocity effects are explained and future study of velocity effects outlined. Correlations between the tangential and longitudinally determined pressure-sensitive combustion parameters are discussed together with experimental and theoretical data. The second combustion instability research concerns nonlinear phenomena – in this case instability requires energy addition for initiation. Since such energy input is an important part of the problem, one phase of the research is the study of what a shock pulse fired into a rocket chamber actually produces within the chamber. High frequency response crystal gages and a velocity probe are being used in the measurement of pressure and velocity. Even with a tangentially oriented pulse the shock wave is shown to travel across the chamber while smaller amplitude periodic velocity and pressure disturbances travel in the tangential direction.

2400

Princeton U. [Dept. of Aeronautical Engineering] N. J.

COMBUSTION PHENOMENA IN ROCKET MOTORS (Abstract), by M. Webb, I. Glassman, and L. Crocco. [1961] [2]p. [AF 49(638)938] Unclassified

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

Using the optical light scattering technique developed for measuring the Sauter mean diameter of a polydispersion of liquid droplets, characteristics of a swirl atomizer have been studied. With water as the working fluid the effects of atomizer pressure drop, ambient gas density and viscosity on cold sprays were investigated. The complex surfaces of Sauter mean diameter for the above parameters have been mapped. It was found that for a fixed atomizer pressure drop a maximum droplet diameter occurs at about the same kinematic viscosity for each gas. In the application of the same optical technique for the measurement of droplet size and concentration in a high temperature – high pressure flow reactor disturbances of the collimated optical beam by turbulence occurs. A theoretical investigation of the stability boundaries for high frequency longitudinal oscillations in a premixed gas rocket motor has been carried out. By applying appropriate boundary conditions a so-called characteristic equation was deduced. Solutions have been carried out for a relatively simple case of moderate oscillations in a chamber with a short nozzle. These solutions show that the frequencies of oscillation are always close to the natural frequencies of the chamber; that for each value of propellant mixture ratio a minimum value of chamber length exists below which no unstable combustion can take place and beyond which the rocket is always unstable; and that this minimum does not exist and hence combustion never becomes unstable in a range of mixture ratio values extending around stoichiometric. These results are in good qualitative agreement with experimental data recently obtained. Unstable regions were mapped for thick plate injectors which have 10 separate orifices. In 1 injector these orifices were located evenly across the injector face and in the other they were all located in one-half of the face. The instability regions for these 2 configurations were found to be practically identical. A third injector employing 5 orifices with a total area equivalent to the 10 and evenly distributed also gave regions of unstability essentially the same as the others. One could conclude from these results that the recirculation characteristics of the injector do not appear to affect instability in gas rocket motors.

2401

Princeton U. Dept. of Aeronautical Engineering, N. J.

EXPERIMENTAL INVESTIGATION OF THE IGNITION PROCESS OF SOLID PROPELLANTS IN A PRACTICAL MOTOR CONFIGURATION, by R. W. Lancaster. May 3, 1961 [48]p. incl. illus. diagrs. tables, refs. (Rept. no. 548) (AFOSR-836) (AF 49(638)960) AD 259409 Unclassified

A study of the ignition process of a composite solid propellant (80 wt-% NH_4ClO_4 plus 20 wt-% P-13 resin and additives) was made in a combustion chamber whose configuration resembled that of a practical solid propellant motor. A small gas rocket chamber generated high temperature gaseous products, which in turn supplied the ignition energy to the internal surface of a cylindrical thin-web, case-bonded solid propellant grain. The ignition delay, the time between ignition of the gas igniter and the first ignition of the solid propellant grain, was measured as a function of the temperature, pressure, the chemical reactivity of the hot gases, and the velocity of these gases over the solid propellant surface. The ignition times were measured by means of a strain-gage pressure transducer inserted in the solid propellant motor chamber. For the composite solid propellant, values for the ignition delay time ranged from 4.5 to 40 msec, depending upon the mass velocity of the ignition gas in the solid propellant cavity. For constant igniter gas composition, the data fitted an empirical relationship where the result, derivable from transient heating theory, suggests that for constant igniter composition the ignition delay is simply the time required for the attainment of a particular surface temperature at which the incipient reaction runs away. An examination of the linear pyrolysis rates for P-13

resin and ammonium perchlorate also suggests that the attainment of a particular surface temperature is necessary to obtain a combustible mixture of solid propellant vapors adjacent to the propellant surface. (Contractor's abstract)

2402

Princeton U. Dept. of Aeronautical Engineering, N. J.

RESEARCH ON SOLID PROPELLANT IGNITABILITY AND IGNITER CHARACTERISTICS, by E. H. Grant. Final rept. Nov. 1, 1960 - Sept. 30, 1961. Dec. 18, 1961, 6p. incl. table. (Rept. no. 592) (AFOSR-1966) (AF 49(638)960) AD 270114 Unclassified

The ignition was studied of small internal burning solid propellant grains in a rocket motor, utilizing hot combustion products from an upstream gas rocket to test the applicability of the concept that ignition is a runaway gas phase reaction. (Contractor's abstract)

2403

Princeton U. Dept. of Aeronautical Engineering, N. J.

RESEARCH ON SOLID PROPELLANT IGNITABILITY AND IGNITER CHARACTERISTICS, by R. W. Lancaster and K. P. Hall. Second and third quarterly progress repts. Feb. 1 - July 31, 1961. Nov. 1, 1961 [7]p. incl. diagrs. (Rept. no. 538-b and -c) (AF 49-(638)960) Unclassified

During the last few years a continuing program of solid propellant ignition research has been carried on at Princeton U. Experimentally, a laboratory shock tube technique has been employed to produce controllable ignition of solid propellant test specimens. A gas phase ignition theory has been developed which quantitatively correlates the data of these experiments. The research described in this report deals with the controlled ignition of thermal-burning solid propellant grains in a practical motor configuration. The objective is to examine the applicability of the gas phase ignition concept to the practical problem of initiating burning in a solid rocket engine. At the present stage of the subject research the ignition stimulus is supplied by hot gas convectively heating the surface of the propellant in which mixtures of methane, oxygen, and nitrogen are burned, to yield hot combustion product gases whose chemical reactivity, temperature, and mass flow rate are readily controlled. The configuration of the apparatus and data obtained for 1 composite propellant (80% ammonium perchlorate - 20% polyester-styrene resin) under a limited range of exposure conditions have been presented. The chemical reactivity and temperature parameters of the hot igniting gases were held constant while the mass velocity of the hot gases was varied.

2404

Princeton U. [Dept. of Aeronautical Engineering] N. J.

AN EXPERIMENTAL INVESTIGATION OF LONGITUDINAL COMBUSTION INSTABILITY IN A ROCKET MOTOR USING PREMIXED GASEOUS PROPELLANTS, by R. Reiss, L. Glassman, and M. Webb. Dec. 1961, 27p. incl. diagrs. refs. (Rept. no. 589) (AFOSR-1968) (AF AFOSR-62-90) AD 270113 Unclassified

Longitudinal combustion instability in a premixed gaseous propellant rocket motor was studied. The chamber length was varied continuously between 3 and 48 in. A porous media injection plate was used to approximate uniform 1-dimensional propellant injection. A showerhead injector was used to determine the influence of combustion zone recirculation on combustion instability. Two propellant combinations were used, methane - (40% O + 60% N) and H - air. Results, in the form of instability maps, are presented for combination of the propellants and injection schemes. The 2 existing gas rocket instability driving mechanisms are presented and discussed. The influence of chemical kinetics on the instability seems to be unimportant and the driving mechanism is an oscillating heat transfer to the injector couples with a pressure oscillation in the combustion chamber to produce unstable combustion. (Contractor's abstract)

2405

Princeton U. [Dept. of Biology] N. J.

BIOLOGY AND SPACE ENVIRONMENT, by C. S. Pittendrigh. [1961] [4]p. incl. illus. (AFOSR-2378) [AF 49(638)587] Unclassified

Also published in Bull. Atomic Scientists, v. 17: 206-209, May-June 1961.

The probable impact of the space program on the progress of ground based physiology is emphasized. The general tendency to assume that the availability of the new space tools will be the principal source, as in physics, of the anticipated new information is discredited except for exobiology, and attitudes concerning readiness for surprises in realm of space biology are supported.

2406

Princeton U. [Dept. of Biology] N. J.

ON TEMPORAL ORGANIZATION IN LIVING SYSTEMS, by C. S. Pittendrigh. [1961] [33]p. incl. illus. diagrs. refs. (AFOSR-2380) [AF 49(638)587] Unclassified

Also published in Harvey Lectures, Series no. 56: 93-125, 1961.

The vast majority of biological periodicity is not forced in any simple sense by the cycle of physical conditions to which it is adaptively oriented. It depends on an elaborate oscillatory organization in the living system that has been wrought by selection to accomplish a far more diversified adjustment to the external oscillation in conditions than can be achieved by the direct forcing of metabolic change. Discussion

of this oscillatory organization is limited to the daily case where the facts are most fully know. It is well established that innate tidal and lunar oscillations are also present in many organisms and the daily oscillations of organisms are possibly involved in recognizing the phase of the annual cycle.

2407

Princeton U. [Dept. of Chemistry] N. J.

A STUDY OF THREE MODELS FOR THE INTERPRETATION OF INTENSITIES OF VIBRATIONAL BANDS OF DIATOMIC MOLECULES, by D. Garvin. [1961] 23p. incl. illus. tables, refs. (AFOSR-1267) (AF 18(603)134) AD 261205 Unclassified

Transition probabilities for the rotating Morse oscillator have been calculated for dipole functions expressed as power series and as analytical expressions having the expected behavior with internuclear distance, using previously developed methods. Comparison with experimental data suggests that mu prime (reduced mass) for HCl is decreasing at the equilibrium internuclear distance. The general treatment used for the rotational perturbation of the vibrational transition probability is shown to reproduce the experimental data poorly. It is suggested that a recent approximation of this theory is unsatisfactory. (Contractor's abstract)

2408

Princeton U. Dept. of Chemistry, N. J.

DIFFERENTIAL THERMOMETRIC TITRATIONS AND DETERMINATION OF HEATS OF REACTION, by B. C. Tyson Jr., W. H. McCurdy, Jr., and C. E. Bricker. May 1961 [23]p. incl. diagrs. tables, refs. (AFOSR-762) (AF 49(638)467) PB 171950 Unclassified

Also published in Anal. Chem., v. 33: 1640-1645, Nov. 1961.

In the differential apparatus designed for this work, temperature-sensing devices were placed in both the sample and blank solutions. Sensitivity greater than that previously reported for thermometric titrations has been obtained and extraneous heat effects, such as stirring and heats of dilution, have been greatly minimized. This apparatus has been used to follow 14 different reactions and the heat of the reaction has been calculated for 11 of these reactions.

2409

Princeton U. Dept. of Chemistry, N. J.

PHOTOLYTIC DETERMINATION OF TRACE AMOUNTS OF ORGANIC MATERIAL IN WATER, by J. Beattie, C. Bricker, and D. Garvin. [1961] [3]p. incl. diagr. tables. (AFOSR-1059) (AF 49(638)467) AD 432710 Unclassified

Also published in Anal. Chem., v. 33: 1890-1892, Dec. 1961.

A method involving the oxidation of organic compounds in water by exhaustive radiation with ultraviolet light has been developed for the determination of trace amounts of organic material in water. Ferric sulfate is used as a photosensitizer during the photolysis. The carbon dioxide obtained from the oxidation of the organic material present in the water is collected in a cold trap at liquid nitrogen temperature and then transferred to a mass spectrometer for analysis. (Contractor's abstract)

2410

Princeton U. Dept. of Chemistry, N. J.

PHOTOLYTIC DETERMINATION OF TRACE AMOUNTS OF ORGANIC MATERIAL IN WATER, by J. Beattie, C. Bricker, and D. Garvin. June 23, 1961 [3]p. incl. diagr. table. (AFOSR-2597) (AF 49-(638)467) AD 432710 Unclassified

Also published in Anal. Chem., v. 33: 1890-1892, Dec. 1961.

For abstract see item no. 2409, Vol. V.

2411

Princeton U. [Dept. of Mathematics] N. J.

LIMITS AND SPECTRAL SEQUENCES, by S. Eilenberg and J. C. Moore. [1961] [23]p. incl. diagrs. (AFOSR-64-1602) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)431, National Science Foundation and Office of Naval Research) AD 446530 Unclassified

Also published in Topology, v. 1: 1-23, Jan.-Mar. 1962.

The authors tackle the thorny question that the spectral sequence E(A) of a filtered complex A does not cast much light on the homology group H(A), unless for example the filtration is finite in each degree. If the filtration is infinite, things can go wrong in the limit, and it is possible to have for instance $\lim E^r(A) = 0$ but $H(A) \neq 0$. Working in an arbitrary abelian category (in which the countable product of epimorphisms is epimorphic, and the countable sum of monomorphisms monomorphic), the authors introduce the notion of a complete filtration. With each filtered complex is associated a completion having the same spectral sequence. For complete filtrations the relations between the spectral sequence and homology group are much closer, and the main result is that if $f: A \to B$ is a (filtration-preserving) map between complete filtered complexes, and if f induces an isomorphism $E^r(A) \to E^r(B)$ for some $r > 1$, then $H(f): H(A) \to H(B)$ is an isomorphism. Thus in a sense E(A) determines H(A). The authors promise useful and natural examples in a subsequent paper. (Math. Rev. abstract)

2412

Princeton U. [Dept. of Mathematics] N. J.

SUBORDINATION OF NON-GAUSSIAN STOCHASTIC PROCESSES, by S. Bochner. [1961] [3]p. (AFOSR-J325) [AF 49(638)578] Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 48: 19-22, Jan. 1962.

Let $\{X_t\}$ and $\{Y_t\}$ be infinitely divisible stochastic processes for which $E\{\exp(i\alpha X_t)\} = \exp(-t\Psi(\alpha))$ and $E\{\exp(i\alpha Y_t)\} = \exp(-t\Phi(\alpha))$. The process $\{Y_t\}$ is said to be subordinate to the process $\{X_t\}$ if and only if there is $\Phi(\alpha) = c\Psi(\alpha) + \int_{+0}^{\infty}(1 - e^{-t\Psi(\alpha)})d\rho(t)$, where $c \geq 0$, $d\rho(t) \geq 0$, $\int_{+0}^{1} t\,d\rho(t) + \int_{1}^{\infty} d\rho(t) < \infty$. It is proved that (1) if $\{Y_t\}$ has no Poisson part, then $\{Y_t\}$ cannot be subordinate to any other process $\{X_t\}$ but itself, i.e., $\Phi(\alpha) = c\bar{\Psi}(\alpha)$, and (2) if the Poisson part of $\{Y_t\}$ has compact support and if the process $\{Y_t\}$ is subordinate to some process $\{X_t\}$ other than itself, then the Gaussian part of $\{Y_t\}$ is 0, and $\{X_t\}$ is a pure Bernoulli process.

2413

Princeton U. [Dept. of Mathematics] N. J.

UNIFORM CONVERGENCE OF MONOTONE SEQUENCES OF FUNCTIONS, by S. Bochner. [1961] [4]p. [AF 49(638)578] Unclassified

Published in Proc. Nat'l. Acad. Sci., v. 47: 582-585, Apr. 1961.

Let T be a set, S a subset of T endowed with a topology under which it is sequently compact; let further A be a group of permutations of T such that for each $y \in T$, there exists $x \in S$ satisfying $y = \sigma x$ for some $\sigma \in A$. A real function f on T is called almost automorphic if every sequence $\{\alpha_n\}$ in A contains a subsequence $\{\beta_n\}$ with these properties: (i) $\{f\circ\beta_n\}$ is convergent, and if f_β is the limit function, then $\{f_\beta\circ\beta_k^{-1}\}$ converges to f; (ii) the sequence $\{f\circ\beta_k\}$ is uniformly bounded on S, and (iii) is sequentially-continuously convergent on S. Theorem: If $\{f_n\}$ is a decreasing sequence, bounded below, of almost automorphic functions and if for every sequence $\{\beta_k\}$ in A satisfying (i)-(iii) for all f_n simultaneously, the limit $F_\beta = \lim_{n=\infty} f_{n,\beta}$ is almost automorphic, then $\{f_n\}$ converges uniformly on T. This merges a theorem of U. Dini (A = {e}, S = T) with a theorem of L. Amerio concerning almost periodic functions and corresponding to the case when S contains a single point and A is transitive on T.

2414

[Princeton U. Dept. of Mathematics, N. J.]

SUSPENSIONS AND CHARACTERISTIC MAPS FOR SYMMETRIC SPACES, by B. Harris. [1961] [11]p. incl. refs. (AF 49(638)919) Unclassified

Published in Ann. Math., v. 76: 295-305, Nov. 1962.

The theorem given in a previous paper (see item no. 2242, Vol. IV) is generalized as follows: Let G be a compact, connected, simply-connected Lie group with an involutory automorphism σ, K the identity component of the fixed point set of σ. Thus, the first main theorem is stated that relates the homotopy groups of G, K, and G/K and, in particular, gives a split exact sequence relating these groups which is analogous to a known split exact sequence for the corresponding Lie algebras. For the second theorem it is also necessary to have a Lie group L which contains G and in which σ is inner. Then under certain conditions there is a split exact sequence relating the homotopy groups of L/K, L/G, and G/K.

2415

Princeton U. [Dept. of Mathematics] N. J.

DUALITY IN NOETHERIAN RINGS, by J. P. Jans. [1961] [14]p. (AFOSR-392) (In cooperation with Washington U., Seattle) (AF 49(638)921) AD 261318 Unclassified

Also published in Proc. Amer. Math. Soc., v. 12: 829-835, Oct. 1961.

A series of corollaries of the 'shifting theorem' of H. Bass (Trans. Amer. Math. Soc., v. 95: 466-488, 1960) are given. Let A be a finitely generated module over a left and right Noetherian ring R. The dual of A is $A^* = \mathrm{Hom}_R(A, R)$, and σ_A: $A \to A^{**}$ is the natural homomorphism. Following the terminology of Bass, A is said to be torsionless if σ_A is a monomorphism, reflexive if σ_A is an isomorphism. Then if A is a torsionless module, there exists B, torsionless of the opposite band from A, such that $\mathrm{Coker}\,\sigma_A = \mathrm{Ext}^1(B, R)$ and $\mathrm{Coker}\,\sigma_B = \mathrm{Ext}^1(A, R)$. The following are equivalent: (1) $A = A^{**}$ for every torsionless left module A; (2) the right injective dimension of R is ≤ 1. Those rings for which the dual of every left module, is reflexive may be characterized as those rings R such that $[\mathrm{Ext}^2(C, R)]^* = 0$ for all right modules C. If $\dim A = n$ for $1 \leq n \leq \infty$, then $[\mathrm{Ext}^n(A, R)]^* = 0$. Finally, if $A^* = 0$, then there exists B, of dimension ≤ 1, such that $A = \mathrm{Ext}^1(B, R)$.

2416

Princeton U. [Dept. of Psychology] N. J.

MILITARY TRAINING AND PRINCIPLES OF

LEARNING, by R. M. Gagné. [1961] 25p. incl. refs. (AFOSR-1805) (AF 49(638)975) AD 445001 Unclassified

Presented at Sixty-ninth annual Convention of the Amer. Psychological Association, New York, N. Y., Sept. 5, 1961.

This presentation stresses the importance of such learning techniques as task analysis, component task achievement, intra-task transfer, and sequencing of subtask learning as ideas of great usefulness in the design of effective training. The author feels that these techniques are more useful than the well-known learning principles like reinforcement, distribution of practice, and response familiarity. The problem is simply how can what one knows about learning as an event, or a process, be put to use in designing training so that it will be maximally effective. The answer to this question is, in the author's opinion, by the use of techniques described.

2417

Princeton U. Frick Chemical Lab., N. J.

IONIC COPOLYMERIZATION OF SUBSTITUTED STYRENES, by A. V. Tobolsky and R. J. Boudreau. Apr. 4, 1961 [11]p. incl. diagrs. tables, refs. (AFOSR-486) (AF 49(638)974) AD 254273 Unclassified

Also published in Jour. Polymer Sci., Suppl., v. 51: S53-S56, 1961.

An effort to determine the effect of monomer structure, solvent, and initiator composition in ionic copolymerization is made by investigating the monomer pairs: styrene-α-methylstyrene, styrene-p-methylstyrene, styrene-p-methoxystyrene, and p-methylstyrene-p-methoxystyrene. Several Lewis acids and bases were used as initiators in various solvents. The joshi method was used to calculate reactivity ratios and their standard deviations. It is shown that the composition of the copolymers is dependent on the solvent and counter ion for the monomer studied. The data, presented in table form, reveal that $r_1 r_2 = \pm 1$. When this occurs, the two possible ion-pairs do not have identical reactivities. It is also found that the electrophilic substituent constants, σ^+, of Brown (Jour. Amer. Chem. Soc., v. 74: 4848, 1952) are superior to Hammett σ values in correlating reactivity ratios in ionic copolymerizations; and the reaction constant is positive for anionic, nucleophilic copolymerizations.

2418

Princeton U. [Frick Chemical Lab.] N. J.

STUDIES IN IONIC COPOLYMERIZATION, by A. V. Tobolsky and R. J. Boudreau. Apr. 11, 1961, 103p. incl. diagrs. tables, refs. (AFOSR-487) (AF 49-(638)974) AD 254168; AD 609697 Unclassified

The copolymerization of styrene—isoprene with Lewis bases and isobutyl-p-chorostyrene with Lewis acids shows a dependence of copolymer composition on solvents and counterions. The work reported in this thesis was designed to shed light on two questions: (1) Is the effect of solvent and catalyst of general significance in ionic copolymerization. (2) Are ionic copolymerizations generally ideal. Copolymerizations were performed with styrene-α-methylstyrene, styrene-p-methylstyrene, styrene-p-methoxystyrene, and p-methylstyrene-p-methoxystyrene. Various Lewis acids and bases were used in several solvents. Reactivity ratios were calculated for all but the styrene-α-methylstyrene copolymers. The results show that copolymer composition is affected by specific solvents and initiators. Furthermore the extent of this effect is a function of the relative reactivities of the propagating ion-pairs. Evidence is presented to show that in many cases the copolymerizations were non-ideal: $r_1 r_2 \neq 1$. Reactivity ratios for the systems studied are interpreted in terms of the Hammett equation. Electrophilic substituent constants, σ^+, were superior in all cases to Hammett σ values in correlating monomer reactivity with structure. The value of the Alfrey-Price Q and e parameters in ionic copolymerization is examined. The relationship between monomer dipole moments and the electrostatic parameter, σ, is also discussed. It was found that all of these treatments are inadequate to describe ionic copolymerization since they all ignore the effect of solvent and counterion on the charge distribution in the ion-pair. The effect of solvent and counterion on the reactivity of ion-pairs is shown for ionic reactions generally, ionic copolymerization, and ionic diene polymerization. For ionic copolymerization, some generalizations are advanced concerning the effect of substituents, solvents and counterions on the reactivity of ion-pairs and the effect of reactivity on the ideality of copolymerization. In conclusion, the possibility of calculating the charge distribution in the reactive ion-pairs is examined. (Contractor's abstract)

2419

Princeton U. Frick Chemical Lab., N. J.

RADICAL-ANION POLYMERIZATION, by A. V. Tobolsky and D. B. Hartley. [1961] [8]p. incl. diagrs. table, refs. (AFOSR-1784) [AF 49(638)974] AD 400858 Unclassified

Also published in Jour. Polymer Sci., Part A, v. 1: 15-22, Jan. 1963.

Two cases of initiation of vinyl polymerization by radical-ions are considered. In the 1 case the transfer from radical-ion to monomer is instantaneous and virtually complete. Here the relative amount of free radical propagation as compared to anionic propagation is negligibly small. In the second case a continuous feed of radical-ion initiator is considered. Here the relative amount of free radical propagation as compared to anionic propagation may be considerable. Exact expressions are developed for this relative radical versus ionic propagation as a function of conversion. It is suggested that the results of

lithium-initiated copolymerization of methyl methacrylate and styrene may be understood in terms of a model similar to the second case of radical-ion initiation considered in this paper. (Contractor's abstract)

2420

Princeton U. Frick Chemical Lab., N. J.

INITIATION OF METHYL METHACRYLATE BY AROMATIC RADICAL-ANIONS, by A. V. Tobolsky and D. B. Hartley. [1961] [3]p. incl. table. (AFOSR-1785) [AF 49(638)974] Unclassified

Also published in Jour. Amer. Chem. Soc., v. 84: 1391-1393, Apr. 1962.

Methyl methacrylate has been polymerized by a variety of aromatic hydrocarbon radical-ions. Some initiators were found to induce polymerization by electron transfer, others by bond formation with the methacrylate. The mechanism of initiation appears to be governed to a large extent by the orbital energy of the initiator and to be more or less independent of the counterion. (Contractor's abstract)

2421

Princeton U. Frick Chemical Lab., N. J.

A GENERAL TREATMENT OF EQUILIBRIUM COPOLYMERIZATION, by A. V. Tobolsky and G. D. T. Owen. [1961] [9]p. incl. diagrs. table. (AFOSR-65-1634) [AF 49(638)974] Unclassified

Also published in Jour. Polymer Sci., v. 59: 329-337, 1962.

A general theory of equilibrium is developed which is analogous to that of equilibrium homopolymerization. The theory is compared with published experimental results on sulfur-selenium copolymers. The equilibrium constants developed previously for sulfur and for selenium homopolymerization are utilized in this new copolymerization theory, and no other mathematical assumptions are made. The theory is in agreement with the experimental results.

2422

Princeton U. Palmer Physical Lab., N. J.

SOME ANALYTIC PROPERTIES OF A DECAY AMPLITUDE WITH FINAL STATE INTERACTIONS. I. THE VERTEX DIAGRAMS IN K $\rightarrow 3\pi$ DECAY, by G. Barton and C. Kacser. [1961] [12]p. incl. diagrs. refs. (AFOSR-778) (AF 49(638)304) Unclassified

Also published in Nuovo Cimento, Series X, v. 21: 593-604, Aug. 16, 1961.

The simplest vertex-type diagrams for $K \rightarrow 3\pi$ decay contain an internal double pion line; when the total rest-mass parameter λ of this line is taken as discrete, the amplitude possesses on the physical sheet an anomalous branch point above the normal one, subject to the condition $(M^2-\mu^2)/2 < \lambda^2 < (M-\mu)^2$, with M the kaon and μ the pion mass. On integrating over λ^2 this singularity is eliminated. In order to understand the amplitude fully, it must be temporarily considered as a function of 2 complex variables, in which a double dispersion representation is found to hold. The spectral functions are examined in semiclosed form to exemplify these statements, and to give a perturbation-theory illustration of some of the popular approximations in calculations on this decay. (Contractor's abstract)

2423

Princeton U. Palmer Physical Lab., N. J.

SOME PROPERTIES OF THE FIVE - POINT FUNCTION IN PERTURBATION THEORY, by L. F. Cook, Jr. and J. Tarski. [1961] [30]p. incl. diagrs. table, refs. (AFOSR-779) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)304 and Atomic Energy Commission) Unclassified

Also published in Jour. Math. Phys., v. 3: 1-30, Jan.-Feb. 1962.

A preliminary investigation of the 5-point function in its dependence on 2 complex variables is presented. Only single-loop diagrams are examined. The approach involves a determination of the singularity curves and of their regular and singular parts. The geometrical properties of singularity curves are described in detail; in particular, a method for determining the tangency of 2 curves is given. The following general conclusions are drawn: First, real and complex vertex singularities are near the physical regions and, therefore, can produce significant experimental effects. On the other hand, scattering singularities and 5-point poles seem to be further removed from the physical regions. Second, it is not likely that a simple scheme can be found for the description of the analytical properties of the 5-point function. A short discussion of scattering singularities involving unstable masses is also given. (Contractor's abstract)

2424

Princeton U. Palmer Physical Lab., N. J.

SOME EXAMPLES OF CANONICAL TRANSFORMATIONS IN QUANTUM MECHANICS, by F. R. Halpern. [1961] [6]p. (AFOSR-780) (AF 49(638)304) Unclassified

Also published in Jour. Math. Phys., v. 3: 281-286, Mar.-Apr. 1962.

The set of all pairs of polynomials X(x, p) and P(x, p) in the position x and momentum p are found such that X and P have the same commutator as x and p. Several other types of representations of the commutation relations are studied. The reducibility, time, and space inversion properties of these are discussed.

The unitary transformations connecting different representations are exhibited. The use of different representations to solve scattering and bound state problems is indicated. The application of one of the transformations to a partial diagonalization of a perturbed harmonic oscillator Hamiltonian is made. (Contractor's abstract)

2425

Princeton U. Palmer Physical Lab., N. J.

BEHAVIOR OF SCATTERING AMPLITUDES AT HIGH ENERGIES, BOUND STATES, AND RESONANCES, by R. Blankenbecler and M. L. Goldberger. [1961] [21]p. incl. diagrs. refs. (AFOSR-3215) [AF 49(638)304] AD 413494 Unclassified

Also published in Phys. Rev., v. 126: 766-786, Apr. 15, 1962.

An exact Fourier-Bessel representation of the scattering amplitude is introduced and discussed for potential scattering and field theory. It is shown to contain the Mandelstam representation as a special case. The representation automatically satisfies unitarity exactly in the high-energy limit even in the many-channel situation. The behavior of the scattering amplitude for large momentum transfers is discussed and it is demonstrated that this limit is directly connected with the formation of bound states and resonances. A selection rule governing the ordering of resonances is derived. A variational principle for calculating the asymptotic dependence on momentum transfer in potential scattering is formulated. Some interesting relations between the asymptotic behaviors of π-π, π-N, and N-N are developed, and related to the single-particle poles and low-energy resonances. (Contractor's abstract)

2426

Princeton U. Palmer Physical Lab., N. J.

TESTS OF THE SINGLE-PION EXCHANGE MODEL, by S. B. Treiman and C. N. Yang. [1961] [2]p. incl. diagr. (AFOSR-J791) [AF 49(638)304] AD 411450 Unclassified

Also published in Phys. Rev. Ltrs., v. 8: 140-141, Feb. 1, 1962.

The single-pion exchange model (SPEM) of high-energy particle reactions provides an attractively simple picture of seemingly complex processes. Attention is called to the possibility of subjecting the model to certain tests precisely in the domain where the model stands the best chance of making sense. A collision is considered between particles p and k which results in 2 groups of outgoing particles.

2427

Princeton U. Palmer Physical Lab., N. J.

PION PRODUCTION IN THE LOW ENERGY LIMIT, by Y. S. Kim. [1961] [7]p. incl. diagrs. (AFOSR-J803) [AF 49(638)304] AD 413503 Unclassified

Also published in Phys. Rev., v. 125: 1771-1777, Mar. 1962.

The low-energy production reaction $\pi + N \rightarrow \pi + \pi + N$ is discussed in the framework of a simplified kinematics. The discussion is based on the Khuri-Treiman representation for processes with a 3-particle final state. Under the assumption that the pion-pion rescattering term is dominant, branching ratios are derived for various processes. Under the same assumption, a quantitative analysis is given for the effect of the final-state pion-pion interaction on the 3-particle distribution functions. (Contractor's abstract)

2428

Princeton U. [Palmer Physical Lab.] N. J.

REMARKS ON A HILBERT SPACE OF ANALYTIC FUNCTIONS, by V. Bargmann. [1961] [5]p. (AFOSR-J813) (AF 49(638)304) AD 412992 Unclassified

Published in Proc. Nat'l. Acad. Sci., v. 48: 199-204, Feb. 1961.

In an earlier paper (Comm. Pure Appl. Math., v. 14: 187-214, 1961), it is shown that complex analytic functions f(z) on an n-dimensional complex analytic space ($z \in C_n$) subject to the condition $(f,f) \equiv \int_{C_n} |f(z)|^2 d\mu_n(z) < \infty$, with $d\mu_n(z) = \pi^{-n} \exp(-\sum_{k=1}^{n} |z_k|^2) \prod_{k=1}^{n} dx_k dy_k$ ($z_k = x_k + iy_k$) form a separable Hilbert space $\mathfrak{H}_n$. The properties of $\mathfrak{H}_\infty$ which is defined as the closed linear sum of the spaces $\mathfrak{H}_n$ are studied. The space $\mathfrak{H}_\infty$ can be characterized by analytic functions on an infinite-dimensional Euclidean space C_∞ subject to a norm condition which is the obvious generalization of the condition for the finite case. In this space there is a natural realization of creation and annihilation operators in the form of differential and multiplication operation. The connection of this realization with usual Fock-space representation of these operators is worked out in detail.

2429

Princeton U. [Palmer Physical Lab.] N. J.

THE UNREASONABLE EFFECTIVENESS OF MATHEMATICS IN THE NATURAL SCIENCES, by E. P. Wigner. [1959] [14]p. (AFOSR-J820) [AF 49(638)-304] Unclassified

Also published in Commun. Pure and Appl. Math., v. 13: 1-14, Feb. 1960.

The usefulness of mathematics as a tool for the

formation of the laws of physics is emphasized. Its application in physical theories is discussed even though it may be poorly understood. The laws of nature must be already formulated in the language of mathematics to be an object for the use of applied mathematics. The axioms of quantum mechanics as formulated by the great mathematician von Neumann, or, implicitly, by the great physicist, Dirac, are 2 basic concepts in quantum mechanics, states and observables. The states are vectors in Hilbert space, the observables self-adjoint operators on these vectors. Physics chooses certain mathematical concepts for the formulation of the laws of nature, frequently developed independently by the physicist only to find that these concepts have been part of the language of mathematics for years. The role of mathematics in physics will surely increase as the applicability of concepts becomes more apparent, such as the use of analytic functions in the formulation of quantum theory.

2430

Princeton U. [Palmer Physical Lab.] N. J.

ON THE SPECTRAL FUNCTION OF SOME [FEYNMAN] DIAGRAMS IN K → 3π DECAY (Abstract), by C. Kacser and G. Barton. [1961] [1]p. [AF 49(638)304] Unclassified

Presented at meeting of the Amer. Phys. Soc. Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 256, Apr. 24, 1961.

In perturbation theory the discontinuities across the branch cuts arising from the first few diagrams are examined in an attempt to disentangle effects depending on the K mass from those of the ππ interaction. For instance, in the vertex-type diagrams, when the mass parameter λ of the internal double pion line lies in the range $M^2 - \mu^2 < 2\lambda^2 < 2(M - \mu)^2$, an additional, anomalous, branch point appears above the normal threshold. This happens only when the K is unstable. On integrating over λ this anomalous branch point moves down to the normal threshold at $s = 4\mu^2$, but may nevertheless affect the discontinuity across the cut.

2431

Princeton U. Palmer Physical Lab., N. J.

SINGULARITIES OF SCATTERING AMPLITUDES ON UNPHYSICAL SHEETS AND THEIR INTERPRETATION, by R. Blankenbecler, M. L. Goldberger and others. [1961] [8]p. incl. diagrs. [AF 49(638)304] Unclassified

Published in Phys. Rev., v. 123: 692-699, July 15, 1961.

The analytic structure of 2-particle scattering amplitudes on the unphysical sheet of the Riemann surface reached by crossing the 2-particle cut is discussed. The singularities of the amplitudes there are shown to be poles and their physical interpretation is studied. The way in which bound states appear on the physical sheet in the Mandelstam representation, both as isolated poles and as cuts, is traced in detail. The properties of partial wave amplitudes and of the full amplitudes as a function of energy and angle and of energy and momentum are discussed. Finally, a few remarks are made in connection with unstable states. (Contractor's abstract)

2432

Princeton U. [Palmer Physical Lab.] N. J.

BOUND-STATE MODEL OF WEAK AND STRONG INTERACTIONS, by C. H. Albright, R. Blankenbecler, and M. L. Goldberger. [1961] [11]p. incl. diagrs. table, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)304] and Atomic Energy Commission) Unclassified

Published in Phys. Rev., v. 124: 624-638, Oct. 15, 1961.

The pion-nucleon coupling constant is calculated from first principles by use of the N/D matrix method. Three models are introduced which contain pions, nucleons, and weakly interacting intermediate bosons of the scalar, pseudoscalar, and vector variety. The basic interactions are taken to be parity and isotopic spin conserving. Certain physical assumptions in the nature of boundary conditions and the known fact that the weak coupling is very weak, together with the Born approximation for N are used to obtain an eigenvalue equation which expresses the pion-nucleon coupling constant in terms of the 3 masses in the problem. The correct value for g_π^2 can be obtained for an intermediate vector meson of mass comparable to the nucleon mass with essentially no cutoff employed; on the other hand, the experimental value is also obtained with a spin-zero boson and a relatively small cutoff energy. (Contractor's abstract)

2433

Princeton U. Palmer Physical Lab., N. J.

ANALYTICITY PROPERTIES OF THE MOMENTUM-SPACE VERTEX FUNCTION, by W. S. Brown. [1961] [15]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)-304] and National Science Foundation) Unclassified

Published in Jour. Math. Phys., v. 3: 221-235, Mar.-Apr. 1962.

The problem of finding the maximal domain of analyticity of the momentum-space vertex function implied solely by Lorentz covariance, local commutativity, and mass spectrum with thresholds not all zero, is restated as a holomorphy envelope problem. If only 1 of the threshold masses is nonzero, the problem can be divided into 2 simpler problems. The triangle diagram suggests the holomorphy envelope of 1 but

only gives an upper bound on the holomorphy envelope of the other. It is shown that the boundary of the latter most probably consists of the 3 cuts and a single quasi-analytic hypersurface with certain specified properties. If 2 of the threshold masses are equal and the third vanishes, an appealing conjecture suggested by the triangle diagram is shown to contradict a generalization of Jost's example. In the general case some upper and lower bounds are obtained. The Källén-Toll representation and conjecture are discussed. The relation of the first 3 terms in the representation of the position-space vertex function to the Mercedes diagram in perturbation theory is displayed, and it is shown that there is no analogous relation of the fourth term. In the single threshold case this fourth term must account for the singularities of the momentum-space vertex, function of the quasi-analytic hypersurface which bounds the holomorphy envelope. The motivation for studying the analyticity of vertex diagrams is discussed, and the simplest totally symmetric ones are investigated. (Contractor's abstract)

2434

Princeton U. Palmer Physical Lab., N. J.

ANALYTIC PROPERTIES OF PRODUCTS OF FIELD OPERATORS, by R. F. Streater. [1961] [6]p. incl. diagr. refs. [AF 49(638)304] Unclassified

Published in Jour. Math. Phys., v. 3: 256-261, Mar.-Apr. 1962.

It is shown that any function of n-1 four-vectors which is analytic in the forward tube, the backward tube, and some neighborhood of the Jost points has a 1-valued continuation into the extended tube. The theorem is applied to products of field operators between arbitrary states. It is shown that each matrix element of the product is analytic in the envelope of holomorphy of the union of the permuted extended tubes (the domain of analyticity of the most general causal vacuum expectation value). Thus the product of field operators may be regarded as having analytic properties. (Contractor's abstract)

2435

Princeton U. Palmer Physical Lab., N. J.

RESEARCH STUDIES ON MEDIUM ENERGY SCATTERING, by H. O. Funsten. May 1961 [12]p. incl. diagrs. table. (AFOSR-2335) (AF 49(638)920) Unclassified

The (p,p') 3σ, (p,p') and (p,d) proton reactions on C^{12} in the energy range of 17.5 to 20.0 mev have been studied. Absolute differential cross-sections were obtained for the (p,p') reaction to the 12.73 and 15.11 levels in C^{12} and for the (p,d) reaction. Results for the (p,d) reaction are inconsistent with plane wave Butler stripping. (Contractor's abstract)

2436

Puerto Rico U. Dept. of Electrical Engineering, Mayaguez.

FIXED AZIMUTH SWEEP FREQUENCY BACKSCATTER OBSERVATIONS FROM 27 TO 54 MC/S, by B. Dueño. 1961 [33]p. incl. illus. diagrs. (Research rept. no. 4) (AFOSR-1573) (AF 49(638)172) AD 266015 Unclassified

As a result of a fixed azimuth sweep frequency, backscatter observations from 27 to 54 mc/s performed from December 1960 to June 1961, it was found that transequatorial echoes are of 2 types: (1) simple 2 hop propagation supported by high density concentrations at geographic latitudes 5° north and 35° south and (2) propagation of low angle rays supported by the decreasing ionization gradient on the far side of the 5° latitude concentration and the increasing gradient side of the 35° latitude concentration. Also, echoes at F-2 layer heights whose range is independent of frequency were observed frequently in the south direction looking from Puerto Rico. These echoes are explained in terms of high density irregularities imbedded in the F-2 layer having durations from a few min to a few hours. These irregularities are more frequent on the lower edge of the layer. (Contractor's abstract)

2437

Purdue [Research Foundation] Lafayette, Ind.

ON THE SPECTRA OF UNITARY HALF-SCATTERING OPERATORS, by C. R. Putnam. [1961] [4]p. incl. refs. (AFOSR-930) (AF 18(603)139) Unclassified

Also published in Quart. Appl. Math., v. 20: 85-88, Apr. 1962.

The following theorem is proved: Let H_0 and H_1 denote the free and perturbed Hamiltonian 1-dimensional wave mechanical operators $H_0 = -d^2/dx^2$, $H_1 = H_0 + V(x)$ on the Hilbert space $L^2(-\infty, \infty)$, and suppose that $V(x)$ is continuous on $-\infty < x < \infty$, satisfies $0 \leq V(x) \leq$ const. on $-\infty < x < \infty$, and that $\int_{-\infty}^{\infty} V(x)dx < \infty$. Then H_0 and H_1 are absolutely continuous and the strong limits U_+ and U_- of $U_t = \exp(itH_1)\exp(-itH_0)$ exist as unitary operators which satisfy $H_1 = U_+H_0U_+^*$ and $H_1 = U_-H_0U_-^*$. If, in addition $\liminf_{b-a\to\infty} (b-a)^{-3} \int_a^b xV(x)dx = 0$, then the spectrum of each operator U_+ and U_- is the entire unit circle $|z| = 1$.

2438

Purdue [Research Foundation] Lafayette, Ind.

ABSOLUTE CONTINUITY OF CERTAIN UNITARY AND

HALF-SCATTERING OPERATORS, by C. R. Putnam. [1961] [3]p. [AF 18(603)139] Unclassified

Published in Proc. Amer. Math. Soc., v. 13: 844-846, Dec. 1962.

The study of spectrum of unitary operators which effect a unitary equivalence between given pairs of self-adjoint operators acting on a Hilbert space (see item no. 1785, Vol. III; item no. 2279, Vol. IV; and item no. 2437, Vol. V) is continued. It is now shown that if A and D are self-adjoint, with A semi-bounded and D bounded and [domain A ∩ range $D^{\frac{1}{2}}$] dense in H, and if A + D = UAU* with U unitary, then U has a spectral measure which is absolutely continuous to Lebesgue measure on the unit circle. Applications of this result to the wave operators (half-scattering operators) of potential scattering theory are briefly discussed.

2439

Purdue U. Dept. of Chemistry, Lafayette, Ind.

THE HEAT OF FORMATION OF THE HYPOBROMITE ION, by J. E. McDonald and J. W. Cobble. May 1, 1961, 7p. incl. tables, refs. (AFOSR-577) (AF 18-(600)1525) AD 256404 Unclassified

Also published in Jour. Phys. Chem., v. 65: 2014-2015, Nov. 1961.

The heat of formation of the hypobromite ion has been determined by measurement of the heat of hydrolysis of bromine in alkaline solutions at 25°C. The value so obtained was $\Delta H_f^0 = -23.05 \pm 0.2$ kcal/mol. With a free energy of $\Delta F_f^0 = -8.2$ kcal/mol, the partial molal entropy has been determined to be 8.5 ± 0.7 gbs/mol at 25°C. (Contractor's abstract)

2440

Purdue U. Dept. of Chemistry, Lafayette, Ind.

CHEMISTRY OF TECHNETIUM AND RHENIUM, by J. W. Cobble. Final rept. Aug. 1, 1955-May 31, 1961. July 1, 1961, 4p. (AFOSR-1055) (AF 18(600)1525) Unclassified

Accomplishments in the study of the chemistry of rhenium and technetium are listed as follows: development of new standard calorimetric aqueous oxidation procedures applicable to transition metal halides, elucidation of the mechanism of high temperature vaporization of a number of transition metal sulfides; estimation of the thermodynamic functions of many compounds of the transition elements which border the Re-Tc region of the periodic table.

2441

Purdue U. Dept. of Chemistry, Lafayette, Ind.

THE HEATS OF COMBUSTION OF ReS_2 AND Re_2S_7 AND THE THERMODYNAMIC FUNCTIONS FOR TRANSITION METAL SULFIDES, by J. E. McDonald and J. W. Cobble. [1961] [4]p. incl. tables, refs. (AFOSR-3751) (AF 18(600)1525) Unclassified

Also published in Jour. Phys. Chem., v. 66: 791-794, May 1962.

The heats of combustion of ReS_2 and Re_2S_7 have been measured by bomb calorimetry. The heat and free energy of formation at 25° of ReS_2 are -42.7 ± 1.2 kcal mol^{-1} and -41.5 ± 1.2 kcal mol^{-1}, respectively. The similar quantities for Re_2S_7 are -107.9 ± 1.8 kcal mol^{-1} and 101.0 ± 1.8 kcal mol^{-1}, respectively. With data on these key sulfides, along with recalculated heats of formation from previous vapor pressure measurements, it has been possible to estimate the thermodynamic functions for a number of sulfides not previously available. (Contractor's abstract)

2442

Purdue U. Dept. of Chemistry, Lafayette, Ind.

RARE EARTH OXIDE SYSTEMS. PART I. A COMPARISON OF THE HYSTERESIS EFFECTS IN PRASEODYMIUM OXIDE AND EVERETT'S THEORY OF HYSTERESIS, by P. A. Faeth and A. F. Clifford. Mar. 17, 1961, 13p. incl. refs (AFOSR-549) (AF 18(603)45) AD 255160 Unclassified

Presented at meeting of the Amer. Chem. Soc., New York, Sept. 1960.

Also published in Jour. Phys. Chem., v. 67: 1453-1457, July 1963. (Title varies).

The composition-pressure diagram of the Pr-O system has been studied between 10^{-5} and 150 mm oxygen pressure using a quartz beam microbalance. The isotherms between 400 and 500°C show hysteresis between $PrO_{1.80}$ $PrO_{1.83}$ as the pressure varies. At 465°C a hysteresis loop extends over the entire pressure range. Everett's theory of hysteresis is compared to the Pr-O isotherms at 465°C. The seven theorems proposed by Everett are cited and discussed with reference to the Pr-O data. In general the agreement between the properties of Everett's theoretical model of a domain system is good. The behavior of the praseodymium oxide system is thought to be a result of its being composed of domains of various stable compositions, $PrO_{1.83}$, $PrO_{1.80}$, etc. The domains change compositions as a function of the oxygen pressure. (Contractor's abstract)

2443

Purdue U. Dept. of Chemistry, Lafayette, Ind.

RARE EARTH OXIDE SYSTEMS. PART II. THE INFRARED SPECTRA OF PRASEODYMIUM OXIDE AND

PRASEODYMIUM CARBONATE, by P. A. Faeth and A. F. Clifford. Apr. 17, 1961, 17p. incl. diagrs. table, refs. (AFOSR-724) (Also bound with its AFOSR-1897; AD 269098) (AF 18(603)45) AD 258252 Unclassified

Also published in Rare Earth Research; Proc. Second Conf., Glenwood Springs, Colo. (Sept. 24-27, 1961), New York, Gordon and Breach, 1962, p. 35-45.

Several samples of PrO_x have been prepared which have x values between 1.50 and 1.83; by decomposing $PrO_{1.83}$ in vacuo any x value could be prepared. The preparations were analyzed for infrared absorption activity in the region 2-16 microns. 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 microns for the air-exposed oxides is due to hydration-carbonation effects. A sample of praseodymium carbonate was decomposed in vacuo and the spectrum of the resultant compound was observed. A differential thermal analysis of the carbonate in air showed that the dehydration probably is complete below 300°C; the carbonate loses CO_2 at 470°C and 630°C and is subsequently converted to the oxide Pr_6O_{11} near 400°C. (Contractor's abstract)

2444

Purdue U. [Dept. of Chemistry] Lafayette, Ind.

THE OXIDATION AND STOICHIOMETRY OF PRASEODYMIUM AND CERIUM OXIDES, by A. F. Clifford. Final rept. Aug. 31, 1961 [63]p. incl. diagrs. tables, refs. (AFOSR-1897) (AF 18(603)45) AD 269098 Unclassified

The lack of research in naturally occurring semiconductors (oxides) is noted. The stable intermediates between Pr_2O_3 and Pr_6O_{11} are considered and the isotherms of the Pr-O system investigated at temperatures between 400° and 1000°C. The authors then propose that praseodymium oxide is a system composed of domains. A domain is viewed here as a specific number of Pr atoms which act as a unit. The Pr atoms in the domain are subject to reaction with oxygen under certain conditions. In general, the agreement of the properties of the Pr-O system and Everett's hysteresis theory is good.

2445

Purdue U. [Dept. of Chemistry] Lafayette, Ind.

AN X-RAY STUDY ON SEVERAL SAMPLES OF PrO_x. Aug. 31, 1961 [2]p. incl. table. (Bound with its AFOSR-1897; AD 269098) (AF 18(603)45) Unclassified

The x-ray spectra of a series of samples of PrO_x where x varies between 1.500 and 1.833 are discussed. Of particular interest were the phase changes occurring in this stoichiometry range. The position and intensities of lines associated with samples for which x = 1.50 or x = 1.83 varied somewhat with exposure to the atmosphere. No attempt was made to calculate lattice constants or determine the exact crystal structure since only a few major lines were considered entirely reliable. The results were presented in crystal form showing both major and minor phase changes.

2446

Purdue U. [Dept. of Chemistry] Lafayette, Ind.

A PRASEODYMIUM-OXIDE OXYGEN GENERATOR, by P. A. Faeth and A. F. Clifford. Aug. 31, 1961 [2]p. (Bound with its AFOSR-1897; AD 269098) (AF 18(603)45) Unclassified

Also published in Jour. Chem. Education, v. 40: 150-151, Mar. 1963.

The use of the Pr-O system as a source of research quantities of oxygen and the possibility of the regeneration of the oxide reactant in situ are investigated. The generation of oxygen using praseodymium oxide has several advantages. (1) The starting material may be regenerated by simple and economical means. (2) The initial investment of Pr_6O_{11} is never lost as it is in the case of $KMnO_4$ for example. (3) The actual time spent by the operator to perform the generation is small. (4) The equipment needed for the generation is conveniently found in most laboratories with the exceptions of the silica tube and possibly the Toepler pump. A suggested additional use of the oxide is as a source of oxygen at relatively constant pressure to be used in conjunction with the constant oxygen pressure studies of other systems.

2447

Purdue U. Dept. of Chemistry, Lafayette, Ind.

MULTIDENTATE LIGAND KINETICS. I. COPPER(II) AND ETHYLENEDIAMINETETRAACETATONICKELATE(II), by T. J. Bydalek and D. W. Margerum. [1961] [4]p. incl. diagr. tables, refs. (AFOSR-2720) [AF 49(638)60] Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 4326-4329, Nov. 5, 1961.

The kinetics of the substitution reaction between hydrated cupric ion and the ethylenediaminetetraacetatonickelate(II) ion have been studied from pH 1.9 to 4.5 with ionic strength and temperature variation. Both forward and reverse rates were studied. The rate of Cu(II) substitution is 20,000 times faster than the rate of radio-nickel exchange previously measured with the same complex and is not acid catalyzed

as is the radio-nickel exchange. These differences are discussed in terms of partially bonded EDTA intermediates proposed in the 2 systems. (Contractor's abstract)

2448

Purdue U. Dept. of Chemistry, Lafayette, Ind.

COORDINATION CHAIN REACTIONS, by D. C. Olson and D. W. Margerum. [1961] [2]p. (AFOSR-2739) [AF 49(638)60] AD 441694 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 84: 680-681, Feb. 20, 1962.

The exchange reaction between the complex ions triethylenetetramine-nickel (II), NiT^{+2}, and ethylenediaminetetraacetato-cuprate (II), CuY^{-2}, that is $NiT^{+2} + CuY^{-2} \rightarrow CuT^{+2} + NiY^{-2}$, is found to proceed by a chain reaction mechanism. The reaction is initiated by the trace concentration of free triethylenetetramine ($T_T = H_3T^{+3} + H_2T^{+2} + HT + T$) which is in equilibrium with the complex $NiT^{+2} \rightleftharpoons Ni^{+2} + T_T$. This trace of T_T attacks the CuY^{-2} complex, greatly accelerating the rate of EDTA displacement. The trace of EDTA liberated in turn attacks the NiT^{+2} greatly accelerating the rate of triethylenetetramine displacement. Thus the chain propagating steps are $T_T + CuY^{-2} \rightleftharpoons CuT^{+2} + Y_T$ and $Y_T + NiT^{+2} \rightarrow NiY^{-2} + T_T$. Traces of metal ions which can complex triethylenetetramine or EDTA act as chain inhibitors. The Ni^{+2} may act as a chain terminator by the reactions $Ni^{+2} + T_T \; NiT^{+2}$ and $Ni^{+2} + Y_T \rightarrow NiY^{-2}$. These reaction orders are consistent with the proposed mechanism and the detailed kinetic arguments as well as the evaluation of the individual rate constants published. Furthermore, the chain initiating step and the chain terminating step both may be eliminated from the exchange rate by the addition of excess of either trien and EDTA.

2449

Purdue U. [Dept. of Chemistry] Lafayette, Ind.

α-HALOFERROCENES. THE SYNTHESIS OF FERROCENYLACETYLENE, by R. A. Bankeser and W. P. Fitzgerald. [1961] [2]p. (AFOSR-787) (AF 49-(638)297) AD 440519 Unclassified

Also published in Jour. Org. Chem., v. 26: 4179-4180, Oct. 1961.

The synthesis of α-chloroferrocene, α-bromoethyl ferrocene, α,β-dibromoethylferrocene, and ferrocenylacetylene are reported. The α-chloroethylferrocene was prepared by adding dry hydrogen chloride to vinylferrocene in pentane at -78°C and recrystallization. This compound was also prepared by treating an ethereal solution of α-hydroxyethylferrocene containing activated alumina with anhydrous hydrogen chloride. The α-bromoethylferrocene was prepared by adding anhydrous hydrogen bromide to vinylferrocene in pentane at -78°C. Bromine was added to vinylferrocene in pentane at -78°C to form the α, β-dibromoethylferrocene. Ferrocenylacetylene was prepared by adding a pentane solution of the dibromide to potassium amide in liquid ammonia.

2450

Purdue U. Dept. of Chemistry, Lafayette, Ind.

STERIC HINDRANCE AS A FACTOR IN THE ALKYLATION OF AMBIDENT ANIONS: THE ALKYLATION OF POTASSIUM 2,6-DI-t-BUTYLPHENOXIDE, by N. Kornblum and R. Seltzer. [1961] [4]p. incl. diagrs. refs. (AFOSR-441) (AF 49(638)324) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 3668-3671, Sept. 5, 1961.

The reactions of potassium 2,6-di-t-butylphenoxide provide a particularly clear demonstration of the importance which steric effects may assume in the alkylation of ambident anions: methyl iodide gives an 88% yield of ether and 6% carbon alkylation; ethyl iodide gives an 11% yield of ether and 66% carbon alkylation; isopropyl iodide gives exclusively carbon alkylation. (Contractor's abstract)

2451

Purdue U. [Dept. of Chemistry] Lafayette, Ind.

EXCEPTIONS TO THE RULE OF TRANS-NUCLEOPHILIC ADDITION, by W. E. Truce. May 1-Nov. 1, 1961, 3p. (Rept. no. 6) (AFOSR-862) (AF 49(638)-531) Unclassified

Infrared and ultraviolet spectroscopy were used to show that the reaction between sodium p-toluenethiolate and sodium propiolate proceeds in a trans manner, almost exclusively, to yield the cis product.

2452

Purdue U. Dept. of Chemistry, Lafayette, Ind.

NUCLEOPHILIC REACTIONS OF THIOLS WITH ACETYLENES AND CHLOROETHYLENES, by W. E. Truce. [1961] [9]p. incl. refs. (AFOSR-1863) (AF 49(638)531) AD 445176 Unclassified

Also published in Organic Sulfur Compounds, New York, Pergamon Press, v. 1: 112-120, 1961.

Nucleophilic additions of thiols to acetylenes tend to proceed in a trans manner. These reactions, as well as nucleophilic displacements of halogens from olefinic carbon atoms are discussed. The latter displacements may proceed by several different paths. (Contractor's abstract)

2453

Purdue U. Dept. of Chemistry, Lafayette, Ind.

THE STEREOCHEMISTRY OF THE NUCLEOPHILIC ADDITION OF p-TOLUENETHIOL TO 1-p-TOLYLSULFONYL-CYCLOHEXENE, by W. E. Truce and A. J. Levy. [1961] [3]p. incl. diagrs. refs. (AFOSR-2038) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)531 and Minnesota Mining and Manufacturing Co.) AD 611387
Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 4641-4643, Nov. 20, 1961.

p-Toluenthiol adds to 1-p-tolylsulfonyl-cyclohexene, under mildly basic conditions, in a trans manner giving cis-2-p-tolylmercapto-1-p-tolylsulfonyl-cyclohexane. The stereochemistry of the adduct was confirmed by independent synthesis and supported by n m r spectra. A mechanism for the addition is proposed and evidence presented to support it. (Contractor's abstract)

2454

Purdue U. Dept. of Chemistry, Lafayette, Ind.

THE STEREOCHEMISTRY OF THE ADDITIVE OF MESITYLENETHIOL TO MESITYLACETYLENE, by W. E. Truce, H. G. Klein, and R. B. Kruse. [1961] [6]p. incl. table, refs. (AFOSR-2039) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)531 and National Institutes of Health) AD 611388
Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 4636-4641, Nov. 20, 1961.

The addition of mesitylenethiol under basic and non-basic conditions proceeds trans. The configurational assignments to the adduct and its sulfone derivative are based on n m r , infrared and chemical evidence. (Contractor's abstract)

2455

Purdue U. [Dept. of Mathematics] Lafayette, Ind.

[NON-HILBERTIAN REFRACTIONS OF A BOUNDED SYMMETRICAL TRANSFORMATION] Refractions non-hilbertiennes d'une transformation symétrique bornée, by G. L. Krabbe. Apr. 21, 1961, 18p. incl. diagrs. refs. (Technical note no. 8) (AF 49(638)505)
Unclassified

Published in Studia Math., v. 20: 347-357, 1961.

Let (Ω, B, μ) be a measure space, $L_{1/r}$ the usual Lebesgue space with respect to μ for $0 < r \leq 1$, and L^0 the collection of measurable step functions. If H is a bounded operator on $L_{1/2}$ and if the restriction, H^0, of H to L^0 is bounded in the operator norm defined by $L_{1/r}$, then H^0 has a continuous extension to $L_{1/r}$ called the refraction of H; its norm is denoted by $|H|_r$. Suppose H is self-adjoint and its resolution of the identity satisfies $\sup_\lambda |E(\lambda)|_r < \infty$ for $0 < r < 1$. Let J be a compact interval of the real line, $W_p(J)$ the Wiener class consisting of functions which satisfy $\sup \sum_{k=1}^{n} |f(t_k) - f(t_{k-1})|^{1/p} < \infty$, where the sup is taken over all partitions of J, and $F_r(J) = \cup\{W_p(J): 2|r-1/2| < p \leq 1\}$. The author's main result states that the limit of the Riemann-Stieltjes sums formed from $f \in F_r$ and $E(\lambda)$ exist in the uniform operator topology of the bounded operators on $L_{1/r}$. The proof is an application of the Riesz-Thorin convexity theorem and a Hölder-type inequality.

2456

Purdue U. [Dept. of Physics] Lafayette, Ind.

DIMENSIONALITY OF CHARGE SPACE, by D. C. Peaslee. [1956] [2]p. (Sponsored jointly by [Air Force Office of Scientific Research under AF 18(600)-1579] and Atomic Energy Commission)
Unclassified

Published in Nuovo Cimento, Series X, v. 4: 1583-1584, Dec. 1, 1956.

Though there is no lack of experimental evidence to indicate that real space-time is a 4-dimensional manifold, there is much less certainty in attributing dimensions to the charge space of heavy particles. Various hypotheses on the subject are reviewed. Experimental evidence on the dimensionality of charge space becomes increasingly tenuous with increasing n. The 4-dimensional scheme cannot readily account for the Ξ, N mass difference but has a number of formal attractions and is accessible to further experimental study. The possibility of some 5-dimensional charge symmetry is not yet ruled out, but would require the Λ and N to have identical spins and parities. The 6-dimensional hypothesis would require increased statistics on anomalous V-decays for verification.

2457

Purdue U. Dept. of Physics, Lafayette, Ind.

PION-ELECTRON DECAY, by M. Kawaguchi and K. Nishijima. [1957] [3]p. (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)-1579 and Atomic Energy Commission)
Unclassified

Published in Phys. Rev., v. 108: 905-907, Nov. 1, 1957.

On the basis of special invariance assumptions for the interactions, a partial cancellation is expected between nucleon and Ξ particle intermediate states in the decay

$\pi^+ \rightarrow e^+ + \nu + \gamma$ which reduces the rate expected for this process from the nuclear β-decay interaction. The disagreement with experiment for T interaction is thereby reduced.

2458

Purdue U [Dept. of Physics] Lafayette, Ind.

ENERGY RELEASE FROM THE DECAY OF FISSION PRODUCTS, by J. F. Perkins and R. W. King. [1957] [21]p. incl. diagrs. tables, refs. [AF 18(600)-1579] Unclassified

Published in Nuclear Sci. and Engineering, v. 3: 726-748, June 1958.

The total disintegration rates, rates of beta- and gamma-energy release, and gamma-ray spectrum, are calculated for fission products due to thermal neutron fission of U^{235}. Information on decay schemes was largely obtained from the compilations of the Nuclear Data Group of the National Research Council of July, 1957. Total fission yields are from Katcoff and from Steinberg and Glendenin Nuclear charge distributions are taken from Pappas' work, which includes the effect of closed shells. Reactor operating times of 1, 10, 100, and 1000 hr are treated, and the results plotted for decay times ranging from 10^2 to 10^8 sec. In addition, results for instantaneous operation are compared to other calculations and measurements. The present results fall below Way and Wigner's predictions of both disintegration rate and total energy release over the entire range of decay times, though they do agree satisfactorily with the Way-Wigner rule-of thumb expressions. The present results are in very good agreement with experimental measurements. The gamma spectrum is found to vary considerably with decay time but to be only a weak function of reactor operating time. The total beta and antineutrino energies per fission are found to be 7.6 ± 0.5 and 10.0 ± 0.7, respectively. (Contractor's abstract)

2459

Purdue U. [Dept. of Physics] Lafayette, Ind.

GENERAL COVARIANCE AND THE PARTICLE SPECTRUM, by D. W. Joseph. [1960] 22p. (AFOSR-TN-60-1239) (AF 18(600)1579) AD 416349 Unclassified

It is postulated that the wave function of a quantum mechanical system be non-trivially covariant under all transformations among some set of coordinate systems appropriate to our curved space-time. It is next shown that this set can probably not be taken to be the curvilinear coordinate systems of general relativity theory. It is then suggested that a "physically distinguishable" set of coordinates be determined. This amounts to embedding space-time in a pseudo-Euclidean space of dimension n. An example is presented of a model with n = 8 to illustrate how the increase in the number of components of spinors and the requirement that the wave functions vanish at any appreciable distance from the space-time manifold can lead to a spectrum of elementary particles, with a possible prediction of their masses. (Contractor's abstract)

2460

Purdue U. [Dept. of Physics] Lafayette, Ind.

STUDY OF NUCLEAR STRUCTURE AND INTERACTIONS, by R. W. King and S. Gartenhaus. Final technical rept. Feb. 1, 1956-Oct. 31, 1961, 3p. incl. refs. (AFOSR-2325) (AF 18(600)1579) Unclassified

This report lists the personnel who have participated in work done under this contract and publications that resulted therefrom. Twenty-six publications are listed under this contract.

2461

Purdue U. Dept. of Physics, Lafayette, Ind.

S-WAVE PION-NUCLEON SCATTERING, by J. L. Uretsky. [1960] [6]p. incl. diagr. refs. (AFOSR-879) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)767], Atomic Energy Commission, and National Science Foundation) Unclassified

Also published in Phys. Rev., v. 123: 1459-1464, Aug. 15, 1961.

The Mandelstam relations for pion-nucleon scattering are used to obtain equations for the s-wave partial wave amplitudes in the 2 isotopic spin states. The solutions of these equations are investigated in the approximation where only the 1-nucleon contributions and the unitarity integral are kept. It is found that there are no solutions of the form N/D without complex zeros, and that this is a consequence of the large size of the 1-nucleon terms. A comparison with experiment is made which suggests that the dominant contribution to the T = 3/2 s-wave amplitude (other than the 1-nucleon contribution) comes from a region of the complex energy plane that is outside the physical region for the related processes (π-π into NN and "crossed" π-N scattering). An appendix is devoted to discussing the available experimental data and they are found to be consistent with a scattering length (δ/k at threshold) of 0.098 ± 0.004 in the T = 3/2 state. (Contractor's abstract)

2462

Purdue U. [Dept. of Physics] Lafayette, Ind.

ON A VARIATIONAL PRINCIPLE FOR A CLASSICAL PLASMA, by S. Gartenhaus. [1961] [9]p. incl. refs. [AF 49(638)767] Unclassified

Published in Phys. Fluids, v. 4: 1122-1130, Sept. 1961.

A time-dependent version of the Hartree-Fock method is set up for a classical system, by making use of the formal similarity between Liouville's equation for such a system and the Schrödinger equation. The use of a product trial function in the resultant variational principle produces, for a plasma, the collisionless Boltzmann equation. A second application is made to a system for which short-range correlations are small but not negligible. It is found that regardless of the range of the interparticle forces and the magnitude of the density, equilibrium is described only by a Maxwellian velocity distribution.

2463

Purdue U. Dept. of Physics, Lafayette, Ind.

COORDINATE COVARIANCE AND THE PARTICLE SPECTRUM, by D. W. Joseph. [1961] [5]p. incl. refs. (AFOSR-J1253) (AF AFOSR-62-132) AD 424315 Unclassified

Also published in Phys. Rev., v. 126: 319-323, Apr. 1, 1962.

An attempt is made to find an analog, for the quantum mechanics of non-Euclidean space-time, to the classification of representations of the Lorentz group. The difficulty of obtaining any such classification in terms of curvilinear coordinates is pointed out, and the use of a higher-dimensional set of pseudo-Euclidean coordinates is chosen as an alternative mode of attack. A class of representations then follows easily. On the basis of an intuitive approximation it is found that spectra of elementary particles, with conservation of quantities of the nature of isotopic spin, seem to arise from these representations.

2464

Purdue U. Dept. of Physics, Lafayette, Ind.

INTEGRAL EQUATION FOR STATIC NUCLEAR POTENTIAL, by W. M. Frank and A. Tubis. [1961] [19]p. incl. diagrs. (Sponsored jointly by Air Force [Office of Scientific Research] under [AF AFOSR-62-132] and Atomic Energy Commission) Unclassified

Published in Ann. Phys., v. 17: 240-258, Feb. 1962.

The Chew-Low formalism (Ann. Phys., v. 17: 205-239, 1962) is applied to the solution of an integral equation for the potential between 2 fixed nucleons. A unique solution in the form of an expansion in the number of exchanged mesons is easily found, and the contribution of 1 and 2 meson exchanges is evaluated. The potential is shown to agree with the results of certain other calculations. (Contractor's abstract)

2465

Purdue U. [Jet Propulsion Center] Lafayette, Ind.

LUMINOSITY AND PRESSURE OSCILLATIONS OBSERVED WITH LONGITUDINAL AND TRANSVERSE MODES OF COMBUSTION INSTABILITY, by M. J. Zucrow, J. R. Osborn, and A. C. Pinchak. [1959] [4]p. incl. illus. diagr. (Sponsored jointly by [Air Force Office of Scientific Research under AF 49(638)-756] and Office of Naval Research under N7onr-39418) Unclassified

Published in ARS Jour., v. 30: 758-761, Aug. 1960.

Combustion pressure oscillations were observed in 2 experimental gaseous bipropellant rocket motors. The geometries of the 2 motors were different so that 1 rocket motor tended to exhibit only the longitudinal mode while the other displayed only transverse modes of oscillations. The local pressure and the luminosity of the combustion gases were simultaneously recorded while the rocket motors were operating with combustion pressure oscillations. The results indicate that the reaction mechanism which sustains the longitudinal mode is similar to the aerothermodynamic interaction which supports the transverse modes of combustion pressure oscillation. In addition, the results are in agreement with and support the shock or pressure wave mechanism of combustion pressure-oscillations as postulated by Zucrow and Osborn.

2466

Purdue U. Jet Propulsion Center, Lafayette, Ind.

IMPORTANCE OF COMBUSTION CHAMBER GEOMETRY IN HIGH FREQUENCY OSCILLATIONS IN ROCKET MOTORS, by J. R. Osborn and J. M. Bonnell. [1960] [4]p. incl. diagrs. (AFOSR-3399) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)756 and Office of Naval Research under N7onr-39418) Unclassified

Presented at ARS semi-annual meeting, Los Angeles, Calif., May 9-12, 1960.

Also published in ARS Jour., v. 31: 482-486, Apr. 1961. (Title varies)

For abstract see item no. 2307, Vol. IV.

2467

Purdue U. Jet Propulsion Center, Lafayette, Ind.

UNSTABLE BURNING IN LIQUID AND SOLID PROPELLANT ROCKET MOTORS, by M. J. Zucrow and J. R. Osborn. [1961] [13]p. incl. diagrs. tables, refs. [AF 49(638)756] Unclassified

Published in Proc. Bureau of Naval Weapons, Missiles and Rockets Symposium, Concord, Calif. (Apr. 13-21, 1961), Concord, U. S. Naval Ammunition Depot, 1961, p. 153-165.

The desired solution to the problem of unstable combustion in either liquid or solid propellant rocket engines is one which provides either design criteria or a procedure that can be applied by the rocket engine designer so that a rocket motor can be designed with assurance that unstable combustion will be avoided.

It appears that considerably more research effort, experimental and theoretical, will be required before such an ideal solution will be even approached. A better understanding is still needed of the cause and effect mechanisms, and without such knowledge sound theoretical developments are seriously hampered. (Contractor's abstract)

2468

Purdue U. [Jet Propulsion Center] Lafayette, Ind.

COMBUSTION INSTABILITY IN GASEOUS BIPROPELLANT ROCKET MOTORS (Abstract), by J. R. Osborn. [1961] [1]p. [AF 49(638)756] Unclassified

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

An experimental program is being conducted at Purdue U. for determining the manner in which basic variables influence high-frequency combustion pressure oscillations. The experiments were conducted with gaseous bipropellant rocket motors in which the fuel and oxidizer were thoroughly mixed prior to their injection into the combustion chamber. Additional experiments are being initiated with gaseous bipropellant rocket motors in which the fuel and oxidizer are injected separately into the combustion chamber. One of the basic variables that has been investigated for the premixed gaseous motors is the location of the injection point of the combustible materials. Three locations were investigated: (1) at the head end of the combustion chamber, (2) along the length of the combustion chamber, and (3) at the nozzle end of the combustion chamber. The results indicate that the mode of oscillation is influenced by the location of the injection point. Other experimental results discussed include those obtained from a 3 in. diameter motor having a semi-porous injector. That motor was employed for studying the longitudinal mode.



2469

Rabinow Engineering Co., Inc., Washington, D. C.

ANALYSIS OF A PROPOSED SYSTEM FOR CONVERTING ROTARY MOTION INTO UNIDIRECTIONAL MOTION, by J. Rabinow. May 24, 1961 [24]p. incl. illus. diagrs. tables. (AFOSR-938) (AF 49(638)1075) Unclassified

A proposed mechanism is analyzed and presented. The results show that the system does not have any unusual properties, nor does it contradict Newtonian laws of mechanics. The system may have application as an impact machine or vibrator but cannot produce a unidirectional impulse without an equal and opposite impulse. However, the device tested is not an efficient design for an impact or vibration machine. The demonstration device gives the illusion of generating a force without an equal and opposite reaction by making use of the static friction of the load against the floor or other support to absorb the reaction. It cannot perform as claimed in the absence of static friction against an outside reference body. There is no way in which the principle employed in the device can be adapted to provide a space drive. (Contractor's abstract)

2470

Radio Corp. of America. Astro-Electronics Div., Princeton, N. J.

FREQUENCY DEPENDENCE OF PLASMA ACCELERATION BY RADIO-FREQUENCY FIELD GRADIENT, by C. A. Swartz and T. T. Reboul. [1961] [4]p. incl. diagrs. (AFOSR-995) (AF 49(638)658) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 308, Apr. 24, 1961.

Also published in Phys. Fluids, v. 5: 803-806, July 1962.

Plasma acceleration by an rf field gradient has been observed for both 140 mc and 330 mc fields. The kinetic energy gain of the accelerated ions varied inversely with the applied frequency. Comparison with theory indicates that in the interaction region most of the accelerated plasma has a resonant frequency near the applied frequency. The collision frequency which limits the acceleration in the test apparatus is approximately 6 mc. (Contractor's abstract)

2471

Radio Corp. of America. [Astro-Electronics Div.] Princeton, N. J.

SMALL-SIGNAL THEORY OF HIGH IMPEDANCE RF-FORCE PLASMA DEVICES, by H. W. Lorber. [1961] [7]p. incl. diagrs. refs. (AFOSR-1156) (AF 49-(638)658) Unclassified

Also published in Phys. Fluids, v. 5: 1003-1009, Aug. 1962. (Title varies)

Levitation, propulsion, and power-generation devices have been proposed which make use of the dynamic properties of an rf electromagnetic field for exerting a steady force on a plasma. This force, which acts for the most part on the plasma electrons, is due to the time averages of the not-quite sinusoidal electric fields seen by the electrons during their motion through the plasma. The analysis of an rf-force device can be thought of as the simultaneous solution of an electromagnetic-field problem, an rf-force problem, and a fluid-mechanics problem, together with other problems which are beyond the scope of the present discussion. It is shown that in the absence of a magnetostatic field, in the case of small signal and high impedance, the force of the rf field on the plasma can be expressed rather simply, being essentially proportional to the energy density gradient of the rf electric field. An example is presented in which the rf-force expression is applied to a simple plasma propulsion problem involving a plasma and an electrode structure, both of finite extent. The solution is consistent with experimental results. (Contractor's abstract)

2472

Radio Corp. of America. [Astro-Electronics Div.] Princeton, N. J.

FOCUSING OF A CESIUM PLASMA BY THE APPLICATION OF AN RF FIELD GRADIENT, by L. S. Napoli. Oct. 31, 1961 [21]p. incl. illus. diagrs. refs. (AFOSR-1830) (AF 49(638)658) AD 270124 Unclassified

A synthesized cesium plasma was focused by the application of quadrupolar electric fields at frequencies of 141, 395 and 1000 mc. The force was found to decrease with increasing frequency and to increase with increasing applied electric fields. However, the force did not depend on the particle density. These results are in qualitative agreement with theory. (Contractor's abstract)

2473

Radio Corp. of America. Astro-Electronics Div., Princeton, N. J.

PLASMA ACCELERATION BY ELECTRIC FIELD GRADIENT (Abstract), by T. T. Reboul, G. A. Swartz, and G. D. Gordon. [1961] [1]p. (Bound with AFOSR-582; AD 257892) (AF 49(638)658) Unclassified

Presented at Fourth annual AFOSR Contractors' meeting on Ion and Plasma Acceleration, Beverly Hills, Calif., Apr. 20-21, 1961.

Previous work has shown that a plasma can be

accelerated by an rf field gradient. Experimental confirmation was obtained by measuring the transit time of plasma electrons between two probes. In the most recent work, the transit time of the plasma ions was measured. The ion velocity showed a hyperbolic dependence on the maximum rf field amplitude which is consistent with the previous theory. To determine the frequency dependence, measurements were made at 140 mc and 330 mc; the kinetic energy imparted by the rf field was found to be inversely proportional to the applied frequency. A comparison of the experimental data with the theory indicates that the ratio of the plasma frequency to the applied frequency was approximately unity. The collision frequency which limits the acceleration in the test apparatus is approximately 6 mc. A 2.45 kmc rf system has been constructed and future work will involve experiments at this accelerating frequency. Since a plasma of higher density than previously used may be accelerated at this frequency, it is anticipated that the thrust exerted by the rf technique may be measured.

2474

Rand Corp., Santa Monica, Calif.

TRANSFORMATIONAL CRITERIA FOR THE CLASSIFICATION OF PREDICATIVE GENITIVE CONSTRUCTIONS IN RUSSIAN, by D. S. Worth. Jan. 24, 1961, 15p. incl. refs. (Research memo no. RM-2714) (AFOSR-148) (AF 49(638)737) AD 257288
Unclassified

Also published in Proc. Internat'l. Conf. on Machine Translation of Languages and Applied Language Analysis, Teddington (Gt. Brit.) (Sept. 5-8, 1961), London, Her Majesty's Stationery Office, v. 2: 725-735, 1962.

A major advantage of the transformational approach to syntactic structure is that the investigator is no longer bound to the low levels of generality inherent in the morphological detail of actual sentences. Instead, he can regard syntax as a dynamic, addressor-oriented process, the units of which form a hierarchy of functional abstractions. This conception is illustrated by an analysis of Russian constructions containing genitive substantives that must be modified by another unit, although the exact form (adjective or substantive) of this second unit is irrelevant. The transformationally determined varieties of such constructions are cataloged, and it is shown that all such constructions contain either an actual or an implied predication. (Contractor's abstract)

2475

Rand Corp., Santa Monica, Calif.

PROCEDURES FOR THE DETERMINATION OF DISTRIBUTIONAL CLASSES, by K. E. Harper. Jan. 23, 1961, 19p. incl. table. (Research memo no. RM-2713) (AFOSR-149) (AF 49(638)737) AD 257287
Unclassified

Also published in Proc. Internat'l. Conf. on Machine Translation of Languages and Applied Language Analysis, Teddington (Gt. Brit.) (Sept. 5-8, 1961), London, Her Majesty's Stationery Office, v. 2: 687-700, 1962.

Studies in distributional semantics (word correlation) are in progress at the Rand Corp., based on the automatic analysis of a 250,000 word corpus of Russian physics text. The present paper describes some of the typical procedures that will be used in this analysis and discusses some of the salient problems involved. Data derived from current, semiautomatic analysis are also presented. (Contractor's abstract)

2476

Rand Corp., Santa Monica, Calif.

ON THE VALUE OF A DEPENDENCY CONNECTION, by D. G. Hays. Jan. 20, 1961, 21p. incl. diagrs. (Research memo no. RM-2712) (AFOSR-150) (AF 49(638)-737) AD 257286
Unclassified

Also published in Proc. Internat'l. Conf. on Machine Translation of Languages and Applied Language Analysis, Teddington (Gt. Brit.) (Sept. 5-8, 1961), London, Her Majesty's Stationery Office, v. 2: 577-592, 1962.

In sentence-structure determination, values are tentatively defined as numbers assigned to types of syntactic relations in such a way that connections of higher value are established in preference to connections of lower value. For a text in which sentence structures are known the values of some syntactic relations can be estimated by the following plan: assign value 1 to a relation provided no relation is known to have lower value; assign value 2 to a relation provided all relations known to have lower value are also known to have value 1; etc. The same procedure can be used for assigning adjectives to order classes, and for other similar purposes. (Contractor's abstract)

2477

Rand Corp., Santa Monica, Calif.

SIX TASKS IN COMPUTATIONAL LINGUISTICS, by K. E. Harper, D. G. Hays and others. Final rept. Oct. 1961, 107p. incl. tables. (Research memo no. RM-2803) (AFOSR-1362) (AF 49(638)737) AD 264769
Unclassified

Three linguistic problems are discussed: distributional-semantic classification of Russian words, statistical procedures for the discovery of grammatical transformations, and derivational-family classification of Russian words. A set of programs for management of a file of unedited test on magnetic tape is reported. One program to be included in a set of glossary-management programs, this 1 an editing program, is described. Text improvements, setting requirements for a text-editing program, are reported. A list of technical notes prepared under the contract is appended. (Contractor's abstract)

Reaction Motors, Inc., Denville, N. J. see Thiokol Chemical Corp. Reaction Motors Div., Denville, N. J.

2478

[Reading U.] Inst. of Experimental Psychology, Oxford (Gt. Brit.).

RESEARCH ON THE ANALYSIS OF THE NEURAL MECHANISM UNDERLYING PERCEPTION, by D. M. Vowles. Final technical summary rept. no. 1, June 1, 1958-Sept. 30, 1960. Jan. 27, 1961 [26]p. (AFOSR-638) (AF 61(052)114) AD 258869 Unclassified

This report summarizes the experiments conducted under this contract. The research is classified under the following headings: (1) Visual mechanisms in locusts including form discrimination, orientation, brain lesions, and electroretinograms; (2) Quantitative study of instinctive behavior in ants; (3) Maze learning in ants; (4) Brain lesions and instinctive behavior in ants; (5) Electro-physiology of the mushroom bodies; and (6) Localized electrical stimulation of the mushroom bodies.

2479

Rensselaer Polytechnic Inst. Dept. of Aeronautical Engineering, Troy, N. Y.

EFFECT OF FREE-STREAM VORTICITY ON THE BEHAVIOR OF VISCOUS BOUNDARY LAYER ON BLUNT BODY, by T. Y. Li. Feb. 28, 1961 [29]p. incl. diagrs. refs. (Rept. no. TR-AE-6103) (AFOSR-425) (AF 18(600)1591) AD 254876 Unclassified

The effect of shock generated vorticity in the oncoming flow upon the skin friction in the stagnation region of an axisymmetric body traveling at hypersonic speed was investigated under the assumptions of constant density and constant fluid properties. The results indicate that the interaction between the external vorticity and the boundary layer displacement effects produces an induced pressure gradient which must be taken into account in the solution of the problem. The skin friction formula as recently found by Van Dyke is confirmed. (Contractor s abstract)

2480

Rensselaer Polytechnic Inst. Dept. of Aeronautical Engineering, Troy, N. Y.

REVIEW OF HYPERSONIC RESEARCH, by T. Y. Li. Final rept. Dec. 1, 1955-Dec 31, 1960. Mar. 1, 1961 1961, 13p. incl. refs. (Rept. no. TR-AE-6104) (AFOSR-440) (AF 18(600)1591) AD 254455 Unclassified

A summary of the results obtained during studies of hypersonic flow problems carried out at the Rensselaer Polytechnic Inst. is presented. The problems investigated include: (1) effect of free stream vorticity on laminar boundary layer flow, (2) hypersonic flow field around blunt bodies, (3) real gas effects in hypersonic flows, (4) an inverse problem in hypersonic viscous flow, (5) some studies of unsteady hypersonic flow phenomena, and (6) the hypersonic leading edge problem. In the study of the real gas effects in hypersonic flows, considerable further work is necessary for a basic understanding of the nonequilibrium flow effects (Contractor's abstract, modified)

2481

Rensselaer Polytechnic Inst. Dept. of Aeronautical Engineering, Troy, N. Y.

VORTEX FLOW IN A DISSOCIATING GAS, by K. C. Wang. Sept. 1961 [11]p. incl. diagrs. table. (Rept. no. TR-AE-6108) (AFOSR-1512) (AF 49(638)977) AD 267888 Unclassified

Also published in Jour. Aerospace Sci., v. 29: 623-624, May 1962.

Analysis concerns a simple vortex flow in a compressible, inviscid, dissociating gas. Numerical results for frozen flow and equilibrium flow have been obtained using Lighthill's ideal dissociating gas model. The differences in pressure and density between these two limiting cases are large, however, it is relatively small in temperature. For the nonequilibrium flow case, there does not exist a simple vortex flow of the conventional type. (Contractor's abstract)

2482

Rensselaer Polytechnic Inst. Dept. of Aeronautical Engineering, Troy, N. Y.

THE LOSS OF MECHANICAL ENERGY IN THE FLOW OF A DISSOCIATION GAS, by K. Kusukawa and T. Y. Li. Dec. 1961, 20p. incl. diagrs. (Rept. no. TR-AE-6111) (AFOSR-1967) (AF 49(638)977) AD 274317 Unclassified

The problem of nonequilibrium drag is applied to an arbitrary body in steady adiabatic subsonic dissociating gas flow, viscosity, heat conduction and diffusion being neglected. The basic equations are: thermal and caloric equations of state, chemical relaxation equation, general equation of thermodynamic change, and first law of thermodynamics. These basic equations describe completely the thermodynamic behavior of the moving material element subjected to the effects of dissociation and recombination. (Contractor's abstract)

2483

[Rensselaer Polytechnic Inst.] Dept. of Chemistry, Troy, N. Y.

OXIDE FORMATION ON CdTe AND ZnTe (Abstract), by H. D. Coghill, R. K. DiCerbo and others. [1961] [1]p. [AF 49(638)53] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 312, Apr. 24. 1961.

Irreversible changes in the electrical and optical properties of surfaces of single crystals of CdTe and ZnTe occur on exposure to air. The reaction rate increases with increasing temperature. Electron diffraction measurements have established that these changes are due in part to the formation of TeO_2 surface films. This behavior is consistent with the oxygen-sulfide (e.g., ZnS) reaction in which SO_2 is an initial reaction product. Beneath the transparent surface oxide film the oxygen interaction produces a "diffused impurity" layer which also has optical and electrical properties different from the initial sample. One might anticipate n-type conductivity in a layer containing Te vacancies or oxygen substituted for Te. However, p-type conductivity is observed. TeO_2 formation does not simply fit into previously proposed mechanisms for the interaction of oxygen with CdTe. Alternative mechanisms remain to be established.

2484

[Rensselaer Polytechnic Inst. Dept. of Chemistry, Troy, N. Y.]

PHASE EQUILIBRIA IN THE SYSTEM Cd-Te, by M. R. Lorenz. [1961] [9]p. incl. diagrs. tables. [AF 49-(638)50] Unclassified

Published in Jour. Phys. and Chem. Solids, v. 23: 939-947, July 1962.

The system Cd-Te was studied as a function of composition temperature and component pressure over the entire range. The maximum controlled Cd pressure that may be imposed on solid CdTe is 6.7 atm. Similarly for Te_2 pressure, the limit is about 1.6 atm.

The consequence of such a maximum pressure, which also applies to the liquidus, is discussed. The present results then form a foundation for a basic investigation of the semiconductor properties of CdTe in a thermodynamically better understood system. (Contractor's abstract)

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Rensselaer Polytechnic Inst. Dept. of Chemistry, Troy, N. Y.

THE OXIDATION OF TETRABORANE, by K. H. Ludlum, S. E. Wiberley, and W. H. Bauer. June 1961, 1v. incl. diagrs. tables, refs. (AFOSR-401) (AF 49(638)897) AD 259093 Unclassified

An investigation of the explosive oxidation of tetraborane and the partial oxidation of tetraborane was undertaken. Mixtures of tetraborane with O, and with O and inert gas were prepared at known pressures and temperatures in the reaction bulbs; these mixtures exploded on heating. The data obtained indicated a branching chain reaction with chain initiation in the gas phase and chain breaking on the wall of the vessel. The entire range of pressures and temperatures investigated shows the behavior generally attributed to the first explosion limit of a branching chain reaction. Lead tetraethyl was found to inhibit the reaction erratically and in some cases prevented explosion. The partial oxidation of tetraborane was brought about by the slow addition of O to tetraborane in the IR gas reaction cell. A reaction occurred which produced diborane, partial oxidation product, H, and boric acid anhydride. Mixtures of tetraborane and diborane to which O was slowly added reacted similarly. Argon had no effect on the system under the conditions studied. (Contractor's abstract)

2486

Rensselaer Polytechnic Inst. Dept. of Chemistry, Troy, N. Y.

THE OXIDATION OF SYM-DIETHYLDIBORANE, by E. I. Sandvik. Mar. 1961, 80p. incl. diagrs. tables, refs. (AFOSR-710) (AF 49(638)897) AD 259091 Unclassified

The gas phase oxidation of sym-diethyldiborane has been studied under both explosive and non-explosive conditions. The non-explosive partial oxidation has been studied in the temperature region from 40° to 80°C. The overall reaction observed in the partial oxidation is: $(C_2H_5BH_2)_2 + 2O_2 - 2C_2H_5OBO + 2H_2$. Comparison of the relative rates of sym-diethyldiborane consumption, oxygen consumption and hydrogen formation indicates that 2 intermediate partial oxidation products are present. One of these has a peroxide structure. The rate of disappearance of sym-diethyldiborane in the partial oxidation was found experimentally to be zero order in oxygen and first to three-halves order in sym-diethyldiborane. This rate was found to have a temperature dependence corresponding to an activation energy of 32.5 ± 1.5 kcal/mol. The products of explosions with mixtures of 9 oxygen to 1 sym-diethyldiborane were observed to be CO_2, H_2O and a white solid, presumably B_2O_3. The effect of helium and argon on the explosion pressure clearly indicates that the mechanism causing explosion is primarily thermal. The enthalpy change of the partial oxidation reaction has been estimated, using literature values of bond energies and heats of formation, to be approximately 150 kilocal/mol. The explosive oxidation is believed to be an initial rapid partial oxidation reaction generating enough heat to cause complete combustion. A mechanism is proposed for the partial oxidation. The first three reaction steps of this mechanism can give a rate expression three-halves order in sym-diethyldiborane and zero order in oxygen, in agreement with the experimentally observed orders. (Contractor's abstract, modified)

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Rensselaer Polytechnic Inst. [Dept. of Chemistry] Troy, N. Y.

KINETICS OF THE OXIDATION OF BORANES AND

BORANE DERIVATIVES (Abstract), by W. H. Bauer, S. E. Wiberley, and R. L. Strong. [1961] [2]p. [AF 49(638)897] Unclassified

Presented at Second AFOSR Contractors' meeting on Chemical Kinetics of Propulsion, Illinois Inst. of Tech. Armour Research Foundation, Chicago, Sept. 11-12, 1961. (AFOSR-1417; AD 265513)

The explosive oxidation of tetraborane has been studied in glass bulbs of varying diameter with tetraborane-oxygen mixtures in the ratio of 1 to 5. The effects on the explosion limits of added inert gases as well as lead tetraethyl which has also been investigated shows the behavior generally attributed to the first explosive limit of a branching chain reaction. Upon slow addition of tetraborane to oxygen, a partial oxidation occurs, yielding B_2H_6 and $H_2B_2O_3$, with the latter substance decomposing to B_2O_3 and hydrogen. A general mechanism to explain the explosive and partial oxidation of tetraborane has been prepared. Studies similar to those described for tetraborane have been conducted on sym-diethyldiborane. Sym-diethyldiborane may be oxidized at measurable rates to form ethyl metaborate and hydrogen. With the proper conditions of concentration, temperature, and vessel geometry, the heat generated by this reaction may accelerate the reaction until an explosion results. No autoacceleration of the partial oxidation, as was found in the diborane oxidation, was ever observed. Results indicate that the explosive mechanism is predominantly thermal and not chain branching. However, the oxidation reaction is not completely homogeneous which causes deviations from the simple thermal explosive limit theory of Semenoff. The overall reaction observed in the partial oxidation is: $(C_2H_5BH_2)_2 + 2\ O_2 \rightarrow 2\ C_2H_5OBO + 2H_2$.

2488

Rensselaer Polytechnic Inst. Dept. of Chemistry, Troy, N. Y.

SURFACE CATALYZED EXCITATION WITH N AND O ATOMS, by G. G. Mannella, R. R. Reeves, and P. Harteck. [1960] [2]p. (AFOSR-2804) (Sponsored jointly by Air Force Cambridge Research Center; and [Air Force Office of Scientific Research under AF 49(638)928]) Unclassified

Also published in Jour. Chem. Phys., v. 33: 636-637, Aug. 1960.

In a previous publication (Jour. Chem. Phys., v. 32: 946, 1960) the formation of electronically excited species by atom recombination on a cool surface (about 300° K) and subsequent radiation or reaction of the excited species was reported. This surface catalyzed excitation (SCE) was, specifically, observed when N and O atoms were passed over Co, Ni, or prepared Ag at about 1 mm pressure and room temperature. With Ni, the glow was measured at about 5 mm thickness. The lifetime of the excited species calculated from the thickness of these glows was just long enough to fit with the upper limit of the lifetime of $NO(B^2\Pi)$ which is about 10^{-6} sec. The glow over Co is enhanced when a very low O atom concentration is used and when photographed through a blue filter, practically no blue NO radiation is seen, indicating that in the case of Co, an excited N_2 is the primary product being formed. It is possible to explain both the long lifetime of the species responsible for the glow and the intensity of the bands from $v' = 8$ and 6 by assuming that the primary excited molecule is an $N_2(A^3\Sigma_u^+)$. The small amount of O atoms which are necessary to enhance the glow over Co are probably required to condition the surface of the metal and permit the absorbed N atoms which form the excited N_2 molecule to be attached with a binding energy of about 1 ev or less. The $N_2(A^3\Sigma_u^+)$ and $N_2(B^3\Pi_g)$ potential curves cross at about 8.5—9.0 ev or $v = 6—8$. The meta-stable $N_2(A^3\Sigma_u^+)$, which is the upper level of the well-known Vegard-Kaplan system, forms on the metal surface, diffuses into the gas phase and by collision, crosses into the $(B^3\Pi_g)$ state at $v = 8$ and 6 and then radiates immediately from the $(B^3\Pi_g)$ back to the $(A^3\Sigma_u^+)$. When the glow over Ni is photographed through red and blue filters the observations make it logical to conclude that 2 separate mechanisms are involved: the formation of $N_2(A^3\Sigma_u^+)$ and the formation of $NO(B^2\Pi)$. A red glow similar to those produced over Ag, Ni, and Co can also be produced over Cu. But, if N atoms alone are passed over a Cu plate the blue glow of the second positive system of nitrogen appears $(C^3\Pi_u \rightarrow B^3\Pi_g)$. Thus it appears that what was believed to be a rather singular phenomenon now must include the formation of $NO(B^2\Pi)$, $N_2(A^3\Sigma_u^+)$, and even $N_2(C^3\Pi_u)$.

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Rensselaer Polytechnic Inst. Dept. of Chemistry, Troy, N. Y.

SURFACE-CATALYZED ATOM RECOMBINATIONS THAT PRODUCE MOLECULES, by P. Harteck, R. R. Reeves, and G. [G.] Mannella. [1960] [4]p. incl. refs. (AFOSR-2805) (Sponsored jointly by Air Force Cambridge Research Center; and [Air Force Office of Scientific Research under AF 49(638)928]) Unclassified

Presented at Symposium on Fundamental Aspects of Atomic Reactions, McGill U., Montreal, Quebec (Canada), Sept. 1960.

Also published in Canad. Jour. Chem., v. 38: 1648-1651, Oct. 1960.

Various metal surfaces such as nickel, cobalt, copper, and silver give rise to a reddish luminosity in a stream of N- and O-atoms. Spectroscopic and photographic analysis of these glows indicate the formation of electronically excited molecules on the metal surface which diffuse into the gas phase and radiate. Two parallel

processes are involved: the formation of an NO($B\ ^2\Pi$), which results in NO β radiation, and the formation of an $N_2(A\ ^3\Sigma_u^+)$, which, in collision, crosses into the $N_2(B\ ^3\Pi_g)$ state and then radiates back to the $A\ ^3\Sigma_u^+$, giving the N_2 first positive system. The N_2 first positive system observed here shows the strongest bands from $v' = 8$ and 6; these vibrational levels straddle the $A\ ^3\Sigma_u^+ - B\ ^3\Pi_g$ potential energy curve crossing point. This crossing-over of N_2 molecules into the ($B\ ^3\Pi_g$) at this point may explain the observed strong $v' = 6$ transition in normal N-atom recombination if it is assumed that some of the N-atoms recombine into the $A\ ^3\Sigma_u^+$ in addition to the $^5\Sigma_g^+$ state. The N_2 second positive system ($C\ ^3\Pi_u \rightarrow B\ ^3\Pi_g$) has also been observed over copper in an N- and O-atom stream. This is most surprising since the $N_2(C\ ^3\Pi_u)$ has about 1.4 ev more than D_{N_2}. (Contractor's abstract)

2490

Rensselaer Polytechnic Inst. [Dept. of Chemistry] Troy, N. Y.

PHYSICAL PROPERTIES AND STRUCTURE OF MOLTEN SALTS, by G. J. Janz. [1961] [9]p. incl. diagrs. tables, refs. (AFOSR-446) [AF 49(638)978] Unclassified

Presented at Symposium on Recent Advances in the Chemistry of Fused Salts, 139th Amer. Chem. Soc. Nat'l meeting, St. Louis, Mo., Mar. 1961.

Also published in Jour. Chem. Education, v. 39: 59-67, Feb. 1962.

This report gives an indication of the research activity in molten salts for the time interval 1900 to the present date. The enhanced interest in the chemistry of molten salts over the period of the past 2 decades may be attributed, in no small part, to the problems raised by the inadequate knowledge of high-temperature chemistry. It is apparent from this survey that only a small fraction of these investigations were directed to studies of physical properties, and that relatively few of the contributions of this fraction meet the limits of accuracy and precision imposed by the requirements of modern theoretical treatments. The physical properties, techniques of high temperature experimentation, and structure of the molten salts are given.

2491

Rensselaer Polytechnic Inst. Dept. of Chemistry, Troy, N. Y.

BIBLIOGRAPHY ON MOLTEN SALTS, by G. J. Janz. June 1961, 173p. incl. refs. (Technical rept. no. 2) (AFOSR-786) (AF 49(638)978) AD 258774 Unclassified

A compilation is presented of references to published contributions in the area of molten salts from 1833 to 1960. The compilation is arranged first chronologically and then alphabetically by author. An author index is included with an indication of the page numbers on which the corresponding references are located.

2492

Rensselaer Polytechnic Inst. [Dept. of Mathematics] Troy, N. Y.

VIBRATIONS OF A CIRCULAR ELASTIC PLATE UNDER UNIFORM TENSION, by C. J. Martin. [1960] [8]p. incl. tables. (AF 18(600)1586) Unclassified

Published in Proc. Fourth U.S. Nat'l. Cong. of Appl. Mech., California U., Berkeley (June 18-21, 1962), New York, Amer. Soc. Mech. Engineers, v. 1: 277-284, 1962.

The eigenvalue problem, associated with the free vibrations of a circular elastic plate under uniform tension, is solved by means of perturbation expansions in powers of a parameter directly proportional to the tension. For small values of the parameter, the standard technique is employed. For large values, a singular perturbation technique is used to obtain an expansion in reciprocal powers of this parameter. Results obtained are compared with those found by energy techniques. (Contractor's abstract)

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Rensselaer Polytechnic Inst. Dept. of Mathematics, Troy, N. Y.

LIMITED SUPERPOSITION IN PIECEWISE-LINEAR SYSTEMS, by B. A. Fleishman. July 14, 1961, 12p. (Math. rept. no. 45) (AFOSR-1222) (AF 49(638)514) AD 262829 Unclassified

Piecewise-linear systems of the type that arise in relay servomechanisms or problems involving Coulomb friction, which are usually regarded as nonlinear, are shown here to exhibit certain linear behavior. Specifically, for certain sets of input signals (or forcing functions) and associated responses, the responses are linear in the inputs with respect to convex linear combinations; equivalently, the average of a set of inputs has, as its response, the average of the associated responses. The result is illustrated by means of an explicit formula for periodic responses in a second-order on-off control system. (Contractor's abstract)

2494

Rensselaer Polytechnic Inst. Dept. of Mathematics, Troy, N. Y.

WAVE PROPAGATION IN NON-LINEAR MEDIA, by B. A. Fleishman. [1961] [7]p. (AFOSR-3674) (AF 49(638)514) AD 612335 Unclassified

Also published in Proc. Internat'l. Symposium on Nonlinear Differential Equations and Nonlinear Mechanics, Air Force Academy, Colorado Springs, Colo. (July 31-Aug. 4, 1961), New York, Academic Press, 1963, p. 211-217.

The purpose of this paper is to develop some general properties of wave solutions of the equations $u_{tt} - u_{xx} = f(u, u_x, u_t)$ for certain classes of function $f(u, u_x, u_t)$. It is assumed that the variables t, x and u and the parameter c are dimensionless and real-valued. Only functions $f(u, u_x, u_t)$ which are continuous in their arguments are considered, and solutions are sought which are defined for all x and t and which, except when $|c| = 1$, are continuous and bounded and have continuous first and second partial derivatives.

2495

Rensselaer Polytechnic Inst. [Dept. of Mathematics] Troy, N. Y.

THE BENDING OF COLUMNS UNDER AXIAL LOADS OF RANDOM ECCENTRICITY, by W. E. Boyce. May 22, 1961, 16p. incl. diagrs. table. (Math. rept. no. 43) (AFOSR-703) (AF 49(638)962) AD 258422 Unclassified

Also published in Developments in Mechanics; Proc. Seventh Midwestern Mechanics Conf., Michigan State U. (Sept. 6-8, 1961), New York, Plenum Press, v. 1: 143-152, 1961.

An initially straight, homogeneous, isotropic, elastic column is subjected to axial loads whose location with respect to the center line of the column is given by a random eccentricity at each end. Methods are advanced which, on the basis of assumptions concerning the statistical distribution of the eccentricities, provide answers to the following questions: (1) What is the probability that the maximum transverse column displacement occurs in a given interval of the column? (2) For a given load (or for a given absolute midspan displacement) what is the probability that the absolute midspan displacement (or load) lies between preassigned bounds? (Contractor's abstract)

2496

Republic Aviation Corp. Plasma Propulsion Lab., Farmingdale, N. Y.

A REVIEW OF REPUBLIC'S PINCH ENGINE EXPERIMENTAL PROGRAM, by I. Granet and W. J. Guman. Oct. 21, 1960, 40p. incl. illus. diagrs. table. (Rept no. PPL-60-15(160)) (AFOSR-164) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)552 and Office of Naval Research under Nonr-285100) AD 252113 Unclassified

Since 1957 Republic Aviation has been conducting extensive theoretical and experimental investigations in plasma physics. In order to properly supplement this area of investigation the Lab. has designed, constructed and tested several test units specifically built and instrumented for research in the field of plasma physics. Some of the principal test units that have been used for these programs are: Test Rig no. 1, Test Rig no. 2, Triggered Gap Switch, and Fast Acting Gas Value all of which are described in this report. In order to properly design a device that will provide thrust for a specified mission efficiently so that the total weight of the propulsion system is minimized, it is necessary to be knowledgeable in all subsystem areas pertinent to the engine. An explanation of this diagnostic equipment and pertinent specific test data is presented. Also presented are specific experimental results which were obtained at the Plasma Propulsion Lab., and which are pertinent to the understanding and evaluation of a space propulsion system utilizing the pinch process.

2497

Republic Aviation Corp. Plasma Propulsion Lab., Farmingdale, N. Y.

ELECTROMAGNETIC DIFFUSION INTO A CYLINDRICAL PLASMA COLUMN DURING THE EARLY STAGES OF PINCH FORMATION, by J. L. Neuringer, L. Kraus, and H. Malamud. [Jan. 16, 1961] 38p. incl. illus. (Rept. no. PPL-TR-61-1) (AFOSR-320) (AF 49(638)552) AD 252394; PB 155212 Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 309, Apr. 24, 1961.

Also published in Phys. Fluids, v. 4: 1015-1025, Aug. 1961.

Also published in Proc. Symposium on Electromagnetics and Fluid Dynamics of Gaseous Plasma, New York (Apr. 4-6, 1961), Brooklyn, Polytechnic Press, 1962, p. 415-441. (AFOSR-3388) (Title varies)

The diffusion of electromagnetic energy into a cylindrical plasma column due to the discharge of the energy stored in a capacitor is formulated taking into account the effects of the capacitance and inductance of the discharge circuit. The discharge circuit reflects the linear pinch geometry in that the energy source is a charged condenser and the return lead is a perfectly conducting cylindrical shell concentric with and surrounding the plasma column. The plasma properties enter the formulation through an extended Ohm's law which includes the time rate of change of current density. Under the assumption that changes in the ionization density and collision frequency may be neglected, Maxwell's equations lead to a third-order linear partial differential equation for the diffusion current. An exact solution is obtained by Laplace transform techniques using appropriate initial and boundary conditions which take into account the finite external circuitry. The spatial and temporal behavior of the current density distribution as functions of the parameters which characterize both the circuit and the plasma are discussed and compared with that of an ordinary conductor obeying the simple Ohm's law (Contractor's abstract)

2498

Republic Aviation Corp. Plasma Propulsion Lab., Farmingdale, N. Y.

SYNTHESIS OF CURRENT WAVEFORMS BY TYPE C NETWORKS, by D. Rigney, L. Kraus, and H. Melamud. Jan. 30, 1961 [23]p. incl. illus. diagrs. (Rept. no. PPL-TR-61-4(258)) (AFOSR-321) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)552 and Air Force Special Weapons Center under AF 29(602)2866) AD 252395 Unclassified

A theoretical analysis is performed which permits synthesis of any required current waveform when the current is to be discharged through a load inductance, L. The synthesis is accomplished by forcing the characteristic modes of an LC network into correspondence with the harmonic components of the required waveform. Equations are derived which permit solution for the required network parameters, and approximate solutions are given. An IBM 7090 program is available for use when more accurate solutions are required. The experimental synthesis of a current waveform is described. (Contractor's abstract)

2499

Republic Aviation Corp. Plasma Propulsion Lab., Farmingdale, N. Y.

THE ELECTROMAGNETIC DETONATION CONCEPT, by K. M. Foreman. Mar. 30, 1961 [20]p. incl. diagrs. refs. (Rept. no. PPL-TR-61-10) (AFOSR-564) (AF 49(638)552) AD 450160 Unclassified

Presented at the ARS Propellants, Combustion and Liquid Rockets Conf., Palm Beach, Fla., Apr. 26-28, 1961.

The linear pinch process results from the discharge of a high-frequency, large-magnitude electric current in a low pressure gas contained in the cylindrical envelope of 2 parallel electrodes. The effect is to produce a sheath of plasma at the outer periphery of the cylinder (skin effect) which is forced to move radially inward by virtue of its self-induced magnetic field, in the manner of an inertialess magnetic piston. The motion of the electromagnetic piston in a combustible mixture produces a shock front, in advance of the piston, of sufficient strength to induce detonation. The electromagnetic and gasdynamic details of the concept of electromagnetic piston-supported detonation are described. The required characteristics of the electrical power supply are specified. Some aspects of the experimental investigation are discussed including the diagnostic equipment. Finally, speculations are advanced for the application of the concept to electrical atmospheric propulsion and MHD electric power generation devices. (Contractor's abstract)

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Republic Aviation Corp. Plasma Propulsion Lab., Farmingdale, N. Y.

PARAMETRIC STUDIES OF STRONG GASEOUS DETONATIONS, by K. M. Foreman, H. Pevney, and R. MacMillan. Mar. 30, 1961 [22]p. incl. diagrs. (Rept. no. PPL-TR-61-11) (AFOSR-565) (AF 49(638)-552) AD 445977 Unclassified

Presented at the ARS Propellants, Combustion and Liquid Rockets Conf., Palm Beach, Fla., Apr. 26-28, 1961.

Also published in Prog. in Astronaut. and Rocketry, v. 6: 47-63, 1962.

A computer program used for a parametric study of gaseous detonations is described. In addition to being able to define the thermodynamic and gas dynamic properties of the equilibrium, one-dimensional process it is possible to investigate the energy released. On the basis that the net energy release of the detonation equals the changes of enthalpy and kinetic energy of the reactants as they change to reaction products, it is seen that exothermic reactions soon become overridden by endothermic processes as the strong detonation wave velocity increases. Parametric studies of oxygen-hydrogen and air-hydrogen detonations have been conducted for a wide range of initial temperatures and pressures. Typical variations of equilibrium product gas composition and temperature with wave velocity are presented and discussed. For oxygen-hydrogen detonations it is seen that the Chapman-Jouguet condition for the stoichiometric mixture produces the maximum energy release. The limits of detonations are broadened by higher reactant pressures and narrowed and shifted to lower velocities by higher reactant temperatures. (Contractor's abstract)

2501

Republic Aviation Corp. Plasma Propulsion Lab., Farmingdale, N. Y.

A SUPERSONIC PLASMA BEAM, by H. Malamud and B. Bederson. June 1961 [30]p. incl. diagrs. refs. (Rept. no. PPL-TR-61-17(398)) (AFOSR-1429) (AF 49(638)552) AD 286910 Unclassified

The theory and design of a cold plasma beam facility are described. A supersonic beam of alkali metal vapor is produced by conventional wind tunnel techniques. The vapor is ionized to a high degree by the process of surface ionization on the heated (tungsten) walls of the acceleration nozzle, which also acts as an electron emitter to provide charge neutralization in the beam. The limitation on the plasma flux is the effect of particle recombination in the nonequilibrium situation existing in the nozzle. Estimates based on the presently available data on recombination rates give a maximum beam flux of 10^{17} ion/cm^2-sec. (Contractor's abstract)

2502

Republic Aviation Corp. Plasma Propulsion Lab., Farmingdale, N. Y.

MAGNETIC FIELD MEASUREMENTS IN A CYLINDRICAL PINCH TUBE, by T. Donner and L. Aronowitz. Aug. 8, 1961 [31]p. incl. illus. diagrs. tables. (Rept. no. PPL-TR-61-18(415)) (AFOSR-1762) (AF 49(638)-552) AD 272935 Unclassified

Magnetic field measurements in a cylindrical linear pinch tube with magnetic probes and a device named the D-loop are described. Tests were performed with a discharge current frequency of 20 kc in nitrogen at an initial pressure of 0.1 mm Hg. Initial capacitor voltage was varied from 1000 to 5000 v. Plots of the magnetic field distribution, the radial current distribution and the current density in the pinch tube are presented. Experimental results indicate that the discharges are symmetric above 2000 v. The symmetric discharges have the following characteristics. At the start of the discharge, current flows near the outer periphery of the pinch tube. A portion of the current concentrates in a thin shell which moves towards the axis at a high velocity. The remainder of the current flows between the rapidly advancing shell and the outer radius of the pinch tube. There is some evidence that after the formation of the first shell a second shell is formed and moves toward the axis. It appears that magnetic probes sometimes cause perturbations in the discharge which influence their output. (Contractor's abstract)

2503

Republic Aviation Corp. Plasma Propulsion Lab., Farmingdale, N. Y.

CHEMICAL DETONATIONS IN THE UPPER ATMOSPHERE, by K. M. Foreman and P. Wilson. Oct. 20, 1961. 27p. incl. diagrs. table, refs. (Rept. no. PPL-TR-61-24(477)) (AFOSR-1763) (AF 49(638)552) AD 270927 Unclassified

Also published in Proc. Twelfth Internat'l. Astronaut. Cong., Washington, D. C. (Oct. 1, 1961), New York, Academic Press, v. 1: 476-497, 1963.

Detonation characteristics of hydrogen-air mixtures in the 1959 ARDC Model Atmosphere environment, including atomic oxygen and nitrogen, are computed to 450,000 ft assuming 1-dimensional, inviscid, real-gas conditions. The velocity limits of strong detonations (based on total enthalpy change) are discussed. Atomic oxygen reactant suppresses the exothermic reaction to H_2O in favor of recombination, making hydrogen use above 400,000 ft unattractive. Equilibrium temperature and pressure ratios across detonations decrease with altitude, especially above 350,000 ft; they are extremely sensitive, and inversely proportional, to reactant temperature, and pressure exhibits a secondary effect. For comparable detonation conditions, acetylene appears almost as good an energy source as hydrogen. (Contractor's absiract)

2504

Republic Aviation Corp. Plasma Propulsion Lab., Farmingdale, N. Y.

TEMPERATURE AND MIXTURE VARIATION OF STRONG-DETONATION LIMITS, by K. M. Foreman. [1961] [1]p. incl. diagrs. (AFOSR-2842) (AF 49(638)-552) Unclassified

Also published in Jour. Aerospace Sci., v. 29: 469, Apr. 1962.

The extent of the regime of strong gaseous detonations of hydrogen and air is markedly diminished by a decrease in initial pressure or an increase in temperature, and slightly increased by an increase in equivalence ratio.

2505

Republic Aviation Corp. Plasma Propulsion Lab., Farmingdale, N. Y.

PRESSURE VARIATION OF STRONG-DETONATION LIMITS, by K. M. Foreman. [1961] [1]p. incl. diagr. (AFOSR-2843) (AF 49(638)552) Unclassified

Also published in Jour. Aerospace Sci., v. 29: 240, Feb. 1962.

Pressure characteristics of detonation velocity limits are discussed: the upper limit, when the kinetic energy change is equal in magnitude to the enthalpy change, and the Chapman-Jouguet condition associated with minimum prewave velocity and maximum energy release. Through a series of approximations and equations and the use of a digital computer program the real-gas properties (velocity limits) of hydrogen-air detonations are determined.

2506

Republic Aviation Corp. [Plasma Propulsion Lab.] Farmingdale, N. Y.

THE DESIGN, FABRICATION, AND TEST OF A PULSED-PINCH PLASMA ENGINE FOR SPACE APPLICATIONS, by J. J. Pearson, C. C. Cavalconte and others. [1961] [16]p. incl. illus. diagrs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)552 and Office of Naval Research under Nonr-285100) Unclassified

Published in Engineering Aspects of Magnetohydrodynamics; Proc. Second Symposium, Philadelphia, Pa. (Mar. 9-10, 1961) New York, Columbia U. Press, 1962, p. 81-96.

The main features of the prototype plasma engine, XE-1, have been described together with the major instrumentation used for the experimentation work. Testing of the engine is now in progress and it is confidently expected to produce thrust on the order of 10 mlb, for which it was designed.

2507

Republic Aviation Corp. Plasma Propulsion Lab., Farmingdale, N. Y.

ELECTROMAGNETICALLY INDUCED DETONATIONS (Abstract), by W. McIlroy. [1961] [1]p. (Bound with AFOSR-582; AD 257892) (AF 49(638)552) Unclassified

Presented at Fourth annual AFOSR Contractors' meeting on Ion and Plasma Acceleration, Beverly Hills, Calif., Apr. 20-21, 1961.

The results of a parametric study, using an IBM 704 digital computer program, are shown to define the limits of exothermic reactions and indicate the conditions for a significant experiment. The theoretical effort has been concerned with analyzing the circuit needs to meet the required ramp type current wave form, while the experimental effort has been directed toward improving the diagnostic equipment in preparation for a new detonation test stand whose design was completed in January 1961. The current wave form for meeting Chapman-Jouguet detonation conditions has been found producible by a single simple R-L-C circuit. The requirements for magnetically supported strong detonations have been approximated, with the aid of a Fourier analysis computer program, by a 10-branch L-C circuit. Experiments using the original RAC pinch effect device have revealed that the electrode material significantly influences the nature of the pinched discharge and that vaporous electrode material probably plays an important role in the initial phases of the process.

2508

Republic Aviation Corp. Plasma Propulsion Lab., Farmingdale, N. Y.

REPETITIVE PINCH ACCELERATION (Abstract), by W. J. Guman. [1961] [1]p. (Bound with AFOSR-582; AD 257892) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)552 and Office of Naval Research under Nonr-285100) Unclassified

Presented at Fourth annual AFOSR Contractors' meeting on Ion and Plasma Acceleration, Beverly Hills, Calif., Apr. 20-21, 1961.

Since it has become apparent that, for pulsed engine applications, the minimum pinch conditions (i.e., energy, voltage) must be known, a study has been made to determine the various physical mechanisms involved. The discharge initiation phase, the subsequent sheet information and the initial motions of the sheet and gas motions are described. The gas dynamic motions of the current sheet or "magnetic piston" are described using the latest results of the slug, snowplow and gas dynamic models. The following experimental studies are reported: (1) studies of the basic phenomena; e.g., pinch initiation, sheet motions and symmetry, coordination of gas motion and circuit oscillation, and (2) determination of basic engine parameters; thrust, specific impulse, mass conservation and energy conversion efficiency. A description of the plasma pinch engine now undergoing tests at WADD is presented.

2509

Republic Aviation Corp. [Plasma Propulsion Lab.] Farmingdale, N. Y.

TRANSIENTS IN THE FORMATION OF A CURRENT SHEATH AT A PLASMA BOUNDARY (Abstract), by L. Kraus. [1961] [1]p. [AF 49(638)552] Unclassified

Presented at meeting of the Amer. Phys. Soc., Mexico City, Mex., June 22-24, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 371, June 22, 1961.

The formation of a conducting sheath at a plasma boundary due to a strong electromagnetic field is analyzed. The case where the plasma properties do not change was treated previously. Here a simple model of a plasma is used in which the effects of the field on the plasma is taken into account and divided into electron heating, ionization, and ion heating. Each of these phases is treated separately and the problems are reduced to nonlinear diffusion-like equations. Analytic and numerical solutions then provide a time history of the growth of the current sheath and the associated magnetic field. Conditions will be discussed which determine whether the sheath will eventually become a steady state discharge or a dynamic pinch.

2510

RIAS, Inc., Baltimore, Md.

BOUNDED AND ALMOST PERIODIC SOLUTIONS OF SINGULARLY PERTURBED EQUATIONS, by J. K. Hale and G. Seifert. [1961] [7]p. (AFOSR-37) (AF 49-(638)382) AD 424230 Unclassified

Also published in Jour. Math. Anal. and Appl., v. 3: 18-24, Aug. 1961.

Conditions are given in order that the system $\dot{x} = f(t, x, y, \epsilon)$, $\epsilon\dot{y} = g(t, x, y, \epsilon)$, $t \in R$, x, $f \in R^{n_1}$, y, $g \in R^{n_2}$, possess a unique solution near the $\epsilon = 0$ solution, and that the solution be almost periodic. (Math. Rev. abstract)

2511

RIAS, Inc., Baltimore, Md.

ON LINEAR DIFFERENTIAL EQUATIONS WITH A SMALL PARAMETER, by C. Imaz. Mar. 1961, 60p. incl. diagrs. refs. (Technical rept. no. 61-2) (AFOSR-496) (AF 49(638)382) AD 256353 Unclassified

Also published in Bol. Soc. Mat. Mexicana, v. 6: 19-51, 1961.

The purpose of this paper is to study the system (1) $\dot{w} = Aw + \epsilon\Phi(t)w$, w an n-vector, A a constant n-matrix, Φ a periodic matrix of period T which is Lebesgue integrable over a period. By means of a linear (non-constant) change of variables, it is shown that (1) may be reduced to the form (2) $\dot{x} = Hx + \delta\psi(t, \delta, \beta)x$, where $\delta > 0$ is a small parameter (a certain root of ϵ), β a constant parameter, and $H = \text{diag}(0, \Sigma)$, where 0 represents the $\mu \times \mu$ zero matrix, $\mu \leq n$, and Σ has elements $\sigma_i \neq 0 \bmod (2\pi i/T)$ on the main diagonal, elements 0 or 1 on the line above the diagonal, and 0 elsewhere. It is shown that if $e^{-\Sigma T} - I$ is not singular, there exists $\delta_0 > 0$ such that if $0 \leq \delta \leq \delta_0$ there exists a periodic function x which is a solution of (2) provided that β (and other parameters) satisfy a certain system of "bifurcation" equations (which depend on x); the values of β obtained in this way provide some of the characteristic exponents of (1). The problem thus stated may be attacked by a method of successive approximations which is adapted to actual computations. If A is assumed to have all its main diagonal elements equal to ρ, all the elements of the line above the diagonal are 1, and are 0 elsewhere, and if Φ satisfies certain restrictions (one case being, for instance, that $\int_0^T \Phi\, dt = 0$), a precise description of the characteristic exponents is obtained. Theorems on stability and instability, and methods for the computation of the characteristic roots of constant perturbed matrices are also derived as applications of the general method. (Math. Rev. abstract)

2512

RIAS, Inc., Baltimore, Md.

ASYMPTOTIC BEHAVIOR OF SOLUTIONS OF A SYSTEM OF DIFFERENTIAL EQUATIONS, by T. Yoshizawa. [1961] [17]p. incl refs. (AFOSR-749) (AF 49(638)382) Unclassified

Also published in Contrib. Differential Equations, v. 1: 371-387, 1963.

Consider a system of differential equations: (1) $x' = F(t, x) + G(t, x)$ $\left(1 = \frac{d}{dt}\right)$, where $F(t, x)$ and $G(t, x)$ are continuous in $I \times Q$ (I: $0 \leq t < \infty$, Q an open set in n-dimensional Euclidean space R^n). Assuming that if x(t) is continuous and bounded on $t_0 \leq t < \infty$; that is $x(t) \subset Q^*$, (Q^*: a compact set in Q),

(2) $\int_{t_0}^{\infty} G(s, x(s))\, ds < \infty$. The asymptotic behavior of solutions of the system (1) is discussed using the following notations: $\bar{A}$ is the closure of a set A; $d(p, A)$ is the distance between a point p and a set A, that is $d(p, A) = \inf \{ |p - a| ; a \in A \}$. $U(A, \epsilon)$ denotes the ϵ-neighborhood of a set A, that is, $U(A, \epsilon) = \{x; d(x, A) < \epsilon\}$. $C_0(x)$ is the set of functions which satisfy locally a Lipschitz condition with respect to x.

2513

RIAS, Inc., Baltimore, Md.

ASYMPTOTIC BEHAVIOR OF SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS NEAR SETS, by T. Yoshizawa. [1961] 21p. incl. refs. (Technical rept. no. 61-5) (AFOSR-992) (AF 49(638)382) AD 262349 Unclassified

In this paper the asymptotic stability of a set is discussed, and by constructing a Liapunov function the relationships between the solutions of an unperturbed system are considered. To simplify the problems, an autonomous system is considered an unperturbed system. A Liapunov function is constructed for the asymptotic stability in the large of a set. From this result, a Liapunov function is obtained for the asymptotic stability of a set. These results include as a special case, asymptotic stability in the sense of Liapunov and orbital stability. The behavior of solutions of a perturbed system is discussed in which a perturbation term is a combination of the case where it tends to zero as it approaches infinity and the case where it is integrable.

2514

RIAS, Inc., Baltimore, Md.

LOCALLY ONE-TO-ONE MAPPINGS AND A CLASSICAL THEOREM ON SCHLICHT FUNCTIONS, by G. H. Meisters and C. Olech. [1961] 29p. incl. diagrs. refs. (Technical rept. no. 61-4) (AFOSR-1086) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)382 and Army Research Office (Durham) under DA 36-034-ORD-3220) AD 262080 Unclassified

Also published in Duke Math. Jour., v. 30: 63-80, Mar. 1963.

The following classical theorem from the theory of functions of a complex variable has been attributed to Gaston Darboux. If f(x) is single-valued and holomorphic in a simply connected open subset R of complex plane and if f(z) takes no values more than once on some rectifiable simple closed curve C lying in R, then f(z) is schlicht on the compact set X consisting of C and its interior. In this paper some topological theorems are given which are similar to Darboux's theorem and from one of which Darboux's theorem is easily deduced. Theorem 1 differs from the above in 3 aspects: First, it applies to mappings of compact subsets X of n-dimensional Euclidean space E_n (for $n > 2$), and is therefore not restricted to mappings of the complex plane. Secondly, the requirement of analyticity in Darboux's theorem is replaced by the requirement that f be locally one-to-one at each point of its domain X except possibly on a small subset Z. Finally, in theorem 1, it is not required that the boundary of the schlicht region X be a rectifiable Jordan curve, but merely an irreducible separating set of E_n. In theorem 2, by further restricting the set Z, it is enough to require that the boundary of the schlicht region X be connected. Moreover, in

this case, X need no longer be a subset of E_n, but can be an arbitrary compact subset of an n-dimensional manifold M_n (for $n \geq 2$).

2515

RIAS, Inc., Baltimore, Md.

PROLONGATIONS AND GENERALIZED LIAPUNOV FUNCTIONS, by J. Auslander and P. Seibert. [1961] [26]p. (Technical rept. no. 61-7) (AFOSR-1119) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)382 and Army Research Office (Durham) under DA 36-034-ORD-3220) AD 262350 Unclassified

Also published in Proc. Internat'l. Symposium on Nonlinear Differential Equations and Nonlinear Mechanics, Air Force Academy, Colorado Springs, Colo. (July 31-Aug. 4, 1961), New York, Academic Press, 1963, p. 454-462.

Abstract published in Qualitative Methods in the Theory of Non-linear Vibrations; Proc. Internat'l. Symposium on Non-linear Vibrations, Kiev (USSR) (Sept. 12-18, 1961), Kiev Academy of Sciences, v. 2: 332, 1963.

The purpose of this note is to study various types of stability in autonomous systems by means of generalized Liapunov functions in the sense of S. Lefschetz and prolongations in the sense of T. Ura and Funkcialaj Ekavcioj. The concept of prolongation leads to a whole hierarchy of new types of stability, all of which occupy an intermediate place between stability in the sense of Liapunov and asymptotic stability. The most significant among them, called absolute stability, is characterized by the existence of a continuous generalized Liapunov function with a non-positive generalized total derivative. If the latter is strictly negative, asymptotic stability is achieved. The second part of the report is devoted to stability under permanent perturbations or total stability with small bounded perturbation terms. Total stability is characterized as invariance under a certain map which has essential properties in common with Ura's concept of prolongation. In order to study properties of different kinds of stability simultaneously, prolongations abstractly are defined, and their invariant sets considered, thus obtaining stability theorems as corollaries.

2516

RIAS, Inc., Baltimore, Md.

CONTROLLABILITY OF LINEAR DYNAMICAL SYSTEMS, by R. E. Kalman, Y. C. Ho, and K. S. Narendra. [1961] [25]p. incl. refs. (AFOSR-1120) (Sponsored jointly by Air Force [Office of Scientific Research] under AF 49(638)382 and AF 33(616)6952, and Office of Naval Research under Nonr-186616) Unclassified

Also published in Contrib. Differential Equations, v. 1: 189-213, 1963.

Various characterizations of controllability are obtained for linear dynamical systems with finite-dimensional state space. An explicit expression is given for transferring a given state as close as possible to any desired state using minimal control energy. Additional criteria of controllability are obtained in the special case of constant systems. Controllability of discrete-time systems is also treated, including a rigorous proof of the Kalman-Bertram criterion for the controllability of a constant linear system after the introduction of sampling. Finally, figures of merit based on minimal control energy are introduced which serve as a numerical measure of the controllability of a given system. (Contractor's absiract)

2517

RIAS, Inc., Baltimore, Md.

ON THE GLOBAL STABILITY OF AN AUTONOMOUS SYSTEM ON THE PLANE, by C. Olech. [1961] 16p. (Technical rept. no. 61-12) (AFOSR-1130) (AF 49(638)-382) AD 264606 Unclassified

Also published in Contrib. Differential Equations, v. 1: 389-400, 1963.

Consider an autonomous system (S) $x' = f(x)$ ($' = d/dt$) where $x = (x_1, x_2)$, $f(x) = (f_1(x_1 x_2), f_2(x_1 x_2))$ is a class of C^1 on E^2. Suppose $x = 0 = (0, 0)$ is a singular point of (S), and assume that the Jacobian matrix $J(x) = (\partial f_j/\partial x_k)$ has, at each point of E^2, characteristic roots with negative real parts; that is, assume
(i) $\operatorname{tr} J(x) = \partial f_1/\partial x_1 + \partial f_2/\partial x_2 < 0$ on E^2, and
(ii) $\det J(x) = (\partial f_1/\partial x_1)(\partial f_2/\partial x_2) - (\partial f_1/\partial x_2)(\partial f_2/\partial x_1) > 0$ on E^2. Is then the solution $x = 0$ of (S) asymptotically stable in the large, or, in other words, does each solution curve of (S) approach 0 as $t \to \infty$?

2518

RIAS, Inc., Baltimore, Md.

ASYMPTOTIC BEHAVIOR OF THE SOLUTIONS OF DIFFERENTIAL-DIFFERENCE EQUATIONS, by J. K. Hale. [1961] 33p. incl. refs. (Technical rept. no. 61-10) (AFOSR-1370) (AF 49(638)382) AD 264605 Unclassified

Also published in Qualitative Methods in the Theory of Non-linear Vibrations; Proc. Internat'l. Symposium on Non-linear Vibrations, Kiev (USSR) (Sept. 12-18, 1961), Kiev Academy of Sciences, v. 2: 409-426, 1963.

The theory on perturbed differential-difference equations is given. The use of ordinary differential equations is necessary in the testing of perturbation functions by use of the Liapunov functional. The advantages in using this particular function are 2-fold. First the unperturbed equation may be either linear or nonlinear. Secondly, there is no need for an integral representation for the solutions.

2519

RIAS, Inc., Baltimore, Md.

A GEOMETRIC INTERPRETATION OF PONTRYAGIN'S MAXIMUM PRINCIPLE, by E. Roxin. [1961] [28]p. incl. diagrs. refs. (Technical rept. no. 61-15) (AFOSR-1751) (AF 49(638)382) AD 268269 Unclassified

Also published in Proc. Internat'l. Symposium on Nonlinear Differential Equations and Nonlinear Mechanics Air Force Academy, Colorado Springs, Colo. (July 31-Aug. 4, 1961), New York, Academic Press, 1963, p. 303-324.

In connection with problems of control mechanisms, there have been studied systems of differential equations in which some more or less arbitrary control functions appear. An important question is how to choose those control functions to minimize (or maximize) a certain functional of the solution. Physically speaking, this may mean to operate the system in the best possible way, minimizing a cost function or simply the time of operation. Pontryagin and his collaborators pointed out a general principle (the maximum principle), which applies. The problem of what can be accomplished by adequate election of the control function, disregarding the optimization problem, was studied independently by Kalman and the author. In this analysis these problems are considered from a geometrical point of view; the aim is to show interesting relations which remain hidden in a more analytical treatment, like that of Pontryagin, Boltyanskii and Gamkrelidze.

2520

RIAS, Inc., Baltimore, Md.

CRITERIA FOR THE REALITY OF MATRIX EIGENVALUES, by M. P. Drazin and E. V. Haynsworth. [1961] [4]p. (AFOSR-2282) (AF 49(638)-382) Unclassified

Also published in Math. Zeitschr., v. 78: 449-452, Mar. 1962.

All capital letters denote linear transformations on an n-dimensional unitary space V with inner product (x, y). Assume that $H = AS$ is hermitian, where S is positive definite hermitian. Let $S^{1/2}$ be the unique positive definite hermitian determination of the square root of S. Then $S^{-1/2}HS^{-1/2} = S^{-1/2}AS^{1/2}$, and hence A is similar to a hermitian transformation. Thus A has n real eigenvalues with corresponding linearly independent eigenvectors. Similarly, if $ASA^* = S$, then $(S^{-1/2}AS^{1/2})(S^{-1/2}AS^{1/2})^* = 1$, and A is similar to a unitary transformation. From this it follows that A has n eigenvalues of modulus 1 with a corresponding set of n linearly independent eigenvectors. The authors generalize these results (and a similar result for skew-hermitian transformations). For example, they obtain Theorem 1: A necessary and sufficient condition for A to have m real eigenvalues with a corresponding set of m linearly independent eigenvectors is that there exist a positive semi-definite hermitian S of rank m such that AS is hermitian. The proof of necessity is direct.

2521

RIAS, Inc., Baltimore, Md.

ON GLOBAL ASYMPTOTIC STABILITY OF SOLUTIONS OF DIFFERENTIAL EQUATIONS, by P. Hartman and C. Olech. [1961] [25]p. (AFOSR-2837) (In cooperation with Johns Hopkins U. Dept. of Mathematics, Baltimore, Md.) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)382 and AF 18(603)41, and Army Ballistic Missile Agency under DA 36-034-ORD-3514) AD 298161 Unclassified

Also published in Trans. Amer. Math. Soc., v. 104: 154-178, July 1962.

Consider a system of real differential equations for $x = (x^1, \ldots, x^n)$, $(1.1)\ x' = f(x)$ in which $f(x)$ is of class C^1 on E^n. The first part of this paper deals with a generalization of the fact that if $x = 0$ is a locally asymptotically stable solution of (1.1) and the conditions $\operatorname{tr} J(x) = \operatorname{tr} H(x) \leq 0$ and $|f(x)| \geq \text{Const.} > 0$ for $|x| \geq \text{const.} > 0$, then $x = 0$ is a globally asymptotically stable solution of (1.1) to the case of arbitrary $n \geq 2$. The second part of the paper concerns the orbital stability of bounded, nontrivial, solutions of (1.1) and is related to a result dealing with a bounded solution $x = x_0(t)$ of (1.1) in a portion D of E^n where $|f(x)| \geq \text{Const.} > 0$ and $\gamma < 0$. $\gamma(x) < 0$. In the third part of the paper some of the results are extended to nonautonomous systems using the principles of Ważewski (Proc. Internat'l. Cong. Math. (Amsterdam), v. 3: 132-139, 1954). This method can also be used to obtain some of the results of part 2.

2522

RIAS, Inc., Baltimore, Md.

CANONICAL STRUCTURE OF LINEAR DYNAMICAL SYSTEMS, by R. E. Kalman [1961] [5]p. incl. diagrs. (AFOSR-2997) (AF 49(638)382 and AF 33(616)6952) Unclassified

Published in Proc. Nat'l. Acad. Sci., v. 48: 596-600, Apr. 1962.

The usual notion of a dynamical system abstracts the properties of motions (solutions) defined by a system of differential equations and embodies the principal of causality of classical mechanics. The abstract definition given here retains these features but views a dynamical system in terms of observable relation between inputs (stimuli) and outputs (responses). This paper is concerned principally with finite-dimensional linear dynamical systems, and these can be described by a system of differential equations $\dot{x}(t) = F(t)x(t) + G(t)u(t)$ and a relation $y(t) = H(t)x(t)$. The state $x(t)$ is an n-vector, the input $u(t)$ is an m-vector, the output $y(t)$ is a p-vector and $F(t)$, $G(t)$, and $H(t)$ are matrices. The functions, u, F, G and H are continuous. It is then shown that relative to an initial time every such system

can be decomposed in an invariant manner into 4 parts. Only one of these parts, the part which is "completely controllable" and "completely observable", can in general be identified from external observation (impulse response, for example), and that part can be determined in a manner which is essentially unique. This paper is a brief report which defines basic concepts and states some of the important results.

2523

RIAS, Inc., Baltimore, Md.

SOME PHYSICAL SOLUTIONS OF DIRAC-TYPE EQUATIONS, by J. K. Hale and A. P. Stokes. [1961] [5]p. (AFOSR-3145) [AF 49(638)382] Unclassified

Also published in Jour. Math. Phys., v. 3: 70-74, Jan.-Feb. 1962.

The Dirac equation of classical electrodynamics is a third-order differential equation. The purpose of the present paper is to give some sufficient conditions on the force field which will insure that there are solutions of Dirac's equation which approach a motion with constant velocity as time increases. (Contractor's abstract)

2524

RIAS, Inc., Baltimore, Md.

THE EXISTENCE OF OPTIMAL CONTROLS, by E. Roxin. [1961] [11]p. incl. diagrs. (AFOSR-3845) (AF 49(638)382) Unclassified

Also published in Mich. Math. Jour., v. 9: 109-119, 1962.

In this paper the author gives existence theorems for problems of optimal control. Given a differential system (*) $dx/dt = f(t,x,u)$, $t \in E^1$, $x \in E^n$, $f \in E^n$, $u \in U \subset E^m$, with $x(t_0) = x_0$, t_0, x_0 fixed, assume that $f(t,x,u)$, $(t,x,u) \in E^1 \times E^n \times U$, is continuous in (x,u), uniformly Lipschitzian in x, measurable in t for all (x,u), with $f \leq (A|x| + B)u(t)$ (A, B constants, u(t) locally L-integrable). The main assumptions are that U is a fixed compact subset of E^m and $f(t,x,U)$ is convex for every $(t,x) \in E^1 \times E^n$. By assuming in (*) that u is any function u(t), $u(t) \in U$ for all $t_0 \leq t \leq t_1$, t_1 undetermined, $t_1 \geq t_0$, u(t) measurable in $[t_0, t_1]$, one obtains corresponding solutions x(t), $t_0 \leq t \leq t_1$. The set R of all final points $(t_1, x(t_1))$ is a subset of $E^1 \times E^n$. Main theorem: The set R is closed. From here existence theorems follow. For instance, the problem of maximum speed of response has a solution.

2525

RIAS, Inc., Baltimore, Md.

STABILITY UNDER PERTURBATIONS IN GENERALIZED DYNAMICAL SYSTEMS, by P. Seibert. [1961] [11]p. incl. refs. (AFOSR-4487) (AF 49(638)-382) AD 424045 Unclassified

Also published in Proc. Internat'l. Symposium on Nonlinear Differential Equations and Nonlinear Mechanics, Air Force Academy, Colorado Springs, Colo. (July 31-Aug. 4, 1961), New York, Academic Press, 1963, p. 463-473.

It is an important problem in the theory of stability, to what extent small but permanently acting disturbances affect stability properties of dynamical systems. In this note one theorem on ultimate boundedness under perturbations, and a second which contains the theorem of Malkin-Gorsin are proven. The concept of strong stability under perturbations is introduced which is equivalent to uniform asymptotic stability, and therefore, implies total stability. All results for a class of systems similar to the general systems of Zubov are proven allowing more than 1 solution with given initial conditions. The restrictions on the perturbations are formulated in terms of the maximal deviation within time intervals of given length of a perturbed motion from an unperturbed 1 with the same initial values. This method allows consideration of cases where the derivatives themselves remain close together. Furthermore, it gives rise to a new absolute concept of total stability, 1 which is free of the element of arbitrariness inherent in other methods of restricting the perturbation, such as bounds on the norm of the perturbation term.

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RIAS, Inc., Baltimore, Md.

LOCALLY ONE-TO-ONE MAPPINGS AND A CLASSICAL THEOREM ON SCHLICHT FUNCTIONS, by G. H. Meisters and C. Olech. [1961] [18]p. incl. diagrs. refs. (Technical rept. no. 61-4) (AFOSR-J690) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)382 and Army Research Office (Durham) under DA 36-034-ORD-3220) AD 413628 Unclassified

Also published in Duke Math. Jour., v. 30: 63-80 Mar. 1963.

For abstract see item no. 2514, Vol. V.

2527

RIAS, Inc., Baltimore, Md.

ON DIFFERENTIAL EQUATIONS CONTAINING A SMALL PARAMETER, by J. K. Hale. [1961] [36]p. incl. refs. (AFOSR-J1216) (AF 49(638)382) AD 424636 Unclassified

Also published in Contrib. Differential Equations, v. 1: 215-250, 1963.

A method is given of successive approximations for the determination of theorems for the existence of periodic solutions of weakly nonlinear differential systems and for the determinations of boundedness theorems for linear periodic differential systems. The majority of this paper deals with almost linear systems; however, a brief description of how to generalize the method to more general systems is stated. The method can also be applied to differential-difference equations and to cases where the eigenvalues of the coefficient matrix of the linear part of the differential system do not have simple elementary divisors.

2528

RIAS, Inc., Baltimore, Md.

ASYMPTOTIC SYSTEM OF A PERTURBED SYSTEM, by T. Yoshizawa. [1961] [8]p. (AF 49(638)382) Unclassified

Published in Proc. Internat'l. Symposium on Nonlinear Differential Equations and Nonlinear Mechanics, Air Force Academy, Colorado Springs, Colo. (July 31-Aug. 4, 1961), New York, Academic Press, 1963, p. 80-85.

The relationships between solutions of a perturbed system and solutions of the unperturbed system are discussed. Under consideration is a system of differential equations $x' = F(t, x) + G(t, x)$, where $G(t, x)$ is an integrable perturbation term. A set of conditions are presented under which the following 2 theorems are proven: (1) It is assumed that $F(t, x)$ and $G(t, x)$ are continuous in $I \times Q$ and that Γ^+ is nonempty. Then $\tau = +\infty$. (2) It is assumed that Γ^+ is nonempty and $x(t; x_0 t_0) \to \Omega$ as $t \to \infty$, where Ω is a closed set in the space Q and that $F(t, x)$ satisfies the conditions (a) $F(t, x)$ tends to a function $H(x)$ for $x \in \Omega$ as $t \to \infty$ and on any compact set in Ω this convergence is uniform so that $H(x)$ is a continuous function on Ω and (b) corresponding to each $\epsilon > 0$ and each $y \in \Omega$, there exist positive numbers $\delta(y)$ and $T(y)$ such that if $\|x - y\| < \delta(y)$ and $t \geq T(y)$, then $\|F(t, x) - F(t, y)\| < \epsilon$, and $G(t, x)$ satisfies the condition $\int_{t_0}^{\infty} \|G(s, x(s))\| \, ds < \infty$. Then Γ^+ is the union of solutions of the equation $x' = H(x)$, when $x \in \Omega$.

2529

RIAS, Inc., Baltimore, Md.

PERIODIC FUNCTIONS GENERATED AS SOLUTIONS OF NONLINEAR DIFFERENTIAL-DIFFERENCE EQUATIONS, by G. S. Jones. [1961] [8]p. incl. diagrs. refs. (AF 49(638)382) Unclassified

Published in Proc. Internat'l. Symposium on Nonlinear Differential Equations and Nonlinear Mechanics Air Force Academy, Colorado Springs, Colo. (July 31-Aug. 4, 1961), New York, Academic Press, 1963, p. 105-112.

Consider a scalar differential-difference equation (1) $f'(x) = \alpha \sum_{i=1}^{n} \lambda_i f(x - \tau_i)[af^2(x) + bf(x) + 1]$, where $0 < \tau_1 < \tau_2 < \ldots < \tau_n$ and α, a, b and λ_i are real parameters. If φ is an arbitrary function belonging to the space C of continuous functions on $[-\tau_n, 0]$, then one can define a continuous function $f(x, \varphi)$ defined for $-\tau_n \leq x < A$, $A > 0$ which coincides with φ on $[-\tau_n, 0]$ and satisfies equation (1) for $x > 0$. For any fixed $x > 0$, one can define a mapping $T(x)$ taking C into C by the relation $(T(x)\varphi)(\theta) = f(x + \theta, \varphi)$, $-\tau_n \leq \theta \leq 0$. $T(x)$ is completely continuous for $x \geq \tau_n$. For suitable choices of the parameters in (1), the author defines a convex subset S of C and a continuous functional λ taking C into the reals, such that $\lambda(\varphi) \geq \tau_n$ and for φ in S, $T(\lambda(\varphi))\varphi$ belongs to S. The set S is determined by the oscillatory properties of the solutions about $x = 0$. Additional conditions involving the stability properties of the solution $x = 0$ imply the existence of a fixed point of S, which is not a constant function, and thereby the existence of a nonconstant periodic solution of (1). Bounds on the periods, as well as other properties of these solutions are discussed together with some specific cases of (1).

2530

RIAS, Inc., Baltimore, Md.

NUMERICAL STUDY OF PERIODIC SOLUTIONS OF THE VAN DER POL EQUATION, by M. Urabe. [1961] [9]p. incl. diagrs. tables, refs. (AF 49(638)382) Unclassified

Published in Proc. Internat'l. Symposium on Nonlinear Differential Equations and Nonlinear Mechanics, Air Force Academy, Colorado Springs, Colo. (July 31-Aug. 4, 1961), New York, Academic Press, 1963, p. 184-192.

This paper is concerned with the numerical study of van der Pol's equation $\frac{d^2x}{dt^2} - \lambda (1 - x^2) \frac{dx}{dt} + x = 0$ when $\lambda > 0$. In this paper a new method of computing the periodic solutions of van der Pol's equation is sketched and the main results compared with those obtained by a previous method. The results of the comparison show that there exists a maximum point of the amplitude between $\lambda = 3$ and $\lambda = 4$. The present method is based on the numerical solution of a certain equation by means of Newton's method. Consequently, it guarantees the existence of a true periodic solution besides giving a numerical solution.

2531

RIAS, Inc., Baltimore, Md.

STRUCTURES TRANSVERSE TO A VECTOR FIELD, by B. L Reinhart. [1961] [3]p. (AF 49(638)382) Unclassified

Published in Proc. Internat'l. Symposium on Nonlinear Differential Equations and Nonlinear Mechanics, Air Force Academy, Colorado Springs, Colo. (July 31-Aug. 4, 1961), New York, Academic Press, 1963, p. 442-444.

If a vector field is defined on a manifold M, the orbit space of the 1-parameter pseudogroup it generates has some sort of generalized-manifold-with-singularities structure. One line of research has been to consider additional geometric structures on M which pass to the quotient and see what global consequences can be deduced. For example, the theory of invariant integrals due to Poincaré and Cartan is of this nature, and serves as a prototype for further theories. In this short note the author reviews past work along these lines and suggests new directions emphasizing geometric ways to describe the cohomology of the orbit space. (Math. Rev. abstract)

2532

RIAS, Inc., Baltimore, Md.

FURTHER COMMENTS ON THE DERIVATION OF TRAUBE'S RULE, by R. H. Aranow and L. Witten. [1961] [2]p. (AFOSR-2031) [AF 49(638)735] Unclassified

Also published in Jour. Chem. Phys., v. 35: 1504-1505, Oct. 1961.

The change in free energy of the water-hydrocarbon system when a hydrocarbon molecule moves from the interior of the water to the surface is contributed to by 2 factors. One factor is the interaction energy and the other factor lies in the possibility of an entropy change. An estimate of the entropy contribution has been made. The effect of the entropy contribution is to lower the free-energy change by almost the same amount for each CH_2 group added to the molecule, the amount being approximately RT ℓn3. The exact integer 3 comes about by assuming the energy levels to be triply degenerate. Analysis shows that the entropy effects cannot be ignored and may be large. Calculations predict that the entropy change is approximately R ℓn3 plus a small temperature-dependent term.

2533

RIAS, Inc., Baltimore, Md.

INTERNATIONAL SYMPOSIUM ON NONLINEAR DIFFERENTIAL EQUATIONS AND NONLINEAR MECHANICS, United States Air Force Academy, Colorado Springs, Colo., July 31-Aug. 4, 1961, ed. by J. P. LaSalle and S. Lefschetz. New York, Academic Press, 1963, 505p. incl. diagrs. tables, refs. [AF 49(638)930] Unclassified

This symposium brought together a group of pure and applied mathematicians interested in nonlinear differential equations, nonlinear mechanics, control theory, and other related topics. Much of the meeting was devoted to round table discussions on the following subjects: "Oscillations and Asymptotic Behavior", chaired by J. K. Hale; "Applications of Differential Equations", chaired by R. Bellman; "Control and Stability", chaired by R. E. Kaplan; and "Qualitative Theory", chaired by S. Sternberg. Each day concluded a relatively short session of contributed papers.

2534

RIAS, Inc., Baltimore, Md.

SIGNIFICANCE OF P_{700} AS AN INTERMEDIATE IN PHOTOSYNTHESIS, by B. Kok. [1961] [9]p. incl. diagr. refs. (AFOSR-J1429) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)947 and National Institutes of Health) AD 427571 Unclassified

Also published in Proc. of Fifth Internat'l. Cong. of Biochemistry; Mechanism of Photosynthesis, Moscow (USSR) (Aug. 10-16, 1961), New York, Pergamon Press, v. 6: 73-81, 1963.

Kinetic experiments have indicated that in photosynthesis the pigment molecules which absorb the light outnumber the actual trapping centers and associated enzyme chains by several hundred-fold. A small amount of pigment with an absorption band on the long wavelength side of this peak could efficiently collect photons received by an excess of neighboring chlorophyll a molecules. Such a pigment could function as the mediator between light collection and light conversion — or even be the convertor itself. A band at about 700 mμ is found in green plants as well as in brown, red and blue-green algae and the pigment ("P_{700}") responsible for it thus seems to occur as ubiquitously as chlorophyll a. The bleaching of P_{700} appears a direct photochemical step, which is mainly sensitized by chlorophyll a and possibly carotenoid. The bleached form spontaneously returns to the absorbing form in darkness. The most likely mechanism consistent with the results is the following:

(1) P_{700} (red) + X(ox) $\xrightarrow{\text{light, chlorophyll a}}$ P_{700}(ox) + X(red); (2) P_{700}(ox) + Cyt. c(red) $\xrightarrow{\text{photooxidase}}$ P_{700} (red) + Cyt. c(ox); (3) X(red) + Viologen(ox) ⟶ X + Viologen(red); (4) Viologen(red) + O_2 ⟶ Viologen(ox) + H_2O.

2535

RIAS, Inc., Baltimore, Md.

THE PROPERTIES OF CONDUCTION ELECTRONS IN ALKALI HALIDE CRYSTALS. II. A HARMONIC ANALYSIS OF THE ALTERNATING CURRENT SOLUTIONS OF THE EQUATION FOR MOTION OF MOBILE NEGATIVE CHARGE CARRIERS IN ADDITIVELY COLORED ALKALI HALIDE CRYSTALS, by L. Haines and D. Kahn. Nov. 1961 [67]p. incl. tables. (Technical rept. no. 61-16) (AFOSR-1752) (AF 49(638)1017) AD 269112 Unclassified

The equations of motion for space charge limited carrier diffusion in a trap free crystal are discussed. Boundary conditions equivalent to current blocking electrodes are introduced and only the negative charge carrier is assumed mobile. A sinusoidal voltage is applied to the crystal electrodes at $\pm L/2$, where L is the crystal length. A general expression for the qth harmonic of the space average current and the negative charge carrier concentration at the electrode is given. It is shown that for a sinusoidal applied voltage and current blocking electrodes, the field and carrier concentrations have a definite parity which alternates with the order of the harmonic, and the even harmonics of the space average current are zero. Numerical solutions of the current and negative charge carrier concentration at the electrodes show that the harmonic content at low frequencies (less than 100 cps) is very large for an applied voltage greater than kT/e. At frequencies above approximately 100 cps, the so-called small signal linearized theory is applicable. Experimental measurements of the harmonic content at low frequencies (2-20 cps) and large applied voltages (80 vrms) have shown the actual harmonic content to be less than 0.5%. The reason for this discrepancy is being investigated. (Contractor's abstract)

2536

Rice U. [Dept. of Mathematics] Houston, Tex.

MEROMORPHIC FUNCTIONS WITH SMALL CHARACTERISTIC AND NO ASYMPTOTIC VALUES, by G. R. MacLane. [1961] [9]p. (AFOSR-329) (AF 49-(638)205) AD 253921; PB 155657 Unclassified

Also published in Michigan Math. Jour., v. 8: 177-185, 1961.

The aim of this report is to prove that there exists a function $F(z)$, meromorphic in $|z| < 1$, whose characteristic is dominated by an arbitrarily given increasing unbounded function, such that $F(z)$ has no asymptotic value, finite or infinite, and hence no radial limit. The method used to prove this result will not apply to holomorphic functions.

2537

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. [Apr. 1961] [13]p. (Technical note no. 4) (AFOSR-589) (AF 49(638)205) AD 257057 Unclassified

Also published in Duke Math. Jour., v. 29: 191-197, June 1962.

Let $\{\rho_n\}$ be a given sequence of constants satisfying $0 < \rho_n \uparrow \infty$. Let $\mu(r)$, defined on $[0,1]$, satisfy $\rho_1 < \mu(r) \uparrow \infty$ $(r \uparrow 1)$. The author proves that there exist a function $H(\zeta)$, regular in $|\zeta| < 1$ and satisfying $|H(\zeta)| < \mu(r)$ for $|\zeta| = r$, $0 \leq r < 1$, and an expanding sequence of Jordan curves $\{C_n\}$ with the properties: (i) for $n > n_0(\epsilon)$, C_n is contained in, and separates the circles bounding, the annulus $1 - \epsilon < |\zeta| < 1$; (ii) $|H(\zeta)| = \rho_n$ for all ζ on C_n. The construction is geometrical; H is obtained as a function mapping $|\zeta| < 1$ onto a suitable hyperbolic Riemann surface. (Math. Rev. abstract)

2538

Rice U. [Dept. of Mathematics] Houston, Tex.

HOLOMORPHIC FUNCTIONS, OF ARBITRARILY SLOW GROWTH, WITHOUT RADIAL LIMITS, by G. R. MacLane. July 1961 [8]p. (AFOSR-3260) (AF 49(638)205) AD 611398 Unclassified

Also published in Michigan Math. Jour., v. 9: 21-34, Feb. 1962.

This paper exhibits a holomorphic function F in D such that M(r, F) tends to infinity with preassigned slowness and such that, for each θ,

$$\limsup_{r \to 1} F(re^{i\theta}) = \infty, \quad \liminf_{r \to 1} F(re^{i\theta}) = 0.$$

For his construction, the author first chooses two disjoint arcs C_{-1} and C_1 in $D \setminus \{0\}$ such that each radius of D meets both of these arcs. There exists a polynomial $\psi(z) = az + \cdots$ whose real part is less than -1 on C_{-1} and greater than 1 on C_1. A function of the form $F(z) = \Sigma A_n \psi(z^k n)$ has the required properties.

2539

Rice U. [Dept. of Mathematics] Houston, Tex.

EXISTENCE THEOREMS FOR HARMONIC SUPPORT, by G. Johnson. Jan. 21, 1961, 31p. incl. refs. (AFOSR-179) (AF 49(638)632) AD 254457 Unclassified

A general definition for harmonic support with respect to a class of functionals is stated. The existence of a harmonic support for a real analytic function along an analytic arc on which the Laplacian is positive is proved. Applications are made to the study of convexity in complex analytic function theory. (Contractor's abstract)

2540

Rice U. [Dept. of Mathematics] Houston, Tex.

REGULARIZED SET OPERATIONS, by A. Brown. June 30, 1961, 9p. (AFOSR-1010) (AF 49(638)632) AD 264426 Unclassified

The validity of general Boolean identities is investigated for certain set operations in a topological space that are obtained by systematically modifying (regularizing) the usual basic set operations. (Contractor's abstract)

2541

Rice U. [Dept. of Mathematics] Houston, Tex.

THE DETERMINATION OF COEFFICIENTS IN PARABOLIC DIFFERENTIAL EQUATIONS BY MEASUREMENTS IN THE INTERIOR OF THE MEDIUM, by B. F. Jones, Jr. July 1961, 7p. (AFOSR-1153) (AF 49(638)632) AD 264427 Unclassified

Consider the heat equation $\frac{\partial u}{\partial t} = a(t) \frac{\partial^2 u}{\partial x^2}$ in either a bounded medium with zero boundary values or in an infinite rod. Here both a(t) and u(x, t) are unknown. If certain initial values for u(x, t) are prescribed and if $u(x_o, t)$ is measured for all t and for some fixed x_o, then there is exactly one pair, a(t), u(x, t) satisfying the differential equation together with the boundary and initial conditions, and such that u(x, t) takes the required values at $x = x_o$. (Contractor's abstract)

2542

Rice U. [Dept. of Mathematics] Houston, Tex.

AN EXPLICIT FORMULA FOR AN UNKNOWN COEFFICIENT IN A PARABOLIC DIFFERENTIAL EQUATION, by B. F. Jones, Jr. July 1961, 4p. (AFOSR-1154) (AF 49(638)632) AD 264428 Unclassified

Let the heat equation $\frac{\partial u}{\partial t} = a(t) \frac{\partial^2 u}{\partial x^2}$ be satisfied in a semi-finite medium (x > 0), where both a(t) and u(x, t) are unknown If u(x, 0) = 0, $u(0, t) = f \neq 0$, and $-a(t)\frac{\partial u}{\partial x}(0, t) = g(t)$, then under certain mild conditions on g(t) there is exactly one pair a(t), u(x, t) satisfying the differential equation and the boundary and initial conditions. Furthermore, an explicit formula gives a(t) in terms of $g(\tau)$, $\tau \leq t$. (Contractor's abstract)

2543

Rice U. [Dept. of Mathematics] Houston, Tex.

FURTHER RESULTS OF AN UNKNOWN COEFFICIENT IN A PARABOLIC DIFFERENTIAL EQUATION, by B. F. Jones, Jr. July 1961, 9p. (AFOSR-1155) (AF 49-(638)632) AD 264429 Unclassified

The parabolic differential equation $\frac{\partial u}{\partial t} = a(t) \frac{\partial^2 u}{\partial x^2}$, $0 < x < 1$, $0 < t$, is studied where both a(t) and u(x, t) are unknown. If initial and boundary values for u(x, t) are specified, and if $-a(t) \frac{\partial u}{\partial x}(0, t)$ is specified, then under certain hypotheses there is exactly one pair a(t), u(x, t) satisfying the differential equation and the initial and boundary conditions. (Contractor' abstract)

2544

Rice U. Dept. of Mathematics, Houston, Tex.

NUMERICAL METHODS FOR INTEGRO-DIFFERENTIAL EQUATIONS OF PARABOLIC AND HYPERBOLIC TYPES, by J. Douglas, Jr. and B. F. Jones, Jr. [1961] [6]p. (AFOSR-1447) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)632 and Atomic Energy Commission) AD 407273 Unclassified

Also published in Numerische Math., v. 4: 96-102, 1962.

In a discussion on integro-differential equations which arise from physical problems, Volterra was led to the discussion of a parabolic integro-differential equation of the type:

$\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2} + \int_0^t g(x, t)u(x, t)dt$. In this paper this equation is generalized and numerical procedures are given for finding u that are generalizations of the backward and Crank-Nicolson methods for differential equation . A somewhat similar hyperbolic integro-differential equation shall also be treated. The analyses are based on the energy methods of Lees for parabolic and hyperbolic partial differential equations. (Contractor's abstract)

2545

Rochester U. [Dept. of Chemistry] N. Y.

COLLISIONAL TRANSFER OF ELECTRONIC ENERGY BETWEEN CERTAIN POLYATOMIC MOLECULES (Abstract), by D. S. Weir, N. Ichikawa and others. [1961] [2]p. (AFOSR-247) [AF 49(638)679] Unclassified

Also published in Abstracts of Scientific Papers presented at Eighteenth Internat'l. Cong. of Pure and Applied Chemistry, Montreal (Canada) (Aug. 1961), Toronto U. Press, 1961, p. 33-34.

The acetone-sensitized fluorescent and phosphorescent emission of biacetyl has been known for many years. More recently Weir has shown that biacetyl emission

results when a mixture of 3-pentanone and biacetyl is exposed to radiation absorbed almost solely by the pentanone. As biacetyl emission increases, pentanone decomposition decreases so that energy transfer by collision of the second kind is strongly indicated. Since oxygen destroys triplet states of biacetyl and acetone either by chemical reaction or by quenching or by both, the generalization might be made that oxygen always prevents the oxygen-free behavior of triplet states. This assumption needs investigation. In mixtures of biacetyl and 2-hexanone the Norrish Type II process is not inhibited but triplet emission from biacetyl occurs. This suggests the presence of appreciable quantities of triplet-state molecules of 2-hexanone. Since dissociation into radicals (Norrish Type I) is a very minor process at room temperature, either there is a large amount of unidentified product (formed with a quantum yield greater than 0.5) or the majority of the triplet-state molecules undergo internal conversion to the ground state in the absence of biacetyl. Benzene in the singlet state produced at 2337A is very little self-quenched. The addition of biacetyl causes biacetyl emission with an efficiency which passes through a maximum as a function of pressure. In this case energy transfer from the singlet state of benzene to the biacetyl is probable. Acetaldehyde is very effective in sensitizing phosphorescent emission from biacetyl. On the other hand, there are peculiarities as a function of wavelength which are hard to understand. All of these sensitized emissions can be related to photochemical behavior. Tentatively certain generalizations about steric effects may be made.

2546

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

A SIMPLE SYNTHESIS OF BICYCLO[2.1.1] HEXANE, by R. Srinivasan. [1961] [2]p. (AFOSR-597) [AF 49-(638)679] Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 2590-2591, June 5, 1961.

A new route for the synthesis of bicyclo[2.1.1]hexane is presented which may be particularly applicable to the hydrocarbons of this series. It was found that the vapor phase photolysis of norcamphor led to the formation of bicyclo[2.1.1]hexane , 1,5-hexadiene, and carbon monoxide. Bicyclo[2.1.1]hexane was separated from the other products by distillation and vapor phase chromatography. Structure and properties of the hexane are given as well as the possible application of this synthetic technique to other compounds.

2547

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

MERCURY PHOTOSENSITIZED DECOMPOSITION OF NORCAMPHOR AND d-CAMPHOR, by W. A. Noyes, Jr. [1961] [5]p. incl. diagrs. refs. (AFOSR-1268) (AF 49(638)679) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 4923-4927, Dec. 20, 1961.

The mercury photosensitized decomposition of norcamphor has been found to lead to carbon monoxide, 3 hydrocarbons of formula C_6H_{10} and a polymer as the major products. The 3 hydrocarbons have been identified as 1,5-hexadiene, allylcyclopropane and bicyclo[2.1.1]-hexane, respectively. The minor products included bicyclo[2.2.0]hexane and nortricyclene. The formation of 1,5-hexadiene and bicyclo[2.1.1]hexane along with CO is analogous to the formation of ethylene cyclobutane and CO in the photolysis of cyclopentanone. The mechanism of the formation of allylcyclopropane was traced by the use of norcamphor deuterated in the α-methylene group. The process probably involes a symmetric intermediate which can rearrange in 1 or 2 equivalent ways to give allylcyclopropane. Mercury sensitized decomposition of d-camphor gave carbon monoxide, 1,5,5-trimethylbicyclo[2.1.1]hexane, 5,6-dimethylheptadiene-1, 5 and a polymer as products. The bicyclic hydrocarbon was found to be optically active. The mercury sensitized decomposition of ketones derived from bicyclo[2.2.1]-heptane may be a useful route to the synthesis of hydrocarbons derived frombicyclo[2.1.1]hexane. (Contractor's abstract)

2543

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

PHOTOCHEMISTRY OF CYCLOPENTANONE. I. DETAILS OF THE PRIMARY PROCESS, by R. Srinivasan. [1961] [4]p. incl. diagrs. tables, refs. (AFOSR-J684) (AF 49(638)679) AD 414921 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 4344-4347, Nov. 5, 1961.

In the photochemistry of cyclopentanone, three processes are known to be important. These lead to CO + $2C_2H_4$ (1), CO + $\overline{CH_2CH_2CH_2CH_2}$ (2) and 4-pentenal (3), respectively. Evidence is now presented to show that since there is no detectable light emission from cyclopentanone when excited at 3130A, and since oxygen does not suppress any of the processes, these processes probably do not arise from a triplet state. Photolysis of cyclopentanone in the presence of O_2^{18} does not lead to detectable amounts of cyclopentanone-O^{18}. The effect of pressure or of the addition of a foreign gas on the distribution of the products has been interpreted to mean that the relative importance of the three photochemical processes (which probably occur from the same upper singlet state) is dependent on the vibrational energy possessed by the molecule at the instant of decomposition. It is estimated that the lowest vibrational level at which the processes leading to carbon monoxide, i.e., (1) and (2) can still occur differ by 2.5 kcal from the lowest vibrational level from which process (3) can occur. The lack of a scavenging effect on the products through the addition of even 35.5 mm of oxygen suggests that the previously postulated diradical hypothesis for (1) and (2) should be reconsidered. (Contractor's abstract)

2549

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

PHOTOCHEMISTRY OF CYCLOPENTANONE. II. TRANSFER OF VIBRATIONAL ENERGY FROM THE EXCITED STATE, by R. Srinivasan. [1961] [3]p. incl. diagr. tables. (AFOSR-J685) (AF 49(638)679) AD 414922 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 4348-4350, Nov. 5, 1961.

The photochemical production of carbon monoxide, ethylene, cyclobutane and 4-pentenal from cyclopentanone at constant temperature, pressure and wave length (3130A) have been studied as a function of the pressure of inert gases. Argon, hydrogen, methane, carbon dioxide, cyclopropane and cyclobutane have been used as inert gases. In all cases, over the pressure ranges used (10 to 400 mm), the amount of ketone photolyzed, as determined by mass balance, was independent of the total pressure. The results have been interpreted to mean that the vibrational energy of the ketone molecule is lost gradually (one or a few quanta at a time). From a quantitative interpretation of the data, relative efficiencies for the inert gases for the transfer of vibrational energy from cyclopentanone have been obtained. (Contractor's abstract)

2550

Rochester U. [Dept. of Chemistry] N. Y.

BAND STRUCTURE OF SOLID ARGON (Abstract), by R. S. Knox and F. Bassani. [1961] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)679] and Atomic Energy Commission) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 293, Apr. 24, 1961.

The OPW method, as modified by Bassani and Celli has been used to compute the lowest-lying conduction states in (fcc) solid argon at the symmetry points Γ, X, L, and K. The 3s and 3p valence bands have been treated by simple tight binding theory. The potential consists of a sum of effective atomic potentials, where a free electron-like expression is used for the exchange contribution. The lowest conduction state appears to be Γ_1, lying 12.4 ev above the highest valence state (Γ_{15}). The reliability of the potential used will be discussed, and the results of the computation will be compared with present experimental and theoretical knowledge of the electronic structure of the solid rare gases.

2551

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

PHOTOCHEMICAL PRIMARY PROCESS IN BIACETYL VAPOR AT 4358A, by W. A. Noyes, Jr., W. A. Mulac, and M. S. Matheson. [1961] [7]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)679] and Atomic Energy Commission) Unclassified

Published in Jour. Chem. Phys., v. 36: 880-886, Feb. 15, 1962.

At 4358A at room temperature the quantum yield for the primary dissociation of biacetyl increases with intensity. It is thus implied that the primary process is second order in some active species. By use of the rotating sector it is shown that the species responsible for this effect has a mean life close to that ascribed to an excited triplet state for biacetyl. At higher temperatures this intensity effect disappears and one of the products strongly inhibits both the phosphorescence and the primary dissociation. At these temperatures the data may best be treated by assuming that the triplet state of biacetyl undergoes a unimolecular dissociation with an activation energy of about 15 kcal. (Contractor's abstract)

2552

Rochester U. [Dept. of Mathematics] N. Y.

CAMERON-MARTIN TRANSLATION THEOREMS IN THE WIENER SPACE OF FUNCTIONS OF TWO VARIABLES, by J. J. Yeh. [1961] [12]p. (AFOSR-J1293) (AF 49(638)1046) AD 424218 Unclassified

Also published in Trans. Amer. Math. Soc., v 107: 409-420, June 1963.

The Cameron-Martin translation theorems have proved useful in the evaluation of various Wiener integrals. The analogue of 1 of these theorems for the integration of continuous functionals in the Wiener space of functions of 2 variables was considered by Kitagawa. In this article a rigorous statement together with a proof for the theorem of Kitagawa and the translation theorem for Wiener measurable sets and Wiener integrals of arbitrary measurable functionals are given.

2553

[Rochester U. Dept. of Physics and Astronomy, N. Y.]

A SURVEY OF NEUTRAL HYDROGEN AT HIGH GALACTIC LATITUDES, by W. C. Erickson, H. L. Helfer, and H. E. Tatel. [1958] [8]p. incl. diagrs. table. (Sponsored jointly by [Air Force Office of Scientific Research under AF 49(638)52] and Convair Scientific Research Lab.) Unclassified

Published in Paris Symposium on Radio Astronomy. Cite U., Paris (France) (July 30-Aug. 6, 1958). Stanford, Stanford U. Press, 1959, p. 390-397. (AFOSR-4512)

Approximately 1000 observations of neutral hydrogen have been obtained with the 54-channel H-line receiver and the Würzburg antenna of the Carnegie Inst. of Washington. H-line profiles have been observed at 10

intervals along the ±20, ±30, and ±40 degree parallels of galactic latitude; at 20° intervals along the ±50 and ±60 degree parallels; at 40° intervals along the ±70 and ±80 degree parallels and at the poles. Approximately 2 dozen observations have been taken at points near the galactic plane in order to correlate these observations with the Leiden survey. The beamwidth of the Würzburg antenna was about 2°. The observations were taken in 2 series, one series during the summer of 1957, and the other during January 1958. The video frequency bandwidth of the receiver is 12 kc/sec. The profiles consist of averages of from 2 to 6 scans with integration times from 4.8 to 7.5 min. (Contractor's abstract)

2554

Rochester U. Dept. of Physics and Astronomy, N. Y.

ON THE VELOCITY FIELD OF THE NEARBY INTERSTELLAR HYDROGEN (Abstract), by H. L. Helfer. [1959] [1]p. (AF 49(638)52) Unclassified

Published in Astronom. Jour., v. 64: 128, May 1959.

This is a progress report upon the analysis of the 21-cm survey for $|b| \geq 20°$, undertaken at the Dept. of Terrestrial Magnetism, Carnegie Inst. of Washington. Rough agreement between Shain's local magnetic pole of the Galaxy, and the crudely defined pole of the high-latitude interstellar hydrogen suggests that the distribution of the interstellar gas is quite dependent upon the local magnetic field and that the possibility that the velocity-distance relation for the gas is different from that of the stars cannot be ignored. A solution for the velocity-distance relation of the nearby gas is attempted. Including only first order terms one may write for the radial velocity: $V(l,b) = a + sR$, where R is the distance and $s = K + \cos^2 b\,(C + B_1 \sin 2l + B_2 \cos 2l)\,(A_1 \sin l + A_2 \cos l) \sin 2b$, $a = W_1 \cos l \cos b + W_2 \sin l \cos b + W_3 \sin b$. The preliminary values are $K = 1.000$, $C = 0.820$, $B_1 = 0.311$, $B_2 = -0.182$, $A_1 = 0.743$, and $A_2 = -0.322$. The values of W_1, W_2, W_3, determined from the value of $V(1,b) - V(1 + 180°, -b)$ are found to be 1.24 km/sec, 2.62 km/sec, and -1.60 km/sec, respectively, but these values are quite crude. If accepted literally, this would suggest that the circular velocity of the local gas is about 3 km/sec faster than that of the stars.

2555

Rochester U. Dept. of Physics [and Astronomy] N. Y.

EARLY EVOLUTION AT MASS TEN, by M. P. Savedoff and S. R. van Dyck. [1960] [5]p. incl. diagrs. [AF 49-(638)52] Unclassified

Published in Mem. Soc. Roy. Sci. Liege, Series 5, v. 3: 523-527, 1960.

An evolutionary sequence of star models has been computed assuming initially a homogeneous star of 10 solar masses with a composition X = .70, Y = .27, and Z = .03. With the inclusion of radiation pressure, numerical integrations were performed and it was found that the mass of the star interior to the point where the envelope becomes convectively unstable increases with time. The dominance of electron scattering at the inner boundary of the envelope means that a sudden decrease of the hydrogen content, presumably resulting from convective mixing, implies a stable temperature gradient. In summary, within numerical limitations and physical limitations imposed by rough treatment of the opacity, the sequence of models presented represents an evolutionary sequence which renders core hydrogen contents below X = .005 before any contractional energy sources appear. No large change in the estimated evolutionary time scale is indicated other than that anticipated for the difference assumed in composition.

2556

Rochester U. Dept. of Physics and Astronomy, N. Y.

THE KINEMATICS OF THE LOCAL GAS SYSTEM, by H. L. Helfer. [1961] [9]p. incl. diagrs. tables, refs. (AFOSR-127) (AF 49(638)52) Unclassified

Also published in Astronom. Jour., v. 66: 160-168, May 1961.

Some features of the 21-cm velocity measurements of hydrogen gas for $|b| \geq 20°$ are analyzed. An argument is presented for consideration of an expression for the residual velocity-distance relation of the form

R. V. (km/sec) $= 1.24 \cos l^I \cos b^I + 2.62 \sin l^I \cos b^I - 1.60 \sin b^I - Sr\{1 - [1.1 + \sin 2(l^I + 53°)] \cos^2 b^I + 0.25 \sin(l^I - 48°) \sin 2b^I\}$, where r is the distance and S is an unknown (positive) scale factor. Crude arguments suggest $S \sim 10$ km sec^{-1} kpc^{-1}. Some implications of these numerical values and of the assumption that the local gas system is associated with the stellar Gould's belt system are briefly discussed. (Contractor's abstract)

2557

Rochester U. Dept. of Physics and Astronomy, N. Y.

GAS DYNAMICS ON COSMIC SCALES, by M. L. Savedoff. Final rept Dec. 1, 1956-Nov. 30, 1961. 7p. incl. refs. (AFOSR-3055) (AF 49(638)52) Unclassified

The research of the various projects supported in whole or in part by this contract is briefly reviewed. H. L. Helfer and his collaborators have examined the detailed observational tests of current theories of nuclear genesis. By studying a large number of stars (now about 30) it has been shown that statistically significant abundances can be obtained for individual elements. From studies of high galactic latitude 21 cm emission of neutral hydrogen, a detailed model for the local notions of this gas was obtained. The virial theorem paper is an attempt to evaluate the reliability of masses of clusters of galaxies obtained from comparison of their dimensions and kinetic energies in the

absence of knowledge of their distribution of intergalactic matter. As the precise results depend significantly on the distribution of this matter one can explain the anomalously high masses deduced by these methods. M. L. Savedoff and S. R. van Dyck discovered that the Kushwaha models for the evolution of stars of 10 solar masses were inadequate in their representation of the extent of the internal convection zone. With S. Vila, savedoff has studied the stability of particular simple gas dynamic motion in the presence of a self-gravitational field. It is shown that the classical theory of Jeans does not lead to correct results. In fact, for a gas flow for which the pressure and density are related by $P \propto \rho^{\gamma}$, instability is found for $\gamma < 5/3$ during uniform collapse ($r \propto r$). Helfer and Savedoff found that in observing weak hydrogen signals, the uncertainties in the base line precluded any real determination of signal size. Current evidence for He^3/He^4 ratios in planetary and galactic nebulae shows no indications of He^3 as abundant as observed in Cosmic Rays by Appa Rao. Savedoff and Helfer have also discovered the possibility of an exponential term in the gravitational potential. This term would occur if the gravitational potential has a finite range.

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Rochester U. Dept. of Physics and Astronomy, N. Y.

THE INFLUENCE OF ISOTOPIC COMPOSITION ON THE MAXIMUM IN THE COSMIC RAY ENERGY SPECTRA, by M. V. K. Appa Rao and M. F. Kaplon. May 8, 1961 [10]p. incl. diagrs. refs. (AFOSR-875) [AF 49(638)303] AD 446541 Unclassified

Also published in Nuovo Cimento, Series X, v. 21: 369-372, July 16, 1961.

One of the interesting results obtained from measurements on the quiescent primary cosmic ray beam is the observation that the differential rigidity spectrum of the doubly charged component is similar to that of the singly charged component. Additionally, the observation of a maximum at low energies has been attributed as being due to a magnetic mechanism whose intensity is associated with the solar cycle. The possibility is examined that this maximum may arise in part from a misinterpretation of the data due to oversimplifying assumptions about the composition of the beam. It has recently been observed that the doubly charged component of cosmic rays contains an appreciable abundance of He^3-nuclei. The influence of this composition on the usual interpretation of the measurements, which do not recognize it, is examined here. It is shown that this leads, in part, to a maximum in the spectrum as conventionally deduced from observations. It is also shown that a maximum or the enhancement of 1 occurs due to plotting spectra on a basis of energy per nucleon instead of rigidity. It is shown that a maximum arises due to the lack of recognition of the He^3 component in the usual measurements coupled with the assumption that these are He^4.

2559

Rochester U. [Dept. of Physics and Astronomy] N. Y.

ISOTOPIC COMPOSITION OF THE LOW-ENERGY HELIUM NUCLEI IN THE PRIMARY COSMIC RADIATION, by M. V. K. Appa Rao. [1961] [6]p. incl. diagrs. tables, refs. (AFOSR-4121) (AF 49(638)303) AD 446540 Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 53, Feb. 1, 1961.

Also published in Phys. Rev., v. 123: 295-300, July 1, 1961.

The isotopic composition of the low-energy helium nuclei in the primary cosmic radiation has been determined by using the "constant sagitta" scattering method on the tracks of helium nuclei stopping in a nuclear-emulsion stack flown at a geomagnetic latitude $\lambda = 55°N$ and at a mean atmospheric depth of 8.5 g/cm^2; tracks with zenith angles less than 30° were accepted. The ratio of $He^3/(He^3 + He^4)$ for the same energy per nucleon (between 200 and 400 mev) is found to be 0.41 ± 0.09 at flight altitude. The correction for production of secondary He^3 in the residual atmosphere is calculated to be 4%. If one assumes that no He^3 nuclei are present at the source, the observed ratio corresponds to a traversal of 14 ± 3 g of interstellar matter by the low-energy helium nuclei. The value of $He^3/(He^3 + He^4)$ corresponding to the same magnetic rigidity (between 1.3 and 1.6 bv) is found to be 0.36 ± 0.11 which corresponds to a traversal of 12.2 ± 3.5 g of interstellar matter. The observed ratio may indicate the presence of He^3 at the source of cosmic rays, or may be a reflection of local production within the solar system. (Contractor's abstract)

2560

Rochester U. Dept. of Physics and Astronomy, N. Y.

DIRECTIONAL HIGH ENERGY GAMMA-RAY COUNTER, by G. G. Fazio and E. M. Hafner. [1961] [6]p. incl. diagrs. (AFOSR-4122) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)303] and National Aeronautics and Space Administration) AD 446542 Unclassified

Also published in Rev. Scient. Instr., v. 32: 697-702, June 1961.

A directional Čerenkov counter has been developed for detection of energetic gamma rays from balloons and satellites. It is sensitive to photons whose directions lie within a 10° cone. It is completely insensitive to backward fluxes and almost completely insensitive to charged particles. Several different versions of the

system have been constructed, and tested in bremsstrahlung beams. The angular resolution has also been indirectly confirmed by using the device to count cosmic ray muons at sea level. (Contractor's abstract)

2561

Rochester U. Dept. of Physics [and Astronomy] N. Y.

THE $He^3/(He^3 + He^4)$ RATIO IN PRIMARY COSMIC RADIATION, by M. V. K. Appa Rao. [1961] [5]p. incl. diagrs. tables. (AFOSR-4124) [AF 49(638)303] AD 446539 Unclassified

Also published in Jour. Geophys. Research, v. 67: 1289-1293, Apr. 1962.

The ratio $R = He^3/(He^3 + He^4)$ is determined using a nuclear emulsion stack exposed at the geomagnetic latitude 61°N on August 3, 1958, under 3.8 g/cm^2 of matter. The ratio R found at the top of the atmosphere is 0.31 ± 0.08 for the same energy per nucleon (160-355 mev) and 0.33 ± 0.08 for the same rigidity (1.05 - 1.48 bv). These values are lower than previous observations, but in agreement within the statistical errors, thus implying very little or no time variation in the ratio R over a period of one year. (Contractor's abstract)

2562

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. Levakare. Aug. 31, 1961, 10p. incl. illus. refs. (Rept. no. NYO-10246) (AFOSR-4126) [AF 49(638)303] AD 284608 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 were analyzed. The relevant parameters, needed for the study of the primary cosmic ray deuterons were obtained at this energy. (Contractor's abstract)

2563

Rochester U. [Dept. of Physics and Astronomy] N. Y.

ISOTOPIC COMPOSITION, by M. F. Kaplon. [1961] [6]p. incl. table. [AF 49(638)303] Unclassified

Presented at Internat'l. Conf. on Cosmic Rays and the Earth Storm, Kyoto (Japan), Sept. 4-15, 1961.

Published in Jour. Phys. Soc. Japan, v. 17, Suppl. A-III: 68-73, Jan. 1962.

This report summarizes the papers presented on isotopic composition in the session on cosmic rays of the International Conference on Cosmic Rays and the Earth Storm. Particular emphasis is placed on the work of Appa Rao of Rochester U.

2564

Rochester U. [Dept. of Physics and Astronomy] N. Y.

PHOTON DEGENERACY IN LIGHT FROM OPTICAL MASER AND OTHER SOURCES, by L. Mandel. [1961] [2]p. incl. refs. (Technical note no. 6) (AFOSR-91) [AF 49(638)602] Unclassified

Also published in Jour. Opt. Soc. Amer., v. 51: 797-798, July 1961.

The purpose of this note is to compare δ (the average number of photons in the light beam which are to be found in the same quantum state, or in the same cell of phase space) for a number of sources and to draw attention to the very large values of δ which can now be obtained for visible light from recently developed optical masers. The expression is shown to be in good approximation by the Einstein expression for degeneracy of black body radiation in an enclosure. It follows that, for normal incandescent sources at temperatures of a few thousand degrees K, beams have degeneracies of the order 3×10^{-4}, while values of 10^{-3} are obtainable from gas discharge sources. In optical masers, on the other hand, with surface coherence across the source, degeneracies as high as 5×10^7 are observed. Suggestions are made as to how this property will be of great value in laboratory experiments involving photon correlation.

2565

Rochester U. [Dept. of Physics and Astronomy] N. Y.

NOTE ON THE PROOF OF "GABOR'S EXPANSION THEOREM", by K. Miyamoto. [1961] [2]p. (Technical note no. 7) (AFOSR-411) (AF 49(638)602) Unclassified

Also published in Jour. Opt. Soc. Amer., v. 51: 910-911, Aug. 1961.

A note of clarification is added to the author's article, "On Gabor's Expansion Theorem" (item no. 2407, Vol. IV). It is pointed out that the formula $u(x, y, z) = \sum_{j=1}^{\infty} a_j(z) f_j(x, y)$ and the formula $k^2(s_x^2 + s_y^2) = \beta_j$ are valid only in the neighborhood of the object area. A different expansion of $u(x, y, z)$ is needed for the region between the object area and the aperture. A mathematical analysis of the transition from the object area to the aperture is then presented.

2566

Rochester U. [Dept. of Physics and Astronomy] N. Y.

SOME PROPERTIES OF COHERENT LIGHT, by L.

Mandel and E. Wolf. [1961] [5]p. incl. diagr. (Technical note no. 8) (AFOSR-412) (AF 49(638)602) Unclassified

Also published in Jour. Opt. Soc. Amer., v. 51: 815-819, Aug. 1961.

The present paper is concerned with the study of some general properties of coherent light. A clear definition of coherence is given, which appears to be preferable to definitions previously proposed by other authors. Several new theorems relating to correlation functions and the spectral density functions of coherent light are derived. The results are used to establish the Huygens-Fresnel principle for a coherent optical field. This principle has previously been freely apolied to such a field, although the validity of the principle has only been justified for the much more idealized (and physically unrealizable) case of a field which is strictly monochromatic. The present formulation of the Huygens-Fresnel principle involves only observable quantities and not the instantaneous amplitudes and the instantaneous phases of the light vibrations. (Contractor's abstract)

2567

Rochester U. [Dept. of Physics and Astronomy] N. Y.

CONCEPT OF CROSS-SPECTRAL PURITY IN COHERENCE THEORY, by L. Mandel. [1961] [9]p. incl. diagrs. tables, refs. (Technical note no. 11) (AFOSR-570) (AF 49(638)602) Unclassified

Also published in Jour. Opt. Soc. Amer., v. 51: 1342-1350, Dec. 1961.

An examination of the conditions under which the normalized coherence function $\gamma(x_1, x_2, \tau)$, at 2 points x_1 and x_2 in an optical field, is reducible to the product of a function of x_1, x_2 and a function of τ leads to the concept of spectral purity. Spectrally pure beams of light are characterized by the property that their coherence function is so reducible and, operationally, by the fact that superposition does not affect the spectral distribution. Light beams that do not have this property are spectrally impure and it is shown to be characteristic of such beams that the interference fringes exhibit a detailed periodic coloring. A measure of the departure from spectral purity is introduced and evaluated in some special cases. It is shown by an example that spectrally pure and spectrally impure beams of light may be derived from the same source with similar optical components. Moreover, these beams may be identical as regards their intensity, their spectral distribution and their degree of coherence and differ only as regards their state of spectral purity.

2568

Rochester U. [Dept. of Physics and Astronomy] N. Y.

COHERENCE PROPERTIES OF ELECTROMAGNETIC RADIATION; REPORT ON CONFERENCE, Rochester U. Inst. of Optics, June 27-29, 1960, ed. by R. E. Hopkins and E. Wolf. Apr. 1961, 125p. incl. illus diagrs. refs. (Technical note no. 5) (AF 49(638)602) AD 256057 Unclassified

Published in part in Phys. Today, v. 14: 28-34, May 1961.

The aim of this conference was to provide a forum for the exchange of ideas between scientists carrying out research on various aspects of coherence, especially in connection with coherent scattering, stimulated emission, propagation of partially coherent light, intensity interferometry, and coherence problems of instrumental optics and of radio astronomy. The committee aimed at arranging a conference of an informal nature and for this reason no written contributions were solicited. However, to meet at least partially the numerous requests for some permanent record of the conference, the present report was prepared. It consists of a preprint of a review article which appeared in "Physics Today" (see above) an account of the introductory talk and abstracts or condensed version of the majority of the papers presented at the meeting.

2569

Rochester U. Dept. of Physics and Astronomy, N. Y.

GENERALIZATION OF THE MAGGI-RUBINOWICZ THEORY OF THE BOUNDARY DIFFRACTION WAVE. PART I, by K. Miyamoto and E. Wolf. [1961] [11]p. incl. diagrs. refs. (Technical note no. 9) (AFOSR-793a) (AF 49(638)602) Unclassified

Also published in Jour. Opt. Soc. Amer., v. 52: 615-625, June 1962.

As a first step towards a generalization of the Maggi-Rubinowicz theory of the boundary diffraction wave, a new vector potential W(Q, P) is associated with any monochromatic scalar wavefield U(P). This potential has the property that the normal component of its curl, taken with respect to the coordinates of any point Q on a closed surface S surrounding a field point P, is equal to the integrand of the Helmholtz-Kirchhoff integral; that is,

$$\mathrm{curl}_Q W(Q, P)\cdot n = \frac{1}{4\pi}\left\{U(Q)\frac{\partial}{\partial n}\left(\frac{\exp(iks)}{s}\right) - \frac{\exp(iks)}{s}\frac{\partial}{\partial n}U(Q)\right\},$$

where s is the distance QP and $\partial/\partial n$ denotes the differentiation along the inward unit normal n to S. Further it is shown that the vector potential always has singularities at some points Q on S and that the field at P may be rigorously expressed as the sum of disturbances propagated from these points alone. A closed expression for the vector potential associated with any given monochromatic wavefield that obeys the Sommerfeld radiation condition at infinity is derived and it is shown that in the special case when U is a spherical wave, this expression reduces to that found by G. A. Maggi and A. Rubinowicz in their researches on the boundary diffraction wave.

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Rochester U. Dept. of Physics and Astronomy, N. Y.

GENERALIZATION OF THE MAGGI-RUBINOWICZ THEORY OF THE BOUNDARY DIFFRACTION WAVE, PART II, by K. Miyamoto and E. Wolf. [1961] [12]p. incl. diagrs. refs. (Technical note no. 10) (AFOSR-793b) (AF 49(638)602) Unclassified

Also published in Jour. Opt. Soc. Amer., v. 52: 626-637, June 1962.

With the help of the results derived in Part I of this investigation, a new representation is obtained for the field arising from diffraction of a monochromatic wave by an aperture in an opaque screen. It is shown that within the accuracy of the Kirchhoff diffraction theory, the diffracted field $U_K(P)$ may be expressed under very general conditions in the form

$$U_K(P) = U^{(B)}(P) + \Sigma_j F_j(P).$$

Here $U^{(B)}$ represents a disturbance originating at each point of the boundary of the aperture and $\Sigma_j F_j(P)$ represents the total effect of disturbances propagated from certain special points Q_j in the aperture. Expressions for $U^{(B)}$ and $F_j(P)$ are given, in terms of the new vector potential which was introduced in the previous paper (item no. 2569, Vol. 7). In the special case when the wave incident upon the aperture is plane or spherical, the last term in (1) is found to represent a wave disturbance $U^{(G)}(P)$ which obeys the laws of geometrical optics. The formula (1) then becomes equivalent to a classical result of Maggi and Rubinowicz, which may be regarded as a mathematical refinement of early ideas of Young about the nature of diffraction. It is shown further, that even when the incident wave is not plane or spherical, the last term in (1) is, at least approximately, equal to a "geometrical wave." The results suggest a new approach to the solution of certain types of diffraction problems and provide a new insight into the process of diffraction.

2571

Rochester U. Dept. of Physics and Astronomy, N. Y.

CORRELATION IN THE FLUCTUATING OUTPUTS FROM TWO SQUARE-LAW DETECTORS ILLUMINATED BY LIGHT OF ANY STATE OF COHERENCE AND POLARIZATION, by L. Mandel and E. Wolf. [1961] [7]p. incl. refs. (Technical note no. 12) (AFOSR-1152) (AF 49(638)602) Unclassified

Also published in Phys. Rev., v. 124: 1696-1702, Dec. 15, 1961.

By treating light fluctuations as a random process (stationary and Gaussian to second order), an expression is derived for the correlation in the output fluctuations of two square-law detectors which are illuminated by a plane light wave of any state of coherence and polarization. The expression takes a particularly simple form when, as is usually the case, the light is spectrally pure in the sense of a definition introduced elsewhere. The solution yields as a special case, the basic formula relating to the Hanbury Brown-Twiss effect. The generalization discussed here is of particular interest for correlation experiments performed with light beams from optical maser sources. Moreover, the present analysis appears to be simpler than other treatments previously given in connection with more restricted cases. (Contractor's abstract)

2572

Rochester U. Dept. of Physics and Astronomy, N. Y.

CONSISTENCY OF RAYLEIGH'S DIFFRACTION FORMULAS WITH KIRCHHOFF'S BOUNDARY CONDITIONS, by N. Mukunda. [1961] [2]p. incl. diagrs. (AFOSR-1180) [AF 49(638)602] Unclassified

Also published in Jour. Opt. Soc. Amer., v. 52: 336-337, Mar. 1962.

The purpose of this report is to clear up a point concerning Rayleigh's diffraction formulas and Kirchoff's boundary conditions. As is well known, when the Helmholtz-Kirchhoff integral formula is applied to the problem of determining the field diffracted by an aperture, and the field in the plane of the aperture is approximated by Kirchhoff's boundary conditions, a solution is obtained which is mathematically inconsistent. The inconsistency arises from the fact that in this formulation the boundary values for the wave function U and its normal derivative $\partial U/\partial n$ are specified on the plane of the screen independently; however, under circumstances the specification of either U or $\partial U/\partial n$ is sufficient to determine the solution uniquely and so these 2 quantities may not be prescribed independently. The inconsistency is clearly manifested by the fact that the solution U(P) given by the Helmholtz-Kirchhoff formula (plus Kirchhoff's boundary condition) does not recover the assumed boundary values as the point P approaches the plane of the aperture. However, from the analysis it follows that the discontinuous normal derivative assumed in Kirchhoff's boundary conditions is recovered by the second Rayleigh formula. A detailed example of this point is given.

2573

Rochester U. Dept. of Physics and Astronomy, N. Y.

EQUATIONS GOVERNING THE PROPAGATION OF SECOND-ORDER CORRELATIONS IN NON-STATIONARY ELECTROMAGNETIC FIELDS, by Y. Kano. [1961] 18p. (AFOSR-1474) (AF 49(638)602) Unclassified

Also published in Nuovo Cimento, Series X, v. 23: 328-338, Jan. 16, 1962.

The main results of E. Wolf and P. Roman relating to the propagation of second-order correlations in electromagnetic fields are generalized to the case of a non-stationary field containing currents and charges. The basic differential equations relating the correlations are derived. They fall into 2 groups, one of which contains only differential equations of the first order, but involves

certain parameters that seem difficult to be determined experimentally. When these quantities are eliminated a second set of equations is obtained. Equations of this set are of a higher order but they contain only the electric and magnetic correlation tensors and a tensor characterizing the correlation in the electric currents. (Contractor's abstract)

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Rochester U. Dept. of Physics and Astronomy, N. Y.

FLUCTUATIONS OF LIGHT BEAMS, by L. Mandel. [1961] [106]p. incl. diagrs. refs. (AFOSR-1714) (AF 49(638)602) Unclassified

Also published in Prog. in Opt., v. 2: 183-248, 1963.

The subject of radiation fluctuations is discussed in some detail starting with an historical introduction followed by a discussion of the wave picture of light, practical applications, and a section on the particle picture. Two appendices are included dealing with the connection between the correlations of real and complex wave functions and the derivation of the distribution p(n, T, t). The representation of the wave amplitude, envelope and intensity fluctuations, intensity correlations in partially coherent fields, the effect of partial polarization, and the spectral density of the intensity fluctuations are well discussed. The practical applications of the wave picture include the measurement of intensity correlation, correlation between band limited signals, the problem of noise, stellar correlation interferometry, and the determination of spectral line profiles. The section on the particle picture includes parts on the photon wave function in configuration space and the probability of photo-emission, the probability distribution of the photo-electric counts, correlation between counting fluctuations, partially polarized light beams, and bunching effects and excess counting coincidence.

2575

Rochester U. Dept. of Physics and Astronomy, N. Y.

THE BOUNDARY DIFFRACTION WAVE IN THE PRESENCE OF ABERRATIONS (Abstract), by K. Miyamoto and E. Wolf. [1961] [1]p. [AF 49(638)602] Unclassified

Presented at meeting of the Opt. Soc. Amer., Pittsburgh, Pa., Mar. 3, 1961.

Published in Jour. Opt. Soc. Amer., v. 51: 478, Apr. 1961.

In a paper presented at the previous meeting of the Opt. Soc. of Amer., it was shown that diffraction of any wave by an aperture may be regarded as interference between a wave originating in the boundary of the aperture (boundary wave) with waves propagated from certain special points within the aperture. In the present paper the generalized theory of the boundary diffraction wave is applied to the useful case where the wave incident upon the aperture is adequately represented by geometrical optics. A simple expression is derived for the associated vector potential. The asymptotic behavior of the solution, for large value of the propagation constant $k = 2\pi/\lambda$ (λ being the wave length) is examined and is compared with the asymptotic behavior of the solution based on Kirchhoff's diffraction theory. It is shown that the effect of the special points in the aperture is precisely the same as that of the critical points of the first kind in Kirchhoff's theory and that the leading terms in the expansion of the boundary wave are the same as the contributions from critical points of the second and third kind.

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Rochester U. Dept. of Physics and Astronomy, N. Y.

THE HUYGENS-FRESNEL PRINCIPLE FOR COHERENT WAVE FIELDS (Abstract), by L. Mandel and E. Wolf. [1961] [1]p. [AF 49(638)602] Unclassified

Presented at meeting of the Opt. Soc. Amer., Pittsburgh, Pa., Mar. 3, 1961.

Published in Jour. Opt. Soc. Amer., v. 51: 478, Apr. 1961.

Although the Huygens-Fresnel Principle (in its elementary form) is usually justified as an approximate propagation law for strictly monochromatic fields, it is in fact applied in practice to a much broader class of fields, namely to those which are coherent. A justification of the validity of the Huygens-Fresnel Principle for such fields will be discussed from the standpoint of modern coherence theory. For this purpose the concept of full coherence will be re-examined and a generalization will be given about the form of the mutual coherence function of a fully coherent wavefield. The results are also useful in determining the limiting forms of certain theorems (e.g. those relating to frequency response analysis for partially coherent illumination) which were established in the field of partial coherence in recent years.

2577

Rochester U. Dept. of Physics and Astronomy, N. Y.

PROPAGATION OF MUTUAL COHERENCE IN A MATERIAL MEDIUM (Abstract), by J. C. Urbach. [1961] [1]p. [AF 49(638)602] Unclassified

Presented at meeting of the Opt. Soc. Amer., Pittsburgh, Pa., Mar. 3, 1961.

Published in Jour. Opt. Soc. Amer., v. 51: 478, Apr. 1961.

It is known that the mutual coherence function in vacuo obeys 2 wave equations. A question arises as to the behavior of mutual coherence in a dispersive material medium. It is shown that in a homogeneous isotropic medium the mutual coherence function obeys an integro-differential equation. In the case of certain non-dissipative media, the kernel of the integral in this equation can be found explicitly. Approximate forms of the equation are derived, these may prove useful in some applications.

2578

Rochester U. [Dept. of Physics and Astronomy] N. Y.

He^3-NUCLEI IN THE PRIMARY COSMIC RADIATION, by M. V. K. Appa Rao and M. F. Kaplon. [1961] [5]p. incl. diagrs. table. (AFOSR-4123) [AF AFOSR-62-32] 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: 48-52, Jan. 1962.

The ratio of $He^3/He^3 + He^4$) was determined in 2 high-altitude balloon flights at $\lambda = 55°$ N on July 30, 1957 and $\lambda = 61°$ on Aug. 3, 1958.

2579

Rochester U. [Inst. of Optics] N. Y.

BAND STRUCTURE OF SOLID ARGON, by R. S. Knox and F. Bassani. Apr. 1961, 23p. incl. diagr. tables, refs. (Technical rept. no. 8) (AFOSR-950) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)432 and Atomic Energy Commission) AD 259698 Unclassified

Also published in Phys. Rev., v. 124: 652-657, Nov. 1961.

The orthogonalized plane wave method in the perturbation approximation of Bassani and Celli is used to compute the lowest-lying conduction states in (f. c. c.) solid argon at the symmetry points Γ, X, L, and K. The 3s and 3p valence bands are treated by tight-binding theory. The potential used in the computation consists of a sum of effective atomic potentials in which a free-electron-like expression is used for the exchange contribution. The lowest conduction state appears to be s-like (Γ_1), lying 12.4 ev above the highest valence state (Γ_{15}). The results of the computation are compared with present theoretical and experimental knowledge of the electronic structure of solid rare gases. (Contractor's abstract)

2580

Rochester U. Inst. of Optics, N. Y.

[OPTICAL AND ELECTRICAL PROPERTIES OF SOLIDS], by D. L. Dexter and R. M. Blakney. Final rept. Sept. 1, 1958-Aug. 31, 1961 [14]p. incl. refs. (AFOSR-1485) (AF 49(638)433) AD 268434 Unclassified

The central aim of the research accomplished under this contract has been an increased understanding of the processes of optical excitation and energy transfer in insulators and semiconductors, based on experimental studies of absorption, luminescence, photoconductivity, and photo-emission. Emphasis has been placed on those phenomena which are properties of the pure material, or of the simpler kinds of lattice imperfections. This report summarizes the work done along these lines at the Inst. of Optics during the past 3 years.

2581

Rochester U. Inst. of Optics, N. Y.

PHOTOCONDUCTIVITY IN RbI AND KI, by Y. Nakai and K. Teegarden. [1961] [5]p. incl. diagrs. (AFOSR-2150) [AF 49(638)433] Unclassified

Presented at the 1961 Internat'l. Conf. on Photoconductivity, Cornell U., Ithaca, N. Y., Aug. 21-24.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 483, Nov. 24, 1961.

Also published in Jour. Phys. and Chem. Solids, v. 22: 327-331, Dec. 1961.

A threshold for intrinsic photoconductivity has been observed in RbI and KI at room temperature and lower temperatures. These experiments were carried out with an electrode arrangement quite different from that employed previously by Teegarden and in a considerably cleaner vacuum. Photoconductivity occurs on the short wavelength side of the first exciton band in the region of the shoulder previously ascribed to the onset of band-to-band transitions. Photoconductivity also can occur on the long wavelength side of the first exciton peak when F-centers or other kinds of electron-surplus centers, formed by irradiation with ultraviolet light, are present in the crystals. (Contractor's abstract)

2582

Rochester U. Inst. of Optics, N. Y.

PHOTOCONDUCTIVITY AND THE EXTERNAL PHOTOELECTRIC EFFECT IN PbS, by A. Smith and D. Dutton. [1961] [13]p. incl. diagrs. refs. (AFOSR-2151) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)433] and National Aeronautics and Space Administration) Unclassified

Presented at the 1961 Internat'l. Conf. on Photoconductivity, Cornell U., Ithaca, N. Y., Aug. 21-24.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 484, Nov. 24, 1961.

Also published in Jour. Phys. and Chem. Solids, v. 22: 351-363, Dec. 1961.

The yields for photoconductivity and external photoemission in the vacuum UV spectral region, 584-3000A, were measured using polycrystalline layers and natural crystals. The photoconductive yield in PbS layers rises approximately linearly with incident photon energy $h\nu$ up to 7.5 ev; further extension of the measurement was thwarted by the magnitude of the external photocurrent. The rise in yield, as reported previously (see item no. ROC.04:009, Vol. III), is attributed to collision multiplication beginning as $h\nu_t = 2$ ev. The observed photoelectric threshold for galena crystals was ~ 5 ev, and for

layers ~ 6 ev. Both kinds of specimen exhibit very large external photoyields at high hν: 10-20% at hν = 14.5 ev. The energy distribution of emitted electrons was examined using retarding-potential methods. The high photoelectric thresholds imply that any electron with sufficient energy to escape would be subject to scattering due to collision multiplication, an effect expected normally to limit the attainable photoelectric yield. From the observed high ultimate yields as well as the changes in the energy distribution of the emerging electrons with increasing hν, it is concluded that scattering by collision multiplication, considered as a function of hν, is not a monotonically rising function, but has a max. The data suggest strongly that this occurs for incident photon energies of slightly more than 9 ev. (Contractor's abstract)

2583

Rochester U. Inst. of Optics, N. Y.

CREATIVE THINKING AND COMPUTING MACHINES IN OPTICAL DESIGN, by R. E. Hopkins and G. Spencer. [1961] [5]p. incl. diagrs. tables. (AFOSR-J40) [AF 49-(638)668] AD 297159 Unclassified

Also published in Jour. Opt. Soc. Amer., v. 52: 172-176, Feb. 1962.

Present optical programs of the Rochester U. Inst. of Optics, are made up of a group of subroutines which may be used in a large variety of ways. These routines are automatic first- and third-order aberration, fifth-order aberration, ray tracing, energy distribution, and tolerance analysis. The design procedure is to string these routines together into iterative loops. As the design nears completion a high and higher degree of automation is possible. Perhaps the greatest value of the computer is that it enables designers to explore some of their wildest ideas. The program is flexible enough to allow individual differences in the method of approaching the design. (Contractor's abstract)

2584

Rochester U. Inst. of Optics, N. Y.

THIRD-ORDER AND FIFTH-ORDER ANALYSIS OF THE TRIPLET, by R. E. Hopkins. [1961] [6]p. incl. diagrs. tables, refs. (AFOSR-J41) [AF 49(638)668] AD 297252 Unclassified

Also published in Jour. Opt. Soc. Amer., v. 52: 389-394, Apr. 1962.

A series of triplet objectives have been corrected to the same third-order values and compared by computing the fifth-order aberrations. The calculations show that the most symmetrical solutions have reduced fifth-order coma but have an inward curving, high-order astigmatism. (Contractor's abstract)

2585

Rome U. School of Aeronautical Engineering (Italy).

MODELING TECHNIQUE FOR HEAT TRANSFER SIMILARITY PROBLEMS AT HIGH SPEEDS, by L. Broglio, G. Ravelli and others. Jan. 1961, 47p. incl. illus. diagrs. (Technical note no. 1; SIARgraph no. 57) (AFOSR-1203) (AF 61(052)198) AD 262099 Unclassified

A general method for the analysis of the heat transfer on bodies flying at very high speed is presented. In Part I, a modeling technique relative to the use of the blowdown supersonic and hypersonic wind tunnel to solve the complete similarity problems is given. In Part II, an application of the above technique is presented, and experimental results of turbulent heat transfer coefficients on blunt bodies at Mach numbers 3.98 and 4.01 are presented. (Contractor's abstract)

2586

Rome U. School of Aeronautical Engineering (Italy).

AN EXACT SIMILARITY LAW AND A METHOD OF INTEGRATION FOR RE-ENTRY TRAJECTORIES, by L. Broglio. Sept. 1961, 73p. incl. diagrs. table. (Technical note no. 4; SIARgraph no. 61) (AFOSR-2109) (AF 61(052)198) AD 273110 Unclassified

A method for solving re-entry trajectories is presented. Elimination of ballistic parameter yields similar solutions. Similarity is shown to hold also for other significant quantities. Practical results are shown. Comparison with other methods is made. (Contractor's abstract)

2587

Rome U. School of Aeronautical Engineering (Italy).

ON GUIDANCE AND LANDING ACCURACY REQUIREMENTS IN RE-ENTRY TRAJECTORIES, by L. Broglio. June 1961, 51p. incl. diagrs. (Technical note no. 5; SIARgraph no. 63) (AFOSR-2726) (AF 61(052)198) AD 294976 Unclassified

Problems referring to re-entry trajectory guidance requirements are solved. Errors is velocity and angles, represented by means of errors in limiting conic parameters, produce variations in maximum deceleration, total heat transferred, angular ranges, etc. Charts to evaluate such variations are described. Perturbations with respect to the simplifying assumptions are considered, and general small-perturbations theory is developed. Any perturbation gives rise to changes in the limiting conic parameters; by considering the effect of a unit perturbation, the effect of a distributed set of them is obtained by simple integration. (Contractor's abstract)

2588

Royal Coll. of Science and Tech. Dept. of Chemistry, Glasgow (Scotland).

SOME SUBSTITUTED CYCLOPENTADIENYL DERIVATIVES OF NICKEL, COBALT, IRON, MOLYBDENUM, AND TITANIUM, by G. R. Knox, J. D. Munro and others. [1961] [6]p. incl. diagrs. refs. (Technical note no. 1) (AFOSR-2027) (AF 61(052)321) AD 613753
Unclassified

Also published in Jour. Chem. Soc. (London), No. 904: 4619-4624, Oct. 1961.

The applicability of methods for the synthesis of substituted ferrocenes directly from substituted cyclopentadienes, in particular from fulvenes, diazocyclopentadiene, and the anions of aminomethyl- and ethoxycarbonyl-cyclopentadienes is established for those other transition metals which are known to afford stable cyclopentadienyl derivatives. Certain chemical and physical properties of the compounds are given.

2589

Royal Coll. of Science and Tech. [Dept. of Mathematics] Glasgow (Scotland).

APPLICATIONS OF THE THEORY OF THE GENERAL HODOGRAPH EQUATION. PART I. KIRCHHOFF-HELMHOLTZ FLOW PAST A WEDGE, by A. G. Mackie. [1961] [7]p. incl. diagr. (AF 61(514)1170)
Unclassified

Published in Proc. Cambridge Philos. Soc., v. 58: 631-637, Oct. 1962.

The solutions of the equation $\frac{\partial^2 \psi}{\partial \sigma^2} + k(\sigma)\frac{\partial^2 \psi}{\partial \theta^2} = 0$ obtained by the author are applied to determine the Kirchhoff-Helmholtz flow past a wedge in which the free stream Mach number has any value from 0 to 1 inclusive. For small wedge angles the results are developed further and expressions are found for the drag coefficient and for the asymptotic shape of the free streamlines far downstream. While general formulae are obtained for an arbitrary function $k(\sigma)$, more detailed results are given for the particular function $k(\sigma)$ which corresponds to the case of a polytropic gas. (Contractor's abstract)

2590

Royal Coll. of Science and Tech. [Dept. of Mathematics] Glasgow (Scotland).

APPLICATIONS OF THE THEORY OF THE GENERAL HODOGRAPH EQUATION. PART II. THE NON-SYMMETRIC FLOW AT SONIC SPEED PAST A FLAT PLATE, by A. G. Mackie. [1961] [8]p. incl. diagrs. table. (AF 61(514)1170) Unclassified

Published in Proc. Cambridge Philos. Soc., v. 58: 638-645, Oct. 1962.

For a gas with a general equation of state the stream function for the flow past a flat plate is determined when the plate is held at an angle $(1/2)\pi - \alpha$ to the stream. At infinity the Mach number $M_1 = 1$, extend from the edges of the plate to infinity downstream. The method of solution requires the determination of the correct singularity corresponding to the free stream and the subsequent satisfying of the boundary conditions. The drag coefficient is determined in the form of a contour integral and the computational problems in evaluating the drag are discussed. The integral is evaluated for small values of α for a gas with an equation of state as given by Tomotika and Tamada. (Contractor's abstract)

2591

Royal Coll. of Science and Tech. Dept. of Mathematics, Glasgow (Scotland).

FURTHER STUDIES ON THE HODOGRAPH METHOD IN GAS DYNAMICS, by D. C. Pack, J. B. Helliwell, and A. G. Mackie. Final technical rept. June 1961. 5p. (AFOSR-917) (AF 61(052)407) AD 264002
Unclassified

The flow of a free stream past a wedge profile at incidence has been examined for the Roshko and Weinstein-Cole models, with the stagnation point forced to be at the tip of the wedge. The free stream singularity consisted of a dipole and a simple pole. The solution of the boundary value problem for a wedge placed centrally in a channel was formulated in terms of dual integral equations. Lift coefficients and the dimensions of the profile have been computed as functions of the transonic similarity parameter. The generalized hodograph equation has been solved to determine the Kirchhoff-Helmholtz flow past a wedge with free stream Mach number between zero and unity. The variation of drag coefficient with Mach number has been studied and asymptotic forms found for the free streamlines downstream. The stream function has also been found for the flow of a general gas past a flat plate held at an angle of incidence in a sonic stream, and the drag coefficient expressed in analytical form. (Contractor's abstract)

2592

Royal Coll. of Science and Tech. Dept. of Mathematics, Glasgow (Scotland).

A FLOW PATTERN AT HIGH SUBSONIC SPEEDS PAST A WEDGE AT INCIDENCE IN A FREE STREAM AND A CHOKED CHANNEL, by J. B. Helliwell. Aug. 1961, 22p. incl. diagrs. tables, refs. (Technical note no. 2) (AFOSR-2213) (AF 61(052)407) AD 613747
Unclassified

Also published in Jour. Math. and Phys., v. 40: 1-22, Apr. 1961.

The flow pattern past a thin wedge-like profile set at a small angle of attack in a gas flowing with high subsonic velocity is discussed on the transonic approximation, by the hodograph method. In the model considered, the flow has a stagnation point at the nose of the wedge and limit

lines (on which the velocity is sonic) extend from the shoulders of the wedge normally into the free stream; the distances from the nose to the shoulders are unequal. The problem leads to dual integral equations with Bessel function kernels, which are solved for the cases where the wedge is in an unbounded stream and in a channel completely choked by the limit lines. The lift and drag coefficients are calculated. (Math. Rev. abstract)

2593

Royal Inst. of Tech., Stockholm (Sweden).

[LIQUID FLOW IN TUBES. VI.] VISCOSITY DATA ON FLOWS OF DILUTED WATER THROUGH CYLINDRICAL PIPES, by E. R. Lindgren. Dec. 1, 1961 [24]p. incl. illus. diagrs. refs. (Technical note no. 3) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)375, Swedish Natural Science Research Council, and Swedish State Council of Technical Research) AD 271796 Unclassified

Also published in Arkiv Fysik, v. 22: 503-515, 1962.

This report deals with pressure drop measurements on flows of distilled water through cylindrical, plexiglass pipes. In some cases there is an increase of the apparent dynamic viscosity with increasing rates of flow. However, the present experiments indicate a systematic decrease of this effect with decreasing tube diameter, so that even a decrease of the viscosity with increasing flow rate has been recorded. Furthermore, the experiments indicate a systematic increase of the absolute viscosity values with increasing tube diameter. Altogether the present experiments give a rather confused picture of the viscous properties of Aqua Distillata. There is an urgent need for other independent investigations, in order to check the findings of the present experiments. (Contractor's abstract)

2594

Royal Inst. of Tech., Stockholm (Sweden).

VISCOUS FLOW PHENOMENON, by E. R. Lindgren. Dec. 20, 1961, 14p. incl. diagr. (AFOSR-1969) (AF 61-(052)375) AD 271795 Unclassified

Experimental studies on the transition process of pipe flow of liquids and the viscous behavior of distilled water are presented. The research comprises 4 parts (a) Study on the effects of lateral tube deflections on some turbulent transition quantities. (b) Studies on the spontaneous release of tube turbulence related to tube diameter and variations of microscopic surface roughness. (c) Study of phenomena occurring when intentionally agitated disturbances have been introduced into the flow by injecting liquid of controlled amounts of momentum. (d) Measurements of the apparent viscosity of distilled water flowing through cylindrical pipes. (Contractor's abstract)

2595

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

STUDIES ON THE HYDROLYSIS OF METAL IONS. PART 35. THE HYDROLYSIS OF THE LANTHANUM ION, La^{+3}, by G. Biedermann and L. Ciavatta. [1961] [20]p. incl. diagrs. tables, refs. (Technical note no. 12) (AFOSR-198) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)162 and Swedish Natural Science Research Council) AD 611300 Unclassified

Also published in Acta Chem. Scand., v. 15: 1347-1366, 1961.

The hydrolysis equilibria of the La^{+3} ion have been studied at 25°C by hydrogen ion concentration measurements. The total $[La^{+3}]$ ion concentration was varied between 0.1 and 1.0 while the ClO_4^- ion was held constant at 3 M by the addition of $LiClO_4$. These data, which indicate a slight hydrolysis in the log h range -6.5 to -8.1, can be explained by assuming the equilibria

$$La^{+3} + H_2O \rightleftharpoons LaOH^{+2} + H^+ \qquad \log\beta_{1,1} = -10.1 \pm 0.1 \quad (1)$$

$$2La^{+3} + 11_2O \rightleftharpoons La_2OH^{+5} + H^+ \qquad \log\beta_{1,2} = -9.9_5 \pm 0.1 \quad (2)$$

$$5La^{+3} + 9H_2O \rightleftharpoons La_5(OH)_9^{+6} + 9H^+ \qquad \log\beta_{9,5} = 71.4_5 \pm 0.1 \quad (3)$$

Equally good agreement with the data is obtained by replacing equilibrium (3) with

$$6La^{+3} + 10H_2O \rightleftharpoons La_6(OH)_{10}^{+8} + 10H^+ \qquad \log\beta_{10,6} = 78.7_5 \pm 0.1 \quad (4)$$

No other mechanism involving the formation of only three hydrolyzed species, could be found which would explain the experimental data. (Contractor's abstract, modified)

2596

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

ON THE CRYSTAL STRUCTURE OF Sn_2OSO_4, by G. Wernfors. [1961] [10]p. incl. diagrs. tables, refs. (Technical note no. 13) (AFOSR-199) (Sponsored jointly by Air Force Office of Scientific Research under AF 61-(052)162, Faculty of Mathematics and Natural Science, Lund U., and Swedish Natural Science Research Council) AD 272011 Unclassified

Also published in Acta Chem. Scand., v. 15: 1007-1016, 1961.

A crystalline basic tin(II)sulfate, Sn_2OSO_4, has been prepared, and powder, rotation and Weissenberg photographs have been taken. The crystals proved to be tetragonal with a = 10.930A, c = 8.931A, and V = 1 067A^3. The systematically absent reflections are characteristic of space group no. 114 $P42_1c$. In the unit cell there are

8 formula units. The tin positions have been found from Patterson projections and sections. Results show that the 16 tin atoms of the unit cell are arranged in two 8-fold positions, and that they form isolated groups each containing 8 atoms. (Contractor's abstract)

2597

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

HIGH-SPEED COMPUTERS AS A SUPPLEMENT TO GRAPHICAL METHODS. I. FUNCTIONAL BEHAVIOR OF THE ERROR SQUARE SUM, by L. G. Sillén. [1961] [14]p. incl. diagrs. refs. (Technical note no. 14) (AFOSR-3216) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)162, Swedish Atomic Energy Research Council, and Swedish Natural Science Research Council) AD 287117 Unclassified

Also published in Acta Chem. Scand., v. 16: 159-172, 1962.

The paper discusses the principles underlying "LETAGROP", a computer program being used for calculating, from experimental data (y_i, a_{1i}, a_{2i}...), (i = 1... n), a set of unknown constants k_r (r = 1,...N), assuming a functional relationship $y = f(k_r, a_1, a_2...)$. The "best" values k_r'' searched for, are those that minimize the error square sum U. The method may be described as a generalized least-squares method, valid also for non-linear and implicit functions, which are hard to treat by the standard treatment for linear functions or by the Gauss' approximation method. The functional behavior of U ($k_1 \ldots k_N$) is discussed for the general linear case, and for N = 1 and N = 2. The standard deviations D_r are interpreted geometrically by means of the extreme values $k_r'' \pm D_r$ of each k_r on the D boundary, defined by $U - U_0 = \sigma^2$. A high-speed computer can very easily map U ($k_1 \ldots k_N$), even for non-linear and implicit functions. As an approximation it is assumed that U is a second-degree function of the k_r; then $\frac{1}{2}(N + 1)(N + 2)$ points suffice to calculate the position of the minimum and the D boundary. Starting from a first, approximate set k_r', the best values k_r'' are reached by (usually only 2 or a few) successive approximations. The need for choosing the k_r as independent as possible is pointed out. The limitations of the whole least squares approach are discussed. At present there seems to be still more need for better chemical work than for better statistical treatment. (Contractor's abstract)

2598

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

HIGH-SPEED COMPUTERS AS A SUPPLEMENT TO GRAPHICAL METHODS. II. SOME COMPUTER PROGRAMS FOR STUDIES OF COMPLEX FORMATION EQUILIBRIA, by N. Ingri and L. G. Sillén. [1961] [19]p. incl. diagrs. table. (Technical note no. 15) (AFOSR-3217) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)162, Swedish Atomic Energy Research Council, and Swedish Natural Science Research Council) Unclassified

Also published in Acta Chem. Scand., v. 16: 173-191, 1962.

A series of programs for high-speed electronic computers have proved useful in investigations on equilibria with polynuclear complexes. The programs are so constructed, that, when a new system is to be studied, only a small part (the "SP") needs to be rewritten (and this is easily done) whereas the main part (the "HP") can be used without change. It could also be used for problems from other fields, chemical or not. The programs KUSKA, PROKAUS, PROKAIS, HALTA and LETAGROP are given in full — written in Ferranti Mercury Autocode — their principles are discussed, and some initial difficulties of a general interest are pointed out. LETAGROP may be called a generalized least-squares method for finding a set of unknown constants from experimental data, even with a non-linear and implicit functional relationship. The principles of LETAGROP were indicated in part I. (Contractor's abstract)

2599

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

THE CRYSTAL STRUCTURE OF $InOHSO_4(H_2)_2$, by G. Johansson. [1961] [17]p. incl. diagrs. tables, refs. (Technical note no. 16) (AFOSR-3771) (AF 61(052)162) Unclassified

Also published in Acta Chem. Scand., v. 15: 1437-1453, 1961.

Crystals of the basic indium sulfate $InOHSO_4(H_2O)_2$ are monoclinic with unit cell dimensions: a = 6.06A, b = 7.89A, c = 12.66A, β = 107.5°. The indium atoms are octahedrally surrounded by oxygen atoms at an average distance of 2.16A with no significant differences between the In — O bond lengths. The InO_6 octahedra are joined together by means of common corners, to chains running parallel to the b axis. Different indium-oxygen chains have no oxygen atoms in common but are linked together by means of hydrogen bonds to the oxygen atoms of the sulfate groups. (Contractor's abstract)

2600

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

THE CRYSTAL STRUCTURES OF $[Al_2(OH)_2(H_2O)_8](SO_4)_2 \cdot 2H_2O$ AND $[Al_2(OH)_2(H_2O)_8](SeO_4)_2 \cdot 2H_2O$, by G. Johansson. [1961] [18]p. incl. diagrs. tables, refs. (Technical note no. 17) (AFOSR-3772) (AF 61(052)162) Unclassified

Also published in Acta Chem. Scand., v. 16: 403-410, 1962.

The crystal structures of a basic aluminum sulfate, $Al_2O_3 \cdot 2SO_3 \cdot 11H_2O$, and the isomorphous selenate have been investigated by means of x-ray crystallographic methods. The crystals are monoclinic and the space group, $P2_1/n$. The unit cell dimensions are: a = 8.15A, b = 12.48A, c = 8.40A, β = 101.9° for the sulfate and a = 8.26A, b = 12.76A, c = 8.48A, β = 102.1° for selenate. The structure contains discrete aluminum-oxygen complexes of the composition Al_2O_{10}, which are built up from 2 AlO_6 octahedra sharing an edge. The hydrogen atoms have been located by indirect methods. Their positions indicate that the formula for the Al_2O_{10} group should be written $[Al_2(OH)_2(H_2O)_8]^{4+}$. These ions are joined by means of hydrogen bonds to the oxygen atoms of the sulfate or the selenate groups and the water molecules. (Contractor's abstract)

2601

Royal Insl. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

ON THE CRYSTAL STRUCTURE OF $Na_4Ge_9O_{20}$, by N. Ingri and G. Lundgren. [1961] [9]p. incl. diagrs. tables, refs. (Technical note no. 18) (AFOSR-3773) (AF 61-(052)162) Unclassified

Also published in Arkiv Kemi, v. 18: 479-487, 1961.

An x-ray investigation of the crystal structure of $Na_4Ge_9O_{20}$ has been started. The crystals are tetragonal ($a = 14.98 \pm 0.01A$, $c = 7.384 \pm 0.005A$) and belong to space group no. 88, $I4_1/a$. The positions of the 36 germanium atoms in the unit cell have been determined. The positions of the sodium and oxygen atoms will be given in a forthcoming publication; until then it is not possible to decide whether the structure contains discrete polyanions or not. (Contractor's abstract)

2602

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

STUDIES ON THE HYDROLYSIS OF METAL IONS. PART 38. THE HYDROLYSIS OF MERCURY(II) IN PERCHLORATE MEDIUM, by I. Ahlberg. [1961] [16]p. incl. diagrs. tables, refs. (Technical note no. 19) (AFOSR-3774) (AF 61(052)162) Unclassified

Also published in Acta Chem. Scand., v. 16: 887-902, 1962.

The hydrolysis of Hg(II) has been studied at 25.0°C with the media 3.0 M $(Na)ClO_4$, $(Ca)ClO_4$ and $(Mg)ClO_4$. $[H^+]$ was measured with a glass electrode and in the more dilute solutions $[Hg^{2+}]$ was measured with a redox electrode, Hg_2^{2+}, Hg^{2+}/Pt. The data for $(Mg)ClO_4$ and $(Ca)ClO_4$ media coincide and differences for $(Na)ClO_4$ are attributed to variations in activity factors. (Contractors's abstract)

2603

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

THE MONONUCLEAR HYDROLYSIS OF VANADIUM(V), by D. Dyrssen and T. Sekine. [1961] [2]p. incl. diagrs. (Technical note no. 20) (AFOSR-3775) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)162 and Swedish Council for Atomic Research) Unclassified

Also published in Acta Chem. Scand., v. 15: 1399-1400, 1961.

The purpose of the present work was to study the mononuclear hydrolysis of vanadium(V) in the lower pH range to determine the acidity constants of the following equilibria at 25°C: $VO_2^+ + H_2O \rightleftharpoons HVO_3 + H^+$; K_{a1} and $HVO_3 \rightleftharpoons VO_3^- + H^+$; K_{a2}. The following results can be drawn from the data. The slope derived shows the existence of an uncharged vanadium species in the hexol phase with one proton less than $VO_2(H_2O)_n^+$ and that there exists a monovalent negative vanadium ion in the aqueous phase with one proton less than the uncharged complex in the organic phase. It also shows that the stability range of the uncharged complex is not very large. In each run, about the same amount of V^{48} was added to the system and, therefore, the total vanadium concentration in each phase varies with the distribution ratio. Still the limiting slopes are exactly +1 and -1. This indicates that no polynuclear species are formed. The following values of λ, K_{a1} and K_{a2} were determined: $\log\lambda = 2.10$; $pK_{a1} = 3.30$; $pK_{a2} = 3.70$.

2604

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

EQUILIBRIUM STUDIES ON POLYANIONS. 9. THE FIRST STEPS OF ACIDIFICATION OF CHROMATE ION IN 3 M $Na(ClO_4)$ MEDIUM AT 25°C, by Y. Sasaki. [1961] [16]p. incl. diagrs. tables, refs. (AFOSR-3776) [AF 61-(052)162] Unclassified

Also published in Acta Chem. Scand., v. 16: 719-734, 1962.

Emf data (glass electrode, 25°C, 3 M $Na(ClO_4)$) on the reaction of CrO_4^{2-} with H^+ indicated the 2 products $HCrO_4^-$ and $Cr_2O_7^{2-}$ but gave no evidence for other products, for $[H^+] < 0.03$ M. Spectrophotometric data, with the same medium, gave practically the same equilibrium constants. $H^+ + CrO_4^{2-} \rightleftharpoons HCrO_4^-$, $\log \beta_{11} = \log K_1 =$

5.89 ± 0.02 for emf and 5.91 ± 0.01 for spectra. $2HCrO_4^- \rightleftharpoons Cr_2O_7^{2-} + H_2O$, $\log K_{22} = 2.20 \pm 0.02$ for emf and 2.18 ± 0.06 for spectra. For higher acidities, both spectrophotometric and emf data gave small deviations which might be due to new complexes. (Contractor's abstract)

2605

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

ON THE CRYSTAL STRUCTURES OF $FeOHSO_4$ AND $InOHSO_4$, by G. Johansson. [1961] [11]p. incl. diagrs. tables, refs. (Technical note no. 22) (AFOSR-3777) (AF 61(052)162) Unclassified

Also published in Acta Chem. Scand., v. 15: 1234-1244, 1962.

The basic iron sulfate, $FeOHSO_4$, forms orthorhombic crystals with lattice parameters a = 7.33, b = 6.42, and c = 7.14A. The space group is D_{2h}^{16} — Pnma and the unit cell contains 4 formula weights. Each iron atom is octahedrally coordinated with 2 hydroxo-groups and 4 sulfate oxygens. Each hydroxogroup is bonded to 2 iron atoms. The structure of the basic indium sulfate, $InOHSO_4$, has been shown to be similar. (Contractor's abstract)

2606

Royal Inst. of Tech. Div. of Gasdynamics, Stockholm (Sweden).

THEORETICAL INVESTIGATIONS IN LINEAR AND NON-LINEAR PROBLEMS, THE DETERMINATION OF SURFACE INTERACTIONS AND EXAMINATION OF DEVELOPMENT OF SHOCK WAVE IN RAREFIED GAS DYNAMICS, by D. R. Willis. Final technical rept. Jan. 1961, 10p. (AFOSR-418) (AF 61(052)348) AD 254996 Unclassified

The specific problems considered were: the convergence of the integral iteration method of solving the Boltzmann equation using hard sphere molecules; center-point mass flow through an orifice; determining interactions by measuring the number flux of molecules reflected from a moving target and the development of a shock as an infinite flat plate moves, perpendicular to its plane, into a gas initially at equilibrium. A summary of the principal results and conclusions are given. (Contractor's abstract)

2607

Rutgers U. Dept. of Physics, New Brunswick, N. J.

NMR MEASUREMENTS OF SELF-DIFFUSION IN NORMAL HYDROGEN GAS FROM 55°K TO 90°K, by M. Lipsicas. Oct. 1961 [13]p. incl. diagrs. tables, refs. (AFOSR-1584) (AF 49(638)755) AD 266315 Unclassified

Also published in Jour. Chem. Phys., v. 36: 1235-1237, Mar. 1, 1962.

An absolute measurement of the self-diffusion coefficient, D_{11}, in hydrogen gas has been made at 78°K and 117 Amagats. Relative measurements have been made of D_{11} as a function of gas density at 55°, 78°, and 90°K, up to a maximum density of 650 Amagats. The experimental results are compared with viscosity data and with the theories of Buckingham and Mason. The observed density dependence of D_{11} is in marked disagreement with the Enskog dense-gas theory. (Contractor's abstract)

2608

Rutgers U. Dept. of Physics, New Brunswick, N. J.

NUCLEAR SPIN-SPIN RELAXATION, by M. Lipsicas and A. Hartland. [1961] [1]p. (AFOSR-2560) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)755] and National Science Foundation) Unclassified

Also published in Canad. Jour. Phys., v. 40: 382, Mar. 1962.

An accurate and reliable measurement of T_2 in hydrogen gas at 77.5°K, on a gas sample of approximately 100 Amagats density has been made and it was found that T_1 (spin-lattice relaxation time) and T_2 (nuclear spin-spin relaxation time) are equal to within ±4%. The gas sample was sealed in a thick-walled, 4 mm inner diam. glass capillary tube. A 2-pulse nuclear magnetic resonance experiment ($\pi, \pi/2$) was performed to determine T_1, and the multiple echo technique was used to determine T_2. Using coherent pulses of radio frequency at 30.2 mc/s and a magnet capable of providing a homogeneous magnetic field over the 0.15 cc volume of the sample, induction decay following a single $\pi/2$ pulse was found to be exponential and gave a value of $T_2^* = 8.25$ mμ sec. A multiple echo experiment gave a value of $T_2 = 11.75$ mμ sec ± 4%, as compared with $T_1 = 12.0$ mμ sec ± 4% obtained from a 2-pulse experiment. The discrepancy between present results and the earlier measurements serve to illustrate the difficulty of obtaining a reliable value for T_2 when the sample is not spatially well defined and the magnetic field over the sample is not sufficiently homogeneous.

2609

Rutgers U. Dept. of Physics, New Brunswick, N. J.

NUCLEAR MAGNETIC RESONANCE OF Xe^{129} IN NATURAL XENON, by R. L. Streever and H [Y.] Carr. [1961] [6]p. (AFOSR-J189) (AF 49(638)755) AD 428414 Unclassified

Also published in Phys. Rev., v. 121: 20-25, Jan. 1961. (Title varies)

For abstract see item no. 2443, Vol. IV.

2610

Rutgers U. Graduate School of Library Service, New Brunswick, N. J.

A COMPARISON STUDY OF THREE SYSTEMS OF INFORMATION RETRIEVAL, by N. D. Stevens. New Brunswick, Rutgers U. Press, 1961, 149p. incl. tables, refs. (AFOSR-1895) (AF 49(638)848) AD 268860 Unclassified

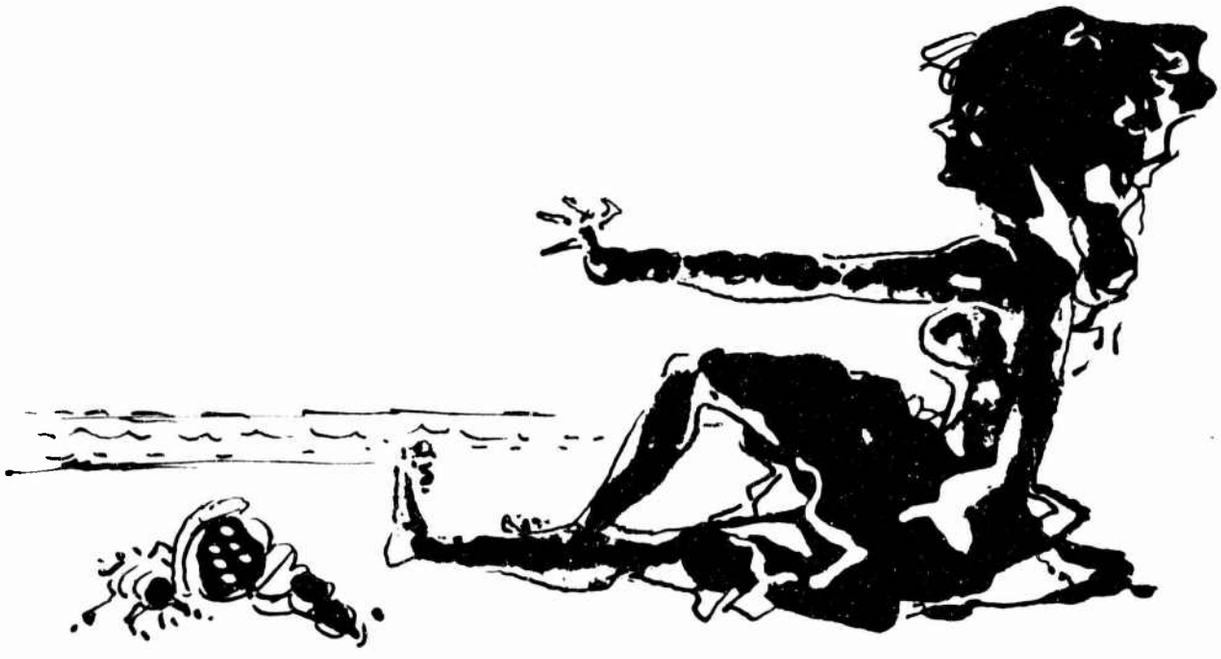
This is a report of a project which was conducted to determine what could be established about the efficiency, under actual operating conditions, of 3 systems of information retrieval, a punched card file, a handbook, and the conventional library reference approach. The analysis was carried out in 3 steps and the report is divided into major sections corresponding to those steps. They were: (1) an investigation into the background, organization, and input factors of the 3 systems; (2) an investigation of the use of the 3 systems, particularly of the punched card and handbook; and (3) an investigation of the operation of the 3 systems in terms of time, cost, and comparability of answers.

2611

Rutgers U. Microwave Electronics Lab., New Brunswick, N. J.

HARMONIC GENERATION AT MILLIMETER WAVELENGTHS, by R. G. Pecina. Final technical rept. Feb. 1, 1960-Aug. 31, 1961. Oct. 1961 [189]p. incl. illus. diagrs. tables, refs. (AFOSR-1532) (AF 49(638)-554) AD 267553 Unclassified

The dependence of the complex dielectric constant of several polycrystalline ferroelectric ceramics upon an applied dc electric bias field over the frequency range from 3.0 to 9.5 kmc is determined. Bias fields of 0, 5 and 10 kv/cm were employed. The ceramic ferroelectrics investigated were barium-strontium titanate mixtures with and without the addition of small percentages of Fe_2O_3 and Ni. An admittance type of measurement has been selected to measure the relative complex dielectric constant. In this method the complex dielectric constant of a material is related to a measured admittance. The complete design of the experimental apparatus is given and the limitations of the measuring technique are evaluated. (Contractor's abstract)



2612

St. John's U. [Dept. of Physics] Jamaica, N. Y.

APPROXIMATE CROSS-SECTIONS FOR INELASTIC COLLISIONS OF ELECTRONS WITH ATOMS. II. FORBIDDEN TRANSITIONS, by J. H. Scanlon and S. N. Milford. [1961] [9]p. incl. diagrs. tables. (AFOSR-3894) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-10 and Office of Naval Research) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 13, Feb. 1, 1961. (Title varies)

Also published in Astrophys. Jour., v. 134: 724-732, Nov. 1961.

A simple approximate formula is derived for the max cross-section σ for quadrupole transitions resulting from electron-atom collisions. An expression for the Bethe cutoff is found in terms of the energy, ϵ_1, at which the maximum occurs. The multipole expansion gives a simple approximate formula for the cross-section σ, in the region $\epsilon > \epsilon_1$, in terms of the quadrupole moment determined from experiment or calculation; the threshold shape is adopted for $\epsilon < \epsilon_1$. The curve for $\sigma(\epsilon_1)$ is found to cross the Born curves with 10% of the Born maxima for several forbidden transitions in hydrogen. Results indicate that the use of this formula may be limited to specific types of transition unless there is a more accurate method to predict the energy at which the maximum occurs. Born and Bethe cross-sections were calculated for 7 forbidden and 3 allowed transitions in hydrogen, namely 1s-2s, 3s; 2s-3s, 3p, 3d; 4s; 2p-3s, 3p, 3d, 4f. (Contractor's abstract, modified)

2613

St. John's U. Dept. of Physics, Jamaica, N. Y.

SPALLATION OF INTERSTELLAR MATTER: COSMIC-RAY INTENSITY IN THE PAST, by S. N. Milford and S. P. Shen. [1961] [2]p. incl. refs. (AFOSR-3895) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-10 and Office of Naval Research) Unclassified

Also published in Phys. Rev., v. 122: 1921-1922, June 15, 1961.

It is pointed out that spallation of interstellar matter by cosmic rays occurs, and that the lithium, beryllium, and boron thus produced can be used as rough indexes of the average interstellar cosmic-ray intensity. Using available data, this method gives an upper limit of the order of $10\ cm^{-2}\ sec^{-1}$ for the intensity of interstellar cosmic rays of kinetic energy > ~50 mev, averaged temporally over the past few billion years and spatially over several cubic kiloparsecs in the solar neighborhood. (Contractor's abstract)

2614

St. John's U. [Dept. of Physics] Jamaica, N. Y.

BORN CROSS SECTIONS FOR INELASTIC SCATTERING OF ELECTRONS BY HYDROGEN ATOMS. IV. APPROXIMATE VALUES FOR ALLOWED TRANSITIONS UP TO n = 10, by G. C. McCoyd and S. N. Milford. [1961] [5]p. incl. diagrs. tables. (AFOSR-3697) (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-10 and Office of Naval Research) AD 414171 Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 13, Feb. 1, 1961. (Title varies)

Also published in Phys. Rev., v. 130: 206-210, Apr. 1, 1963.

The Born total cross section is calculated for the inelastic scattering of electrons by hydrogen atoms undergoing the transitions: 10s → 11p and 10,9 → 11,10. By means of interpolation and extrapolation the cutoff momentum $K_c a_o$ is estimated for all transitions of the type $\Delta n = +1$, $+2$, $\Delta l = +1$, for n = 1 through 10. These are used to construct tables which provide a simple estimate of the Bethe total cross section. (Contractor's abstract)

2615

St. John's U. [Dept. of Physics] Jamaica, N. Y.

ON THE ENERGY RANGE OF VALIDITY OF THE FIRST BORN APPROXIMATION FOR ELECTRON-ATOM COLLISIONS (Abstract), by S. N. Milford and F. R. Pomilla. [1961] [2]p. (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-10 and Office of Naval Research) 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. 137-138. (AFOSR-1327)

It is the aim of the present work to find the energy $E(\chi)$ at which the first Born approximation σ_{B1} differs from the correct cross section σ by the fractional amount χ, i.e.,

$$\sigma - \sigma_{B1} = \chi\sigma \quad (1)$$

Since first order perturbation calculations are almost exact at high scattering energies, the second order calculations give a very small correction which can then be used as a measure of the departure of the first order calculation of the cross section from the true cross section. Thus, if the cross section σ at high energy is expanded in a series of Born terms

$$\sigma = \sigma_{B1} + \sigma_{B2} + \sigma_{B3} + \cdots \quad (2)$$
$$= \sigma_{B1} + y_2\sigma_{B1} + y_3\sigma_{B1} + \cdots$$

where it is assumed that

$$|y_n| \ll 1, \quad y_{n+1} \leq 0\,(y_n^2), \qquad n \geq 2$$

then it follows that

$$\chi = y_2 + 0(y_2^2) \qquad (3).$$

Although (3) is general, it appears that it can be used for specific scattering problems only by carrying through the first and second order Born calculations in detail. The first calculation is made for the total scattering (elastic, inelastic and ionization) of electrons from the 1s and 2s states of hydrogen. By employing the optical theorem, these total cross sections can be found from the second Born differential elastic scattering amplitude at zero scattering angle, thus avoiding extensive angle integrations. The second Born cross sections thus obtained for high energy scattering can then be compared with the first Born results already available, thus giving values for y and subsequently χ from equation (3). Although the above total scattering cross sections give some idea of the probable validity of results for individual inelastic transitions, for example, only an actual calculation of individual transitions will give difinitive results. Hence the first and second Born approximations for inelastic transitions between levels 1 and 2 are compared with those for levels 2 and 3.

2616

St. Louis U. Dept. of Physics, Mo.

THEORETICAL STUDY OF PROBLEMS CONNECTED WITH THE SOLID STATE RASER, by M. Lal Narchal and W. A. Barker. July 1, 1961 [61]p. incl. diagrs. tables. (AFOSR-954) (AF 49(638)612) AD 260779 Unclassified

This work is divided into two parts. In part A a detailed comparison is made of the relative advantages of the Overhauser effect and the Abragam effect for obtaining stimulated emission or resonant absorption of a 4 level system when all the thermal relaxation are taken into account. The results obtained in part A are applied in part B to F_2^- centers in LiF for the purpose of investigating this system as a possible quantum mechanical amplifier. (Contractor's abstract)

2617

St. Louis U. [Dept. of Physics] Mo.

THEORETICAL STUDY OF PROBLEMS CONNECTED WITH THE SOLID STATE RASER. PART I. EIGENVALUES AND INDUCED TRANSITION PROBABILITIES FOR AN ANISOTROPIC SPIN HAMILTONIAN, by R. Neusel. PART II. EFFECT OF FINITE PROBABILITY ASSOCIATED WITH THE DETECTION FIELD ON THE ENHANCEMENT OF A RASER, by M. Lal Narchal. Nov. 1, 1961, 44p. incl. diagrs. tables, refs. (AFOSR-1794) (AF 49(638)812) AD 289455 Unclassified

Part I. The approximate energy eigenvalues of the spin Hamiltonian of the type derived by Abragam and Pryce (Proc. Roy. Soc. (London), v. 205A: 135, 1951), and the induced transition probabilities, are given. No restrictions (such as axial symmetry) are made on the elements of the tensors of second rank in the Hamiltonian. The results are valid for an orientation of the external fields with respect to the crystal axes. The electron Zeeman interaction is taken as the dominant interaction and the remaining interactions as a perturbation, except for the quadrupole interaction which is neglected. Part II. The method of partial distributions has been applied to study the effect of the input signal field strength on the enhancement and signal power output of a 4 level RASER amplifier. The enhancement is always found to have a finite value and is relatively insensitive to the input signal field strength for Overhauser effect experiments. For Jefferies-Abragam effect experiments, the limiting enhancement is a function of the relative strength of flip-flip and flip-flop type of thermal relaxations. The dominance of electron paramagnetic relaxations and output increases from zero to a maximum value when the input signal field strength increases from 0 to ∞.

2618

St. Louis U. Dept. of Physics, Mo.

DYNAMIC NUCLEAR POLARIZATION, by W. A. Barker. [1961] [22]p. incl. diagrs. tables, refs. (AFOSR-1799) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)612] and Atomic Energy Commission) AD 295905 Unclassified

Also published in Rev. Mod. Phys., v. 34: 173-185, Apr. 1962.

The interest in the production and detection of nuclear polarization in atomic, nuclear and elementary particle physics as well as in solid state and low temperature physics is demonstrated by 7 examples. The mechanism of dynamic polarization is discussed and a nuclear polarization chart is produced tabulating the energy level scheme, population distribution, enhancement of nuclear magnetic resonance, nuclear polarization and electronic polarization for 4 static and 24 dynamic cases. The construction and utility of the chart are discussed in detail together with its limitations. Finally a table of experimental results keyed to the polarization chart is provided and the methods of detection of dynamic polarization are compared. The techniques of dynamic nuclear polarization are compared with static methods and their limitations considered.

2619

St. Louis U. [Dept. of Physics] Mo.

NUCLEAR POLARIZATION (Abstract), by W. A. Barker. [1961] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)612] and Atomic Energy Commission) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 75, Feb. 1, 1961.

The population distribution and nuclear polarization

achieved by static or dynamic methods depends on several factors: (1) the magnitude of the nuclear Zeeman energy as compared to the hyperfine interaction energy; (2) the algebraic sign of the nuclear magnetic moment; (3) the algebraic sign of the hyperfine interaction constant; (4) the magnitude and orientation of the pumping radiation; and (5) the type and relative magnitude of the relaxation mechanisms. Four static and 24 dynamic cases will be discussed.

2620

San Andres U. Laboratorio de Fisica Cosmica de Chacaltaya, La Paz (Bolivia).

ON THE FORBUSH DECREASES REGISTERED BY DIRECTIONAL TELESCOPES AT CHACALTAYA, by I. Escobar, N. W. Nerurkar and others. [1961] [8]p. incl. diagrs. (AFOSR-1274) (AF 49(638)290) Unclassified

A study has been presented about the onset times of Forbush decreases associated with M-type storms. It is found that there is a delay of about 6 hr between them in total intensity in East and West pointing telescopes at Chacaltaya. Some characteristics of the associated solar corpuscular emission are discussed. (Contractor's abstract)

2621

San Andres U. Laboratorio de Fisica Cosmica de Chacaltaya, La Paz (Bolivia).

RECOVERY CHARACTERISTICS OF FORBUSH EFFECT, by I. Escobar, N. W. Nerurkar and others. [1961] [9]p. incl. diagrs. table. (AFOSR-1306) (AF 49(638)290) Unclassified

The rate of recovery of cosmic ray intensity from the Forbush decreases at low and middle latitudes is presented for various magnetic storms registered during 1957-1960. It is found to be rapid (~ 3 days) for strong magnetic storms and slow (~ 10 days) for weak magnetic storms. This simple picture is modified whenever 2 magnetic storms are intermingled. Various types of interferences of the storms and the associated cosmic ray effects are discussed. In addition, some characteristics of the associated solar emissions are derived. (Contractor's abstract)

2622

San Andres U. Laboratorio de Fisica Cosmica de Chacaltaya, La Paz (Bolivia).

ON THE NATURE OF SOLAR EMISSION OF IONISED MATTER ASSOCIATED WITH FORBUSH DECREASES, by I. Escobar, N. W. Nerurkar and others. [1961] [9]p. incl. tables. (AFOSR-1307) (AF 49(638)290) Unclassified

The recovery characteristics of the Forbush decreases have been analyzed for the solar coordinates of the associated emission of ionized matter. It is found that the recovery is fast or slow depending upon whether the emission is near or far from the central meridian. It is suggested that the solar emission is either in narrow cones or omnidirectional and its magnetic field configuration is similar to that suggested by Gold (Jour. Geophys. Research, v. 64: 1655, 1959). In addition, the interaction between 2 magnetic bottles and its effect on cosmic ray intensity are discussed. (Contractor's abstract)

2623

San Andres U. Laboratorio de Fisica Cosmica [de Chacaltaya] La Paz (Bolivia).

THE RECOVERY CHARACTERISTICS OF FORBUSH DECREASES AND THE CONFIGURATION OF THE ASSOCIATED SOLAR EMISSION, by I. Escobar, N. W. Nerurkar and others. [1961] [6]p. incl. diagrs. tables. (AFOSR-2800) (AF 49(638)290) 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-II: 422-427, Jan. 1962.

Forbush decreases accompany a single magnetic storm and vary from a few fractions of a percent to as high as 30%. The recovery rate varies from a few minutes to 15 days and is dependent on the intensity of the magnetic storm. The recovery rates of the mixed Forbush decreases appear to be related with the volume occupied space by the emission associated with magnetic storms. It is suggested that these emissions of solar matter are of 2 types: in narrow cones and omnidirectionally. It is shown that this explains satisfactorily the wide range of recovery rates of Forbush decreases and also aids in understanding the total absence of magnetic storms after some large solar disturbance.

2624

San Andres U. Laboratorio de Fisica Cosmica de Chacaltaya, La Paz (Bolivia).

[ANALYSIS OF DECREASING INTENSITY OF COSMIC RADIATION DURING THE SHORT INTERVAL OCCURRING NOVEMBER 13, 1960] Analisis del descenso de intensidad de la radiacion cosmica de corto intervalo ocurrido el 13 Noviembre de 1960, by I. Escobar, N. W. Nerurkar and others. [1960] [4]p. incl. diagr. (AF 49-(638)290) Unclassified

Presented at joint meeting of the Amer. Phys. Soc. and Sociedad Mexicana de Fisica, Mexico City, June 1961.

Published in Resumen de Labores, 1960, La Paz (Bolivia) Laboratorio de Fisica Cosmica, Mar. 1961, p. 51-53.

Also published in Proc. Nat'l. Acad. Sci., v. 47: 1873-1875, Dec. 1961. (Title varies)

The records of a neutron monitor operated on Chacaltaya mountain in Bolivia show, superimposed on a Forbush decrease, a sudden decrease of about 4% lasting about 1½ hr. From data from other stations it is concluded that the effect was world-wide and had the same energy

dependence as the Forbush effect. It is suggested that the effect is due to a well-defined comparatively small region of higher than average magnetic field strength, in a cloud of ionized solar gas, which is responsible for the Forbush decrease.

2625

San Andres U. Laboratorio de Fisica Cosmica de Chacaltaya, La Paz (Bolivia).

[MONITORING NEUTRONS] Monitor de neutrones, by O. Troncoso. [1960] [6]p. incl. diagrs. (AF 49(638)290) Unclassified

Published in Resumen de Labores, 1960, La Paz (Bolivia), Laboratorio de Fisica Cosmica, Mar. 1961, p. 17-20.

The installation of the Neutron Monitor at Chacaltaya is described. Results obtained from July to December 1960 are presented. The monitor is to measure cosmic radiation as a function of time and energy.

2626

[San Andres U. Laboratorio de Fisica Cosmica de Chacaltaya, La Paz (Bolivia)]

UNDERDEVELOPED COUNTRIES AND THE SCIENTIFIC RESEARCH, by I. Escobar. [1961] 4p. [AF 49(638)290] Unclassified

Presented at Centennial Conf. on Science and Engineering Education, Massachusetts Inst. of Tech., Cambridge, Apr. 1961.

The question that faces underdeveloped countries is, "Should these countries limit the effort entirely to the solution of the basic educational problems such as the elimination of illiteracy, the improvement of the level of its universities and the development of technological training; or should they also initiate significant programs of modern scientific research"? The author takes the position that this question should be ansered in favor of the creation of a few and specialized centers of research without overlooking the obvious needs for development of fundamental education. The author believes that this is the only way that it is possible to improve the scientific and engineering teaching and at the same time to develop a national conscience of the importance of science which is indispensable for the growth and survival of the country. The Cosmic Physics Laboratory of Chacaltaya in La Paz, Bolivia is used as an example to support the author's point of view, showing the advantages of this type of institution and the problems it must face.

2627

San Andres U. Laboratorio de Fisica Cosmica de Chacaltaya, La Paz (Bolivia).

BOLIVIAN AIR SHOWER JOINT EXPERIMENT, by K. Suga, I. Escobar and others. [1961] [3]p. incl. diagrs. (In cooperation with Massachusetts Inst. of Tech., Lab. for Nuclear Science, Cambridge) [AF 49(638)290] Unclassified

Presented at Internat'l. Conf. on Cosmic Rays and the Earth Storm, Kyoto (Japan), Sept. 4-15, 1961.

Published in Jour. Phys. Soc. Japan, v. 17, Suppl. A-III: 128-130, Jan. 1962.

A joint air shower experiment is being set up and is near the full operation at an altitude of 5,200 m in Bolivia. The principal objectives and brief account of the equipment are given.

2628

San Andres U. Laboratorio de Fisica Cosmica de Chacaltaya, La Paz (Bolivia).

ON A SHORT-LIVED COSMIC RAY DECREASE ON NOVEMBER 13, 1960, by I. Escobar, N. W. Nerurkar and others. [1961] [4]p. incl. diagr. (AF 49(638)290) Unclassified

Reported here is a very abrupt and short lived cosmic ray decrease observed on November 13, 1960, with data analyzed on short-time intervals. It is reported that immediately after a magnetic storm of sudden commencement at 10h21m UT, the cosmic ray intensity started decreasing rapidly for the first hr and gradually thereafter following the general pattern of the Forbush decrease. A little later than 1300 UT the cosmic ray intensity at Chacaltaya dropped suddenly, remained 3 to 4% below for about 1½ hr and jumped suddenly to predrop value. Later it continued decreasing slowly for more than 6 hr following the profile of the first decrease. The striking features of these events may be summarized as the very rapid decrease, equally fast recovery and very short duration. The analysis of the November event shows in addition that it was world wide in character and had energy dependence same as the Forbush effect. Cosmic ray decreases associated with magnetic storms are believed to be caused by a cloud of ionized solar gas with magnetic fields enveloping the earth. It is suggested that clouds responsible for big magnetic storms contain within them well defined regions, where the magnetic field strength is higher and consequently cosmic ray intensity is lower than the rest of the cloud. When such a region is passing the earth the cosmic ray intensity registers an additional decrease. Because of comparatively small dimensions the decrease lasts for an hr or so and because of its well-defined limits both the decrease and the recovery are very fast.

2629

San Andres U. Laboratorio de Fisica Cosmica [de Chacaltaya] La Paz (Bolivia).

EXTENSIVE AIR SHOWERS AT 4200m, by J. Hersil, I. Escobar and others. [1961] [4]p. incl. diagrs. (AFOSR-3372) (In cooperation with Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge) [AF AFOSR-62-395] 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: 243-246, Jan. 1962.

Extensive air showers at an altitude of 4200 m (El Alto, near La Paz, Bolivia) were studied. It is concluded that the average atmospheric depth of maximum development for showers with a maximum of 2×10^8 particles is about 800 g cm^{-2}. The average lateral distribution at distances greater than 30 m from the core is markedly steeper than at sea level and, unlike the distribution at sea level, it varies significantly with zenith angle. In addition, a map is obtained of the celestial arrival directions of 195 showers with $N > 10^8$ and 6 with $N > 10^9$ corresponding to primary energies in excess of 10^{17} ev and 10^{18} ev respectively. Because of the geographic location most of the events come from the southern hemisphere. No anistropy is evident. (Contractor's abstract)

2630

Sao Paulo U. School of Medicine. Dept. of Physiology (Brazil).

INTERACTION BETWEEN THE SPECIFIC VISUAL SYSTEM AND THE RETICULAR FORMATION, by M. R. Covain and R. F. Marseillan. [1961] [9]p. incl. diagrs. refs. (AFOSR-1423) (AF AFOSR-60-15) AD 416559 Unclassified

Also published in Perspectives in Biology, New York, Elsevier Publishing Co., 1963, p. 439-447.

The effect of the unspecific system upon the visual evoked cortical potential elicited by a flash light has been studied by single shock conditioning stimulation of the mesencephalic reticular formation at various intervals in cats under chloralose anesthesia. The conclusions arrived at during these experiments were the following: There was a differential interaction of the postsynaptic components of the evoked response. An increase of the surface-negative phase was observed. This interaction seems to take place principally at cortical level. The heterosynaptic convergence of the specific and unspecific systems in cortical neurons is given as a possible basis for the mechanism underlying this interaction.

2631

Sao Paulo U. School of Medicine. Dept. of Physiology (Brazil).

CEREBELLO-RETICULAR INTERACTION ON SPINAL REFLEXES (Abstract), by C. Timo-Iaria and J. Antunes-Rodrigues. [1961] [1]p. (AFOSR-1434) (AF AFOSR-60-15) Unclassified

Presented at Fourth Reunion of the Asociacion Latino-Americana de Ciencias Fisiologicas, Sao Paulo (Brazil), July 4-8, 1961.

Also published in Acta Physiol. Latinoamer., v. 11: 299, 1961.

In order to investigate some interactions between cerebellum and the mesencephalic reticular formation the following experiments were performed: group Ia afferents of either the gastrocnemius or tibialis nerves of adult cats were stimulated by single pulses of 2 msec duration and voltage just enough to evoke 50% of the maximal monosynaptic potential recorded from L_7 ventral root; previous stimulation of the ipsilateral reticular formation at definite intervals between 0 and 200 msec induces striking changes of the excitability of the monosynaptic arc; such changes follow a polyphasic and complex time course. After extirpation of some cerebellar areas such effects are significantly noted. Destruction of the ipsilateral anterior lobe usually enhances the late facilitation; ablation of the ipsilateral paramedian lobe strongly depresses such facilitation and destruction of the whole posterior lobe has similar effects on the excitability curve. It seems that a cerebellar component is present in the mesencephalic reticular influences on the investigated spinal reflexes; such component is detected within the 30-50 msec range in a great number of experiments.

2632

Sao Paulo U. School of Medicine. Dept. of Physiology (Brazil).

EFFECT OF SEXUAL HORMONES ON A CONDITIONED AVOIDANCE RESPONSE OF RATS (Abstract), by M. C. Licc. [1961] [2]p. (AFOSR-1435) (AF AFOSR-60-15) Unclassified

Presented at Fourth Reunion of the Asociacion Latino-Americana de Ciencias Fisiologicas, Sao Paulo (Brazil). July 4-8, 1961.

Also published in Acta Physiol. Latinoamer., v. 11: 302-303, 1961.

Sexual hormones are known to alter the electroshock seizure threshold in rats. The question was raised whether those hormones would influence also the acquisition and retention of an avoidance response. Sixty white rats were divided into the following groups of 10 animals each: (1) Males daily treated with 500 μg of testosterone propionate, subcutaneously injected from eve of beginning to just the end of 10 days of training. Since then, injections were administered with intervals of 36 hr. (2) Females treated with 50 μg of estradiol benzoate injected following the same schedule as the previous group. (3) Castrated males. (4) Castrated females. (5) Control males. (6) Control females. A surprisingly higher degree of efficiency was observed in all animals at the first retention test compared with final performance of the training period. Extinction of the conditioned response was early among both castrated and androgen-treated rats. These experiments suggest an evident action of sexual hormones on central mechanisms controlling learning. According to performances of hormone-treated rats, androgens would evoke inhibition and estrogens, facilitation of learning. But the lower performances of both castrated groups point out a more complex interrelationship.

2633

Sao Paulo U. School of Medicine. Dept. of Physiology (Brazil).

EFFECTS OF INTRAVENTRICULAR ADMINISTRATION OF ACETYLCHOLINE, ADRENALINE AND D-TUBOCURARINE IN THE RAT (Abstract), by R. F. Marseillan and A. P. Corrado. [1961] [1]p. (AFOSR-1436) (AF AFOSR-60-15) Unclassified

Presented at Fourth Reunion of the Asociacion Latino-Americana de Ciencias Fisiologicas, Sao Paulo (Brazil), July 4-8, 1961.

Also published in Acta Physiol. Latinoamer., v. 11: 269, 1961.

The motor, vegetative and behavioral effects produced by injection of acetylcholine, adrenaline, and d-tubocurarine in the lateral ventricle were studied in the white rat. The drug, d-tubocurarine produced immediately after the injection a state of excitation varying from increased motor activity to generalized convulsions. With a 5 μg dose the animal showed tachypnea, tremors, extension of the tail, mastication, and restlessness; 1 to 3 min afterwards, clonic movements of a periodic character appeared in 1 of the legs. Some animals had with this dose, generalized seizure with complete recovery later. Larger doses, 10 μg or more, always resulted in intense and sustained tonic-clonic generalized convulsions. The injection of acetylcholine, from 30 to 50 μg, developed an immediate state of depression characterized by diminished motor activity and postural tonus, the animal lying on its side. After some minutes, the rat passed through a phase of catatonia of variable intensity; in this condition, it could be placed and remained in the most absurd positions. No effect was observed with 10 to 30 μg of adrenaline. When larger doses were injected (30-100 μg), the animal appeared depressed, with reduced reflex and motor activity and in some animals signs of a light hypnosis.

2634

Sao Paulo U. School of Medicine. Dept. of Physiology (Brazil).

INTERACTION BETWEEN THE SPECIFIC VISUAL SYSTEM AND THE RETICULAR FORMATION (Abstract), by M. R. Covian and R. F. Marseillan. [1961] [2]p. (AFOSR-1438) (AF AFOSR-60-15) Unclassified

Presented at Fourth Reunion of the Asociacion Latino-Americana de Ciencias Fisiologicas, Sao Paulo (Brazil), July 4-8, 1961.

Also published in Acta Physiol. Latinoamer., v. 11: 296-297, 1961.

Reticular stimulation has been shown to affect the sensory discharge at various levels in the central nervous system. The conclusions have been that the reticular formation plays an important role in the integrative function of the brain. It has been shown previously that a single conditioning shock applied to the reticular formation preceding at a convenient interval the specific test stimulus (tactile) determined a reduction of the negative component of the evoked cortical potential and sometimes an increase of the positive wave. The present work is an attempt to determine the effect of mesencephalic reticular formation stimulation upon the visual evoked potential in order to ascertain if there was a differential effect upon both components of the response. There was a differential interaction of the postsynaptic components of the evoked response. An increase of the surface-positive, and a decrease of the surface-negative phase were observed. This interaction seems to take place principally at cortical level. The heterosynaptic convergence of the specific and unspecific systems in cortical neurons is given as a possible basis for the mechanism underlying this interaction.

2635

Sao Paulo U. School of Medicine. Dept. of Physiology, (Brazil).

INFLUENCE OF LIMBIC SYSTEM ON BLOOD PRESSURE AND RESPIRATION RESPONSES IN THE RAT, by M. R. Covian, J. Antunes-Rodrigues, and D. V. Mendonca. [1961] [7]p. incl. diagrs. table, refs. (AFOSR-J949) (AF AFOSR-60-15) AD 415841 Unclassified

Presented at Fourth Reunion of the Asociacion Latino-Americana de Ciencias Fisiologicas, Sao Paulo (Brazil), July 4-8, 1961.

Abstract published in Acta Physiol. Latinoamer., v. 11: 296, 1961.

Also published in Acta Physiol. Latinoamer., v. 12: 115-121, 1962.

Previous studies have shown that stimulation of limbic structures of animals and man can produce several kinds of autonomic responses. In the present paper the cardiovascular and respiratory changes elicited by the electrical stimulation of different parts of the rat's limbic system are studied. The following structures were stimulated: orbital cortex of the frontal lobe; olfactory tubercle; pyriform cortex; amygdaloid complex; hippocampus; fornix; entorhinal area. The results obtained were as follows: A fall in blood pressure was most frequently observed; only in 2 animals in which the medial nucleus of the anygdala was stimulated, a rise was elicited. The respiratory response consisted, generally, of an increase in amplitude. No consistent change in heart rate was observed. The results reported seem to be mediated through the parasympathetic division of the autonomic nervous system; however, the inhibition of the sympathetic division cannot be disregarded.

2636

Sao Paulo U. School of Medicine. Dept. of Physiology (Brazil).

THE AUTONOMIC HEART RATE REGULATION OF RATS WITH CHRONIC CHAGAS DISEASE (Abstract), by E. M. Krieger and F. G. Alcantara. [1961] [1]p. (AF AFOSR-60-15) Unclassified

Presented at Fourth Reunion of the Asociacion Latino-Americana de Ciencias Fisiologicas, Sao Paulo (Brazil), July 4-8, 1961.

Published in Acta Physiol. Latinoamer., v. 11: 260, 1961.

In two groups of 6 and 8 rats which subsisted the acute form of the disease determined by the inoculation of the T. cruzi the autonomic regulation of the heart rate was studied. During the acute phase the animals presented the typical manifestation of the disease. Electrical stimulation (gross stimulation of the cervical sympathetic system) and the administration of epinephrine were used to test the sympathetic effects on the heart rate. The heart rate responses of the rats with chronic Chagas disease were no different from those presented by the control group. When the vagus nerve was stimulated, the threshold voltages (40/sec - 10 sec total duration) for the bradycardic responses production were almost the same in the control group and in the inoculated animals. However, the bradycardia determined by supramaximal stimuli (with less than 30 sec total duration) was greater in the rats with Chagas disease. The bradycardia produced by the injection of acetylcholine and mecholyl chloride was also more intense in the inoculated rats, although the duration of the effects was almost the same.

Sarah Mellon Scaife Radiation Lab., Pittsburgh, Pa.
see Pittsburgh U. Sarah Mellon Scaife Radiation Lab., Pa.

2637

Sheffield U. (Gt. Brit.).

THE OXIDATION OF REDUCED FLAVIN MONONUCLEOTIDE BY MOLECULAR OXYGEN, by Q. H. Gibson and J. W. Hastings. [1961] [10]p. incl. diagrs. refs. (AFOSR-4187) [AF EOAR-61-2] Unclassified

Also published in Biochem. Jour., v. 83: 368-377, May 1962.

The work described in this paper was undertaken as a preliminary to a study of the kinetics of the bacterial luminescent system. The results show that the oxidation of reduced flavin mononucleotide by molecular oxygen is autocatalytic. Autocatalysis is due to an interaction between oxidized and reduced flavin mononucleotides which yields a compound able to react with oxygen. The compounds described by Beinert (Jour. Amer. Chem. Soc., v. 78: 5323, 1956) in equilibrium mixtures of oxidized and reduced flavins (with absorption at 570 and 900 mμ) are formed rapidly during flavin oxidation. In the presence of luminol, flavin oxidation is accompanied by light-production. There is an initial flash lasting for about 5 msec, followed by a light-emission extending over 0.2 sec. The secondary light-emission is ascribed to the formation of hydrogen peroxide in the reaction mixture. A scheme representing the reaction has been developed and compared with observation by an analogue computer.

Sibley School of Mechanical Engineering, Ithaca, N. J.
see Cornell U. Sibley School of Mechanical Engineering, Ithaca, N. Y.

2638

Siena U. Inst. of Pathology (Italy).

[TONIC PARTICIPATION OF EXTRA-AORTIC VAGAL AFFERENTS IN THE REGULATION OF ARTERIAL PRESSURE IN THE CAT] Partecipazione tonica di afferenze vagali extra-aortiche alla regolazione della pressione arteriosa nel gatto, by M. Guazzi, A. Libretti, and A. Zanchetti. [1960] [2]p. (AFOSR-1250) (AF 61-(052)253) AD 262139 Unclassified

Also published in Boll. Soc. Ital. Biol. Sper., v. 36: 1635-1636, 1960.

In cats decerebrated at the midcollicular level, the height of the pressor response to carotid occlusion is further increased by functional (cold blockade) or surgical interruption of the cervical vagi, even when both aortic nerves have previously been severed. Administration of fully vagolytic doses of atropine at the beginning of the experiment rules out the intervention of the efferent fibers. It has been demonstrated, furthermore, that the potentiating effect of vagal section is not due to respiratory changes, as it is observed also when alveolar CO_2 concentration remains unmodified (continuous recording by an infrared gas analyzer) and/or respiratory movements are controlled by curarization and artificial ventilation. Since the potentiating effect of interrupting extra-aortic vagal afferents can be observed also on the basal arterial pressure level (both sino-carotid and aortic nerves being severed), it is suggested that baroceptive afferents coming from thoracic areas outside the aortic arch (pulmonary bed, atria, etc.) participate in the normal regulation of arterial pressure in the cat.

2639

Siena U. Inst. of Pathology (Italy).

REFLEX MECHANISMS REGULATING HYPOTHALAMIC AUTONOMIC ACTIVITY AND EMOTIONAL BEHAVIOUR. THEIR IMPORTANCE IN CIRCULATORY HOMEOSTATIS, by A. Zanchetti. [1960] [8]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)253, Rockefeller Foundation, and Wright Air Development Center) Unclassified

Published in Proc. Joint W. H. O.-Czechoslovak Cardiological Soc. Symposium on the Pathogenesis of Essential Hypertension, Prague (Czechoslovakia) (May 22-29, 1960), Prague, State Medical Publishing House, 1961, p. 191-198.

This paper discusses the role of posterior hypothalamic centers on circulatory homeostasis, particularly whether these centers are under a tonic inhibitory influence from the sinocarotid and aortic pressoreceptors. All observations were performed in acute preparations, whose hypothalamic activity was released by means of a prechiasmatic decerebration. Previous to brain transection,

both carotid sinuses were prepared by the blind sac technique, by carefully tying all vascular branches arising from them. It was observed that transient interruption of pressoreceptive activity resulted in outbursts of sham rage in the decorticate animal suggesting the hypothalamic centers are under a tonic continuous influence, maintained by the continuous flow of pressoreceptive impulses along the sinocarotid nerves. More evidence on the effectiveness of the pressoreceptive activity was gathered by experiments in which the intrasinus pressure was artificially increased from 0 to 200 mm Hg. It was observed that spontaneous, but not peripherally evoked outbursts of sham rage could be blocked by pressoreceptive stimulation. It was concluded that while pressoreceptive discharges exert an effective inhibitory influence on the spontaneous rhythmic activity of the nervous centers which are responsible for rage behavior, this reflex inhibitory control is easily overwhelmed by simultaneous stimulation of sensory afferents having excitatory action on the same brain mechanism.

2640

Siena U. Inst. of Pathology (Italy).

INHIBITORY CONTROL OF SINOCAROTID PRESSOCEPTIVE AFFERENTS ON HYPOTHALAMIC AUTONOMIC ACTIVITY AND SHAM RAGE BEHAVIOR, by C. Bartorelli, E. Bizzi and others. [1960] [19]p. incl. illus. refs. (Sponsored jointly by [Air Force Office of Scientific Research under AF 61(052)253] and Rockefeller Foundation) Unclassified

Published in Arch. Ital. Biol., v. 98: 308-326, July 31, 1960.

In acute decorticate cats, carotid occulsion below a carotid sinus blind-sac induced outbursts of sham rage which were potentiated by bilateral cervical vagotomy, and abolished by section of Hering's nerves. Sham rage outbursts followed carotid occlusion even when carotid body chemoceptors had been inactivated by embolization with a lycopodium suspension, a finding showing that this effect of carotid occlusion results from transient suppression of pressoceptive discharges, independently of chemoceptive co-excitation. Upper brain mechanisms are indispensable for the appearance of sham rage patterns upon carotid occlusion since the latter procedure failed to evoke any pseudoaffective reactions when midbrain and diencephalon were temporarily inactivated by injection of a minute dose of Thiopental into the external carotid circulation. Pressoceptive stimulation by increasing intrastnusal pressure succeeded in blocking spontaneously occurring outbursts of sham rage, but appeared much less effective in influencing evoked pseudoaffective activity. It is concluded that the central neural mechanisms responsible for sham rage behavior are also within the sphere of the inhibitory influence of sinocarotid pressoceptors.

Sloane Physics Lab., New Haven, Conn. see Yale U. Sloane Physics Lab., New Haven, Conn.

2641

Smithsonian Inst. Astrophysical Observatory, Cambridge, Mass.

UPPER ATMOSPHERIC STELLAR IMAGE STUDY, by G. J. Nielson. Final rept. July 1, 1961, 3p. (AFOSR-1406) (AF 49(638)609) Unclassified

This report summarizes the activities within the project for the period April 24, 1959 until October 1, 1960, when the program was moved from the Smithsonian Astrophysical Observatory (SAO), Cambridge, Mass. to the Astronomy Department, Northwestern U., Evanston, Ill. As early as 1957, the staff of the SAO became actively interested in manned-balloon astronomy. In 1959 it appeared that balloons using the Air Force "HIGH DIVE" gondola would be available for 3 flights to 100,000 ft. The SAO proposed to utilize a 12.5 in. Cassegrain telescope mounted on a 2-gimbal configuration and controlled by a stellar stabilization system. The SAO felt that more experiments should be added to the flights in order to increase the number of observations per hr and thereby gain more data. A critical study of possible experiments to detect radiation in regions of special wavelengths was undertaken. Also under consideration were methods of mounting the telescope assembly to prevent defocusing of the image through expansion and contraction of the telescope over the range of temperatures to be encountered between the ground and 100,000 ft altitude. Progress on the experimentation, stabilization system and gondola and life-support systems were reported on at the first AF609 planning conference in Cambridge, Mass., Sept. 9, 1959. During the summer of 1960 the balloon astronomy activities were transferred from the Smithsonian to Northwestern U.

2642

South Carolina U. Dept. of Electrical Engineering, Columbia.

NON-WAVEGUIDE TRANSMISSION OF MILLIMETER WAVES, by R. G. Fellers, S. T. Moseley, and S. Litman. Final rept. Aug. 7, 1961, 35p. incl. diagrs. tables, refs. (AFOSR-1172) (AF 18(603)43) AD 262463 Unclassified

Research was continued on the development of non-waveguide transmission of millimeter waves. Test results have demonstrated successfully that a free-space transmission system can be operated with much lower attenuation than a conventional waveguide system. It has also been shown that transmission around corners can be accomplished at attenuation figures lower than those for straight line transmission. A number of devices including duplexers, directional couplers, attenuators, wavemeters, and reflectometers have been developed and operated in the free space medium. Theoretical computation of near zone fields and of transmission loss have only been commenced and no definitive results have been obtained. Future work in this field should include extension of the work to higher frequencies, development of additional devices and further pursuit of the theoretical computations. (Contractor's abstract)

2643

Southampton U. (Gt. Brtt.).

RESEARCH ON STEREOCHEMISTRY OF CO-ORDINATION NUMBER FIVE, by G. W. A. Fowles. Final technical rept. Jan. 1, 1960-Dec. 31, 1961, 29p. incl. diagrs. tables. (AFOSR-2373) (AF 61(052)318) AD 279473 Unclassified

This report pays particular attention to compounds formed by the following elements: titanium, vanadium, molybdenum, and tungsten; a few experiments have also been carried out on compounds of zirconium, niobium, and tantalum. Concerning the compounds of the tervalent elements of co-ordination numbers 5 and 6, most of the compounds are those formed in the reaction of titanium (III) and vanadium(III) halides with a range of monodentate ligands. The true co-ordination number has not been determined with certainty for all of those compounds, particularly those which are insoluble in the usual organic solvents. Niobium(III) halides did not react with these ligands. Molybdenum(III) chloride and bromide formed complexes (MoX_3, 3L) with pyridine and tetrahydrofuran. Concerning the oxyhalide complexes of quinquevalent molybdenum and tungsten, a number of oxyhalogene complexes of molybdenum have been made in which the metal atom is apparently covalently bonded to only 5 other atoms. These salts have been made in a variety of ways. Spectral and magnetic susceptibility measurements on these compounds are consistent with their formulation as tetragonal pyramids. Attempts have been made to prepare co-ordination compounds of vanadium(IV) chloride with primary and secondary altphatic amines, but although such compounds can be formed at low temperatures, solvolysis occurs at room temperature with the formation of aminobasic vanadium(IV) chlorides $VCl_2(NHR)_2$, $4NH_2R$ and $VCl_2(NR_2)_2$. Consideration of spectra indicate that in these compounds the vanadium atoms have co-ordination numbers of 8 and 6 respectively.

2644

Southern California U. Dept. of Chemistry, Los Angeles.

AN EXPERIMENTAL TEST OF FRANKEL'S LAW OF FILM THICKNESS, by K. J. Mysels and M. C. Cox. [1961] [10]p. incl. illus. diagrs. (AFOSR-TN-60-1098) (AF 49(638)309) AD 454651 Unclassified

Presented in part at meeting of the Amer. Chem. Soc., Atlantic City, N. J., Sept. 13-18, 1959.

Also published in Jour. Colloid Sci., v. 17: 136-145, Feb. 1962.

Experimental methods for determining the relation between thickness and velocity of pull-out for surfactant films are presented. When applied to a variety of surfactant systems over a wide range of bulk viscosities, purity, and surface viscosity, they yield data in excellent agreement with Frankel's law, which relates film thickness and velocity of pull-out to bulk viscosity, density, surface tension, and the force of gravity on the basis of simple hydrodynamics assuming negligible surface extensibility in the region of interest. (Contractor's abstract)

2645

Southern California U. Dept. of Chemistry, Los Angeles.

ELECTRIC CONDUCTIVITY OF SODIUM DECYL SULFATE SOLUTIONS, by K. J. Mysels and P. Kapauan. [1961] [3]p. incl. diagr. (AFOSR-1950) (Sponsored jointly by [Air Force Office of Scientific Research under AF 49(638)309] and Office of Naval Research) Unclassified

Also published in Jour. Colloid Sci., v. 16: 481-483, Oct. 1961.

A modified method of preparing the sodium decyl sulfate based on the insolubility of its alcoholate is described and conductivity measurements in the highly dilute region and in the c. m. c. region in water and in the presence of salt are reported. The behavior of this compound seems quite normal throughout and it shows no indication of marked dimerization. (Contractor's abstract)

2646

Southern California U. Dept. of Chemistry, Los Angeles.

RESEARCH ON THE CHEMISTRY OF THIOPEROXIDES (SULFENYL ESTERS), by N. Kharasch. Final rept. June 21, 1961, 3p. (AFOSR-969) (AF 49(638)330) AD 621226 Unclassified

The experiments concerned with the chemistry of thioperoxides are presented in brief form. They include the thermal decompositions of sulfenyl esters, extensions of the synthesis of sulfenyl esters, and mechanisms of reactions of sulfenyl halides with alcohols. Results published previously are reviewed and tentative results of investigations not complete are given.

2647

Southern California U. [Dept. of Chemistry] Los Angeles.

SULFENIUM IONS AND SULFENYL COMPOUNDS, by N. Kharasch. [1961] [22]p. incl. diagrs. refs. (AFOSR-2323) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)718], National Science Foundation, Office of Ordnance Research, Petroleum Research Fund of the Amer. Chem. Soc., and Stauffer Chemical Co.) Unclassified

Also published in Organic Sulfur Compounds, ed. by N. Kharasch, New York, Pergamon Press, v. 1, Chap. 32: 375-396, 1961.

The broad scope of the field of sulfenyl compounds is re-emphasized by a general definition of R and X in RSX and by an evaluation of the ionic reactions of such substances. Methods for generating sulfenium ions are described and evidence for the existence of such ions in solution discussed. Brief mention is also made of some

free-radical reactions involving sulfenyl compounds. The analogies between displacements from carbon in alkyl and acyl compounds and sulfenyl compounds are noted. A summary of analytical, biochemical, synthetic and theoretical interests in sulfenyl compounds is included. (Contractor's abstract)

2648

Southern California U. Dept. of Chemistry, Los Angeles.

SULPHENYL NITRATES AND SULPHINYL RADICALS, by R. M. Topping and N. Kharasch. [1960] [2]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)718] and Stauffer Chemical Co.) Unclassified

Published in Chem. and Indus. (London), No. 6: 178-179, Feb. 11, 1961.

In seeking routes to substances of generating sulfinyl radicals, RSO·, a series of sulfenyl nitrates, RSO·NO_2, a new class of sulfenyl derivatives, of both theoretical and practical interest has been prepared. Physical and chemical properties of the nitrates are given. A convenient synthesis involves the sulfenyl chlorides and silver nitrate, in cold acetonitrile solutions; silver chloride precipitates quantitatively, and the sulfenyl nitrates remain dissolved. The synthetic technique is being extended to the synthesis of nitrates from other active chlorides (such as ArSeCl, ArS(O)Cl, $Ar_2P(O)Cl$ and $ArSO_2Cl$) and to the preparations of new classes of sulfenyl compounds by the interactions of sulfenyl halides with various silver salts (such as $AgNO_2$, AgCN, AgOCN, Ag_2CrO_4 and $AgClO_4$).

2649

Southern California U. Dept. of Chemistry, Los Angeles.

TRICHLOROMETHANESULFENYL CHLORIDE AND TRICHLOROMETHANESULFONYL CHLORIDE, by F. A. Drahowzal. [1961] [14]p. incl. refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49-(638)718], Office of Naval Research, and Stauffer Chemical Co.) Unclassified

Published in Organic Sulfur Compounds, ed. by N. Kharasch, New York, Pergamon Press, v. 1, Chap. 31: 361-374, 1961.

Trichloromethanesulfenyl chloride, Cl_3CsCl, 1, has the distinction of being the first of the sulfenyl chlorides to be prepared (Rathke, 1870) and of now being the member of this series of greatest technological and biochemical interest. In its reactions, both ionic and free radical reacttons may be involved. Its preparation by controlled chlorination of carbon disulfide makes it readily available in quantity. The recent review of G. Sosnovsky on trichloromethanesulfenyl chloride (I) is cited and relied on in this chapter; but because of the uniqueness of this substance, and continuing work elsewhere and by the author, to the date of publication, a brief resumé is given. The conversions of the sulfenyl chloride to the sulfenyl esters, RSOR'—the so-called "thioperoxides"—as well as certain properties of the latter are noted. Trichloromethanesulfonyl chloride, Cl_3CSO_2Cl, (II) obtainable by oxidation of the sulfenyl chloride, is also a technically-available substance. Recorded work on this compound is reviewed and the need for further study noted. (Contractor's abstract)

2650

Southern California U. Dept. of Chemistry, Los Angeles.

THE CORRELATION OF SOLVENT EFFECTS ON THE STEREOSELECTIVITIES OF DIELS-ALDER REACTIONS BY MEANS OF LINEAR FREE ENERGY RELATIONSHIPS. A NEW EMPIRICAL MEASURE OF SOLVENT POLARITY, by J. A. Berson, Z. Hamlet, and W. A. Mueller. [1961] [8]p. incl. diagrs. tables, refs. (AFOSR-1371) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)828, Alfred P. Sloan Foundation, and Petroleum Research Fund) Unclassified

Also published in Jour. Amer Chem. Soc., v. 84: 297-304, Jan. 20, 1962.

The logarithms of the ratios of stereoisomeric products in the kinetically controlled Diels-Alder additions of cyclopentadiene to methyl methacrylate and methyl trans-crotonate in various solvents are linearly related to a solvent parameter, Ω, defined as the logarithm of the endo/exo product ratio for the cyclopentadiene-methyl acrylate addition. The Alder Rule of "maximum accumulation of unsaturation" is of minor importance in determining the ratios of products; methyl acrylate obeys the rule in all solvents, methyl methacrylate violates it in all solvents, and methyl trans-crotonate shows borderline behavior, conforming to the rule in polar solvents but not in non-polar solvents. The solvent effects are correlated fairly well in quantitative terms by the Kirkwood-Onsager theory. The qualitative trend of the solvent effects is explicable in terms of an interaction between the permanent dipoles of the diene and dienophile. The parameter Ω is a new empirical measure of solvent polarity; it is linear in Z, in $\log k_{ion}$ for p-methoxyneophyl p-toluenesulfonate, and in $\log k_{rearr}$ for the Curtius rearrangement of benzoyl azide. (Contractor's abstract)

2651

Southern California U. Dept. of Chemistry, Los Angeles.

PROPERTIES OF SOME CYCLOPENTADIENYLIDENE ANHYDRO-BASES, by J. A. Berson and E. M. Evleth. [1961] [2]p. incl. diagrs. table. (AFOSR-1372) (AF 49-(638)828) Unclassified

Also published in Chem. and Indus., No. 34: 1362-1363, Aug. 26, 1961.

Protonation of N-methyl-2-cyclopentadienylidene-1,2-dihydropyridine (I) gives a mixture of the 2 cations (IIa) and (IIb). The 60 mc proton magnetic resonance

spectrum of compound (I) in trifluoroacetic acid solvent shows, in addition to aromatic and olefinic proton absorption, 2 N-methyl peaks at 268 and 263 c/sec. The structure of the N-benzyl-x-cyclopentadienylidene-1, x-dihydropyridine obtained from N-benzylpyridinium chloride and cyclopentadienyllithium (and assigned the structure (IIIa)) has now been confirmed by an independent synthesis of (IIIa) and the only reasonable alternative, (IVa): 4-bromo-N-benzylpyridinium bromide reacts with cyclopentadienylsodium in 1, 2-dimethoxyethane to give compound (IIIa), golden yellow plates from benzene. This substance decomposes above 200° and has infrared, visible, and ultraviolet spectra identical with those of a sample prepared from N-benzylpyridinium bromide and cyclopentadienylsodium (Found: C, 87.44; H, 6.57, N, 6.07%). The analogue (IIIb) is obtained from (i) N-methylpyridinium iodide and cyclopentadienylsodium in 1, 2-dimethoxyethane after 24 hr at room temperature, and from (ii) N-methyl-4-bromopyridinium iodide and cyclopentadienylsodium in 1, 2-dimethoxyethane as golden yellow plates from boiling benzene, decomposing above 200° (Found: C, 83.97; H, 7.11; N, 8.86%). These properties and others of these compounds are to be correlated with those calculated by the method of molecular orbitals.

2652

Southern California U. Dept. of Chemistry, Los Angeles.

THE ABSOLUTE CONFIGURATIONS OF SOME SINGLE NORBORNANE DERIVATIVES. A TEST OF THE CONFORMATIONAL ASYMMETRY "MODEL", by J. A. Berson, J. S. Walia and others. [1961] [12]p. incl. diagrs. tables, refs. (AFOSR-2123) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)828], Alfred P. Sloan Foundation, National Science Foundation and Petroleum Research Fund) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 3986-3997, Oct. 5, 1961.

Absolute configurations and maximum rotations are deduced for 46 norbornane derivatives by conversion of 2-endo-norborneol to fenchone and of the 2-methyl-5-norbornene-2-carboxylic acids to camphenilane. Optical resolutions of both epimeric 2-methyl-5-norbornene-2-carboxylic acids are described, that of the exo-acid being apparently virtually complete. The conformational asymmetry model correctly predicts the signs of rotation for a number of these substances, but gives incorrect predictions for 6 norbornane derivatives, the configurations of which can be deduced from information in the literature. (Contractor's abstract)

2653

Southern California U. Dept. of Electrical Engineering, Los Angeles.

ELECTROMAGNETIC RADIATION FROM A DIPOLE IN AN ANISOTROPIC PLASMA, by H. H. Kuehl. Sept. 1961, 113p. incl. diagrs. refs. (USCEC rept. no. 79-203) (AFOSR-1582) (AF 49(638)522) AD 266993 Unclassified

The general solution to the problem of the radiation of an electric dipole in a magnetically-biased cold plasma is presented. Several waves exist which travel in different directions with different indices of refraction. These waves interfere to produce beats and amplitude modulation and cause the resultant time-average energy flow to have components in other than the radial direction, contrary to the isotropic case. The propagation direction for the waves was determined. For the lossless case considered, the field was unbounded in certain directions for certain values of the plasma frequency and gyro-frequency. An equation is given for the directions of these singularities. The time-average Poynting vector and the group velocity for an individual wave are shown to be purely radial although the resultant Poynting vector due to all waves in the far zone has other components. Various limiting cases are amenable to solution. The case of a high operating frequency is treated; it is shown that the radiation pattern is approximately identical to the isotropic case. (Contractor's abstract)

2654

Southern California U. Dept. of Electrical Engineering, Los Angeles.

LOW FREQUENCY RADIATION FROM AN ELECTRIC DIPOLE IN A COLD ANISOTROPIC PLASMA, by H. H. Kuehl. Nov. 1961, 10p. (USCEC rept. no. 79-204) (AFOSR-1809) (AF 49(638)522) AD 269871 Unclassified

Expressions for the electromagnetic radiation from an electric dipole in an infinite cold anisotropic plasma are presented under the condition that the operating frequency is much less than the ion gyro-frequency. It is found that the major portion of the radiation is concentrated along the direction of the magnetostatic field. (Contractor's abstract)

2655

Southern California U. Dept. of Electrical Engineering, Los Angeles.

RESEARCH IN PLASMA AND MAGNETOHYDRODYNAMICS, by Z. [A.] Kaprielian. Final rept. Dec. 1961, 19p. (USCEC rept. no. 79-101) (AFOSR-1998) (AF 49(638)522) AD 272808 Unclassified

Theoretical and experimental work in 4 major areas are presented: (1) Electromagnetic wave propagation in ionized media; (2) Plasma diagnostics; (3) Electromagnetic scattering properties of a plasma; and (4) Amplification of plasma waves. The results of these investigations were discussed in publications and technical reports and are reviewed briefly. (Contractor's abstract)

2656

Southern California U. Dept. of Electrical Engineering, Los Angeles.

THEORY OF A PLASMA NEGATIVE RESISTANCE

AMPLIFIER, by J. Y. Wada and Z. A. Kaprielian. [1961] [12]p. incl. diagrs. (AFOSR-2869) (AF 49(638)-522) Unclassified

Also published in Jour. Appl. Phys., v. 33: 1551-1562, Apr. 1962.

The purpose of this paper is to present the theory of a plasma negative resistance amplifier based on an approximate quasi-electrostatic model of a modified quadrupole cavity containing a plasma column and hyperbolic quadrupole electrodes with side resonators. The theory is extended to plasmas with finite collision frequencies in a finite magnetic field. By use of a nonlinear equation of the electron motion obtained by expanding the time varying applied electric field in Taylor's series, it is shown that the electrons in a plasma column behave as a nonlinear reactance and that a net signal amplification can be realized when sufficient pump-power is properly applied. It is also shown that the effective noise contributed from the plasma can be reduced by decreasing the plasma electron collision frequency or the plasma density. A preliminary experimental result which indicates the presence of a nonlinear plasma interaction is described. (Contractor's abstract)

2657

Southern California U. Engineering Center, Los Angeles.

INTERACTION BETWEEN A RADIO WAVE AND A PLASMA IN THE PRESENCE OF A UNIFORM MAGNETIC FIELD, by T. Koga. Jan. 1961, 45p. (USCEC rept. no. 83-204) (AFOSR-283) (AF 49(638)831) AD 253452 Unclassified

Also published in Phys. Fluids, v. 5: 1552-1557, Dec. 1962.

Because of the imposed magnetic field, the effect of movements of ions is not to be neglected. Considering a plausible model of plasmas where molecules are partly ionized, Boltzmann type equations are proposed for ions and electrons. By introducing generalized moments of the distribution functions of electrons and of ions, it is easy to solve the equations, obtaining the conductivity of a plasma to an oscillating electric field. The propagation of a radio wave in the plasma is investigated. There are 7 frequencies which characterize the phenomena: (1) Larmor's frequencies of electrons and of ions, (2) frequency of radio wave, (3) plasma frequency and a similar one defined with respect to ions, and (4) collision frequencies of electrons and of ions. The first approximation is treated where frequency (3) is negligibly small compared with frequency (2). In other words, the electric field induced by the group displacements of electrons and of ions is neglected. As special cases, Alfven's theory of hydromagnetic waves and Margenau's theory of radio waves in plasmas with no imposed magnetic field are included in the theory. For the second approximation, the field induced by the group displacements of electrons and of ions may be taken into account. (Contractor's abstract)

2658

Southern California U. Engineering Center, Los Angeles.

EXPERIMENTS IN CRYOPUMPING CO_2, by R. W. Moore, Jr. Mar. 1961 [16]p. incl. illus. diagrs. (USCEC rept. no. 83-205) (AFOSR-561) (AF 49(638)831) AD 256769 Unclassified

Experiments in cryopumping CO_2 were carried out to observe the relationship between the flow rate and the pressure, the formation of the deposit on the condenser and the effects of noncondensables. A steady flow of CO_2 was cryopumped by a condenser cooled to liquid N temperatures. Noncondensable gases (presumably air) in the tube exerted a strong and by far the predominant influence on the pressure upstream of the condenser and on the nature of the deposit. With tube pressures in the range of 0.005 to 0.5 mm Hg, the flow of CO_2, from the inlet at 1 end of the tube to the condenser at the other end, swept the noncondensables downstream causing them to accumulate near the condensing surface. For certain condenser geometries this phenomena caused all or parts of the condenser surface to be blanketed by a noncondensable gas layer through which the condensing gases must diffuse. In some cases the presence of this gas layer caused a considerable increase in the pressure upstream of the condenser. The noncondensable gases were apparently introduced as impurities in the CO_2 and entered the tube along with it. Consequently, when no attempt was made to continuously remove them, the pressure in the tube steadily rose. If any trapping of noncondensables by the condensate occurred, its rate was too small to be observed. (Contractor's abstract)

2659

Southern California U. Engineering Center, Los Angeles.

AN ELASTIC COLLISION MODEL FOR THE KINETIC THEORY OF GASES, by T. Koga. June 1961, 38p. incl. diagrs. refs. (USCEC rept. no. 83-206) (AFOSR-823) (AF 49(638)831) AD 259381 Unclassified

From investigation of studies of impact phenomena of various types of particles and considering the convenience of kinetic theoretical treatment of gases, a semi-empirical model of elastic collisions is proposed. With respect to encounters of charged particles, binary collision is defined in a new sense. In this model, the collision probability (total cross section) of 2 particles may be a function of their relative velocity. With respect to a gas composed of 2 or more types of particles, partitions of momentum and of energy after collisions are plausibly determined, and the conditions which secure the stability of the Maxwell distribution are considered. By this model, analytical treatments of the Boltzmann equation are simplified. The equation may be solved without losing the main characteristics of the pertinent phenomena, even when the state of a gas deviates considerably from thermal equilibrium. (Contractor's abstract)

2660

Southern California U. Engineering Center, Los Angeles.

ELECTRIC CONDUCTIVITY OF A HIGH TEMPERATURE PLASMA TO A RADIO WAVE, by T. Koga. July 1961, 20p. incl. diagr. table. (USCEC rept. no. 83-207) (AFOSR-1184) (AF 49(638)831) AD 262680 Unclassified

The effect of the temperature of a fully ionized plasma on its conductivity in the presence of 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, and a the phase velocity of the wave. (Contractor's abstract)

2661

Southern California U. Engineering Center, Los Angeles.

MICROWAVE MEASUREMENTS OF PLASMA FLOW IN A SUPERSONIC WIND TUNNEL, by K. Oshima. Sept. 1961, 35p. incl. diagrs. tables. (USCEC rept. no. 83-208) (AFOSR-1556) (AF 49(638)831) AD 266686 Unclassified

A 24 kmc microwave interferometer is used to measure the density and the collision frequency of electrons in a plasma flow in a small supersonic wind tunnel, heated by 13 mc radio-frequency power supply. By means of slabs and strips of known dielectric properties, the characteristics of microwave interaction with the tunnel filled with the dielectrics is examined, and it is confirmed that the measured phase shift agrees with the predicted one. Results are obtained for a stable plasma flow, and they show reasonable values. The unstable plasma flow, which usually occurs at high input power and at low pressures, cannot be measured. (Contractor's abstract)

2662

Southern California U. [Engineering Center] Los Angeles.

ELECTRON-HEAVY PARTICLE COLLISION MODEL IN A PLASMA, by T. Koga, J. G. Everton, and P. C. Wilber. [1961] [2]p. incl. table. (AFOSR-1681) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)831] and Office of Naval Research) Unclassified

Also published in Phys. Fluids, v. 4: 1057-1058, Aug. 1961.

Although the usual concept of binary collision is not valid, the "binary collision" may, in an approximate sense, be separated from "group interaction" if $3/2\ kT > e^2 n^{1/3}$, where 3/2 kT is the average energy of motion of a particle, e the electronic charge, and n the number density of charged particles. Assuming that the heavy particle has a much greater mass and smaller speed than the electron and may be ar[illegible] of netural molecule, a collision model is propo[illegible]mple, ionization, and rec[illegible]mbination collisions are considered.

2663

Southern California U. [Engineering Center] Los Angeles.

TRANSPORT PHENOMENA IN A FULLY IONIZED GAS CONFINED IN A STRONG MAGNETIC FIELD, by T. Koga. [1959] [8]p. incl. diagrs. (AFOSR-1682) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)831] and Office of Naval Research) Unclassified

Also published in Phys. Fluids, v. 4: 834-841, July 1961.

In the present paper, the distributions of ions and of electrons in the presence of a strong magnetic field in the z direction are not assumed as being almost Maxwellian. Instead, $f^{(0)}(c_x^2 + c_y^2, c_z, x \pm r c_y/c)$ is taken for the distributions in the zeroth approximation with respect to the ratio (Larmor radius r)/(free path length λ), and an iteration method is developed for solving the Boltzmann equation. First, defining the density of guiding centers of particles, $f^{(0)}$ is expanded into powers of $(r\,\partial f^{(0)}/\partial x)/f^{(0)}$. By coarse-graining the Boltzmann equation over one cycle of Larmor's gyration, equations of moments in the first approximation with respect to r/λ are derived. The simple mode of collision proposed by Bhatnagar et al is assumed. A special case is studied in detail in order to compare the present theory with those of other authors who assume distributions to be almost Maxwellian. The agreement is good. The effects of drifts of guiding centers caused by the spacial nonuniformity of a magnetic field and/or by a static electric field in the presence of a uniform magnetic field are investigated. (Contractor's abstract)

2664

Southern California U. Engineering Center, Los Angeles.

ON TRANSPORT PROCESSES IN A PLASMA (KINETIC EQUATION FOR A PLASMA), by T. Koga. Oct. 1961, 18p. incl. diagrs. (USCEC rept. no. 83-209) (AFOSR-1744) (AF 49(638)831) AD 268355 Unclassified

Authors usually neglect the effect of Coulomb field in the space of radius e2/(3kT/2) surrounding a charged particle, and derive equations of the Fokker-Planck type from the Liouville equation of a plasma. The effect of the inner core field, neglected usually, is shown to be present in an equation of the Fokker-Planck type as an additional term similar to the collision term in an equation of the Boltzmann type. It is shown that the order of this additional term may easily be larger than those of the friction and diffusion terms, the effect of the outer core field. When the effect of the outer core field is larger than that of the inner core field, the assumption of binary interaction is shown to be not feasible. The possible nonlinear and non-Markovian behavior of a particle is neglected. (Contractor's abstract)

2665

Southern California U. Engineering Center, Los Angeles.

THE DISTRIBUTION OF CHARGED PARTICLES NEAR A CHARGED SPHERICAL BODY IN MOTION, by T. Koga. Nov. 1961, 13p. incl. diagrs. (USCEC rept. no. 83-210) (AFOSR-1870) (AF 49(638)831) AD 270431 Unclassified

The distribution function is calculated of charged particles near a charged spherical body, by assuming that (1) at infinite distances, particles are in a Maxwellian distribution, and (2) the spherical body is in motion relative to the gas at infinite distances. By these assumptions, a unique solution of the Boltzmann equation for the distribution is obtained when the force between the sphere and a particle is repulsive, and the trajectory of a particle is hyperbolic. When the force is attractive, however, the solution is not unique. In this case, the trajectory of a particle may be a hyperbola, or a parabola, or an ellipse. It is shown that $dc_x dc_y dc_z dx\, dy\, dz$ is invariant along a trajectory since the motion of a particle is subject to canonical equations. Further, since there are no collisions, the distribution function f itself is to be invariant along a trajectory.

2666

Southern California U. Engineering Center, Los Angeles.

A RADIO WAVE IN A PLASMA IN A UNIFORM MAGNETIC FIELD, by T. Koga. [1961] [10]p. incl. refs. (AFOSR-3987) (AF 49(638)831) 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. 1: 507-516, 1962.

Considering a plausible model of plasmas where molecules are partly ionized, Boltzmann-type equations for ions and electrons are proposed. By introducing generalized moments of the distribution functions, it is easy to solve the equations, obtaining the conductivity of a plasma to an oscillating electric field in the presence of an imposed magnetic field. The propagation of a radio wave in the plasma is investigated. As special cases, Alfvén's theory of hydromagnetic waves and Margenau's theory of radio waves in plasmas with no imposed magnetic field are included in the theory.

2667

Southern California U. [Engineering Center] Los Angeles.

INTERACTION BETWEEN A RADIO WAVE AND A PLASMA, by T. Koga. [1961] [5]p. incl. diagrs. refs. (AFOSR-3988) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)831] and Office of Naval Research) Unclassified

Also published in Phys. Fluids, v. 4: 1162-1166, Sept. 1961.

The interaction between a radio wave and a plasma is studied based on the Boltzmann equation for electrons. Collisions between electrons and heavy particles and the electric field caused by the group displacement of electrons are taken into account. The relation between the current density and the oscillating electric field is obtained. The solution is exact so far as the proposed Boltzmann equation for electrons is concerned. According to the result, the propagation of the radio wave in the plasma is investigated. As the electric field caused by the group displacement of electrons becomes negligibly weak, the results approach those obtained by Margenau. (Contractor's abstract)

2668

Southern California U. Engineering Center, Los Angeles.

INTERACTION BETWEEN A RADIOWAVE AND A PLASMA IN THE PRESENCE OF A UNIFORM MAGNETIC FIELD (Abstract), by T. Koga. [1961] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)831] and Office of Naval Research) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 299, Apr. 24, 1961.

On account of the imposed magnetic field, the effect of movements of ions is not to be neglected. Considering a plausible model of plasmas where molecules are partly ionized, Boltzmann-type equations for electrons and ions are proposed. By introducing "generalized moments" of the distribution functions, it is easy to solve the equations obtaining the conductivity of a plasma to an oscillating electric field. There are 7 frequencies which characterize the phenomena: (1) Larmor's frequencies of electrons and of ions, (2) frequency of radiowave, (3) plasma frequency and a similar frequency defined with respect to ions, (4) collision frequencies of electrons and of ions. As special cases, Alfvén's hydromagnetic wave and Margenau's conductivity are included in the theory.

2669

Southern California U. Engineering Center, Los Angeles.

BLAST WAVES PRODUCED BY EXPLODING WIRES, by K. Oshima. [1961] [16]p. incl. diagrs. tables. (AF 49-(638)831) Unclassified

Published in Exploding Wires; Proc. of Conf. on the Exploding Wire Phenomenon, Boston, Mass. (Nov. 13-15, 1961), New York, Plenum Press, v. 2: 159-174, 1962.

This paper is concerned with the cylindrical blast wave produced by a wire explosion. In order to obtain a strong blast wave, the wire was exploded in a shock chamber evacuated to various low pressures. Density distributions of air were observed with a Mach-Zehnder interferometer. The processes of formation and propagation as well as the internal structure of the blast wave were analyzed.

In the analysis of these data, Taylor-Lin-Sakurai's first approximation and Sakurai's second approximation for strong cylindrical blast waves were used. For the analysis of moderately strong blast waves, a newly presented theory, called quasi-similarity theory, was applied. This theory is based on the assumption that the distributions of the flow velocity, density, and pressure are locally similar. Agreement of experimental results with the corresponding theoretical predictions was satisfactory.

2670

Southern California U. [Engineering Center] Los Angeles.

ON TRANSPORT PROCESSES IN FULLY IONIZED GASES (Abstract), by T. Koga. [1961] [1]p. [AF 49-(638)831] Unclassified

Presented at meeting of the Amer. Phys. Soc., Colorado Springs, Colo., Nov. 15-18, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 149, Feb. 23, 1962.

By means of the so-called BBGKY method, transport processes in fully ionized gases have been investigated by several authors (Tchen, Rostoker and Rosenbluth, Prigogine and Balescu). The Liouville equation is reduced to equations of the Fokker-Planck type which describe the evolution of the distribution function and establish the basis for investigating the incoherent radiation of plasmas (Simon and Harris). From the viewpoint of macroscopic gasdynamics of comparatively low temperature plasmas, some course-graining of these equations is desirable. In this paper a proposed method of course-graining results in equations of distribution functions in which the effect of strong interactions of short-period correlations is described by "collision" terms (which are characteristic of the Boltzmann equation) and the effect of weak interactions of long-period correlations is described by friction and diffusion terms (which are characteristic of the Fokker-Planck equation). Depending on specific conditions, the relative significance of these terms may change. These conditions are considered.

2671

Southern California U. [Engineering Center] Los Angeles.

MOMENT EQUATIONS AND BOUNDARY CONDITIONS FOR MAGNETO-GAS DYNAMICS, by H. T. Yang. [1961] [10]p. incl. refs. (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: 1580-1539, Dec. 1962.

Moment equations are obtained from the Boltzmann equation for a conducting gas in electric and magnetic fields. Relatively simple stress and heat-flux equations yielding 1-fluid description of a slightly ionized gas mixture have been obtained. The associated boundary conditions are obtained by applying conservation laws near the wall. These moment equations and boundary conditions together with Maxwell's electromagnetic equations and their boundary conditions form a determinate system to describe the dynamics of a rarefied conducting gas in electric and magnetic fields. This system includes, as limiting cases, both the Grad 13 moment equations for rarefied gases and the usual continuum magneto-gasdynamic equations. (Contractor's abstract)

2672

Space Recovery Systems, Inc., El Segundo, Calif.

STUDY OF SOFT RECOVERY, by T. W. Knacke, K. R. Paulson, and G. G. Schurr. Mar. 1961, 92p. incl. diagrs. tables, refs. (AFOSR-104) (AF 29(600)2454) AD 255766 Unclassified

The feasibility of recovering a guidance system test vehicle from a single-stage boosted flight using XM-33 and XM-12 boosters is investigated and established. A recovery method is proposed using a variable area drag brake, a parachute system, and aerial snatch by helicopter. Attitude stabilization of the payload during the entire flight is provided by a hot gas reaction control system in conjunction with the guidance system used during the boost phase. Preliminary designs for the necessary subsystems and for the over-all payload and recovery vehicle have been completed and the associated weights and volumes have been estimated. (Contractor's abstract)

2673

[Sperry Rand Corp. Univac Div., Blue Bell, Pa.]

A COMPARISON OF DICTIONARY USE WITHIN TWO INFORMATION RETRIEVAL SYSTEMS, by C. K. Schultz, P. D. Schwartz, and L. Steinberg. [1961] [7]p. incl. diagrs. table. (AFOSR-3515) (AF 49(638)835) Unclassified

Also published in Amer. Doc., v. 12: 247-253, Oct. 1961.

The use of the same computer routines to generate analytical data about the use of the dictionary in 2 information retrieval systems has given the following results: (1) In both systems the shape of the curve for the occurrence of single descriptors in the sample is one-half of a U. The same is true for the occurrence of pairs of descriptors. (2) One system generates many more double, triple, and quadruple combinations of descriptors than the other. This is because that system has a higher number of descriptors per document. Descriptors are ordinarily searched for in triple and quadruple combinations. Whether or not the system providing the higher number of descriptor combinations has the more useful file remains to be proved. (3) A curve has been drawn for each system, measuring the use of single descriptors in terms of the average number of uses of descriptors in that system. The two curves nearly coincide. It is hypothesized that the shape of the curve (nearly a straight line for cumulated frequency of use of descriptors) is an intrinsic characteristic of dictionary use, to which dictionary use in all systems can be related.

More systems will have to be analyzed before an acceptable standard can be chosen for interpreting the meaning of deviations in the curves of individual systems. (Contractor's abstract)

2674

Stanford Research Inst., Menlo Park, Calif.

LUMINESCENCE OF SOLIDS PRODUCED BY SURFACE RECOMBINATION OF ATOMS, by K. M. Sancier, W. J. Fredericks, and H. Wise. Final rept. Aug. 1, 1961 [51]p. incl. diagrs. tables, refs. (AFOSR-1514) (AF 49(638)-353) AD 264453 Unclassified

The objective of this research was to investigate the mechanism by which energy released during heterogeneous recombination of atoms is converted in the lumophor to energies of luminescence and heat. The results of this program will contribute to the knowledge of energy transfer between gases and solids, and of the fundamentals of surface catalysis. An experimental program was launched to obtain quantitative information necessary to develop a detailed understanding of the energy processes involved. The bulk of the work was done with calcium oxide lumophors which were excited by heterogeneous recombination of nitrogen atoms.

2675

Stanford Research Inst., Menlo Park, Calif.

INTERACTION OF 0.2 TO 4.0-EV ELECTRON BEAMS WITH CLEAVED MgO, by C. J. Cook and W. J. Fredericks. [1961] [4]p. incl. diagrs. refs. (AFOSR-3574) [AF 49(638)353] Unclassified

Also published in Jour. Chem. Phys., v. 36: 608-611, Feb. 1, 1962.

An attempt was made to determine the absorption coefficient δ_a for electrons incident on MgO and irradiated MgO for the impacting energy range, 0.2 ev through the conduction band (about 7.3 ev). It was found that electron trapping was so severe that the crystals would not thermally discharge at temperatures below 350°C. Consequently, the charged crystals were neutralized by a less satisfactory technique, high energy electron bombardment. δ_a was reproducible only at energies less than 4 ev. Sharp slope changes were observed at about 1.80 and 3.00 ev. These lines correspond to luminescence spectra obtained for catalytic recombination of N on MgO. Since slow electrons have been observed to interact predominantly with crystal defects, the data support the suggestion that defects can play a dominant role in catalytic reactions. (Contractor's abstract)

2676

Stanford Research Inst., Menlo Park, Calif.

LUMINESCENCE OF SOLIDS EXCITED BY ENERGETIC SPECIES FROM A GASEOUS DISCHARGE. I. LUMINESCENSE SPECTRA, by K. M. Sancier, W. J. Fredericks, and H. Wise. Aug. 1, 1961, 25p. incl. diagrs. tables, refs. (AFOSR-4013) (Also bound with its AFOSR-1514; AD 264453) (AF 49(638)353) Unclassified

Also published in Jour. Chem. Phys., v. 37: 854-860, Aug. 15, 1962. (Title varies)

The luminescence spectra of the lumophors CaO, CaO:Mn, CaO:Bi, MgO, and MgO:Sb excited by heterogeneous recombination of nitrogen atoms were studied. The photoexcitation and photoemission spectra of CaO:Mn are compared with those of atom excitation. The spectra produced by atom excitation are found to be strongly dependent upon lumophor temperature and exposure time to atoms, whereas photoluminescence is not affected by these parameters. The results of atom-excited luminescence are discussed in terms of surface-adsorbed nitrogen atoms in weakly and in strongly bound states whose populations are strongly temperature dependent and subject to surface poisoning. (Contractor's abstract)

2677

Stanford Research Inst., Menlo Park, Calif.

LUMINESCENCE OF SOLIDS EXCITED BY ENERGETIC SPECIES FROM A GASEOUS DISCHARGE. II. RECOMBINATION COEFFICIENTS, by K. M. Sancier, W. J. Fredericks, and H. Wise. Aug. 1, 1961, 17p. incl. diagrs. tables. (AFOSR-4014) (Also bound with its AFOSR-1514; AD 264453) (AF 49(638)353) Unclassified

Also published in Jour. Chem. Phys., v 37: 860-864, Aug. 15, 1962. (Title varies)

The nitrogen atom recombination coefficients of the lumophors CaO and CaO:Mn for release of luminescence and heat by the lumophor were evaluated from an analysis of the atom concentration profile, established in a cylinder of finite length into which the atoms diffuse because of the catalytic activities of the walls and the lumophor surfaces. The kinetics of the recombination leading to luminescence and heat are found to be first order. The values of the recombination coefficients determined for heat appear to be slightly larger than those for luminescence, but this difference is probably no greater than the precision of the measurements. The possibility that the difference arises from the presence of more than one active species in the gas is discussed. The value of the recombination coefficient of Pyrex glass for nitrogen atoms was determined and found to be in good agreement with published values. (Contractor's abstract)

2678

Stanford Research Inst., Menlo Park, Calif.

LUMINESCENCE OF SOLIDS EXCITED BY ENERGETIC SPECIES FROM A GASEOUS DISCHARGE. III. MEASUREMENT OF ABSOLUTE ENERGIES AS LUMINESCENCE AND HEAT, by K. M. Sancier, W. J. Fredericks, and H. Wise. [1961] [3]p. incl. diagr. table. (AFOSR-4015) (Also bound with its AFOSR-1514; AD 264453) (AF 49(638)353) Unclassified

Also published in Jour. Chem. Phys., v. 37: 865-867, Aug. 15, 1962. (Title varies)

The absolute energies of luminescence and heat produced by heterogeneous nitrogen atom recombination on CaO were measured by actinometry and calorimetry, respectively. The heat energy produced on MgO was also measured, and the luminescence energy was estimated from its luminescence intensity relative to CaO. The ratio of energy released as luminescence to that as heat is about 2×10^{-3} for CaO, and about 8×10^{-5} for MgO. The rate of heat production in CaO and MgO may be explained in terms of heterogeneous atom recombination.

2679

Stanford Research Inst., Menlo Park, Calif.

RECOMBINATION COEFFICIENTS OF CaO LUMOPHORS FOR NITROGEN ATOMS (Abstract), by K. M. Sancier, J. L. Hatchett and others. [1961] [1]p. [AF 49(638)353] Unclassified

Presented at meeting of the Amer. Phys. Soc., Monterey, Calif., Mar. 20-23, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 111, Mar. 20, 1961.

A lumophor such as CaO may be made to luminesce when nitrogen atoms recombine heterogeneously on its surface. Simultaneously some of the energy released in the recombination process appears as thermal energy of the solid. Experimentally, the quantity of heat released and the intensity of luminescence produced in the heterogeneous recombination were measured as a function of distance from the atom source, an electrodeless, rf discharge in dry nitrogen. From these measurements the recombination coefficients for heat and light production (γ^H, γ^L) were evaluated. For pure CaO the values of γ^H and γ^L were found to be different. Activation of CaO with manganese produced a second luminescence band at longer wave length with $\gamma CaO{:}Mn^L$ different from γCaO^L. These results suggest different mechanisms of recombination-energy transfer and conversion in the production of luminescence and heat.

2680

Stanford Research Inst., Menlo Park, Calif.

CHEMICAL REACTIONS IN THE LOWER AND UPPER ATMOSPHERE; PROCEEDINGS OF AN INTERNATIONAL SYMPOSIUM, San Francisco, Calif., Apr. 18-20, 1961, ed. by R. D. Cadle. New York, Interscience Publishers, 1961, 390p. incl. illus. diagrs. tables, refs. (AFOSR-2047) (Sponsored jointly by Advanced Research Projects Agency, Air Force Office of Scientific Research under [AF 49(638)955], Atomic Energy Commission, National Institutes of Health, and National Science Foundation) Unclassified

Each day of this symposium was devoted to one of the three aspects described below: Ionospheric research, Geochemistry of the troposphere and stratosphere, and Chemistry of contaminated atmospheres. The first includes the large number of chemical processes being studied by physicists and physical chemists with field measurements, laboratory measurements, and theoretical considerations. The second category includes the chemistry of the ozone region and of condensation and freezing nuclei. The last section includes the problems of city smog which, until about a decade ago, was ignored as an area of scientific investigation. Because of the fact that scientists working in one of the above fields may be totally ignorant of the progress in the other two, this symposium was created in order to open the lines of communication between researchers in these areas.

2681

Stanford Research Inst., Menlo Park, Calif.

MANUAL OF ON-SITE INSPECTION OF UNIDENTIFIED SEISMIC EVENTS, by R. M. Foose, S. Rubin and others. June 30, 1961, 188p. incl. illus. diagrs. tables, refs. [AF 49(638)955] AD 401858 Unclassified

The objective of a manual for on-site inspection operations is to provide a reference for actual field operations of an inspection or exploration of the site of an unidentified seismic event detected by a teleseismic network. It supplements and is a continuation of the Syllabus of On-Site Inspection which deals with an evaluation of specific methods of on-site inspection. This manual is intended to provide a starting point in the planning of field operations. Preparation of the Manual has been carried out in a manner similar to, and concurrent with, the preparation of the Syllabus of On-Site Inspection. Since its completion was critically dependent on having in hand the maximum available information for each of the inspection methods, a special meeting of the evaluation panel was convened after the Syllabus was completed to discuss the optimal plans for using those methods in an actual on-site inspection. It is anticipated that those who are interested in on-site inspection will use the Syllabus and the Manual together even though they have been prepared as separate publications.

2682

Stanford Research Inst., Menlo Park, Calif.

THE STRUCTURE AND ANALYSIS OF COMPLEX SYSTEM PROBLEMS, by K. H. Schaeffer and A. Shapero. May 1961, 25p. incl. diagrs. tables. (AFOSR-810) (AF 49(638)1020) AD 260063 Unclassified

Presented at Nineteenth Nat'l. meeting of the Operations Research Soc. of Amer., Chicago, Ill., May 25-26, 1961.

Many complex systems consist of too many different types of elements and are influenced by too many factors to lend themselves readily to conceptualization through mathematical models, without introducing unrealistic oversimplifications. To structure such systems realistically, an approach has been developed which begins with the classification of the elements affecting the system and the determination of the existence of certain

types of relations between these elements. The approach which is known as the System Analysis and Integration Model (SAIM) has been applied to the analysis of a number of system problems concerning weapon system development, including command and control. Other problem areas to which the method has been applied are the analysis of postattack recovery, political conflicts, and large-scale organizations. The paper concludes with a discussion of the function of this general approach in the development of formal models which realistically represent complex system problems. (Contractor's abstract)

2683

Stanford Research Inst. Poulter Labs. Menlo Park, Calif.

DISTURBANCES AT THE SURFACE OF BURNING SOLID PROPELLANTS, by G. A. Agoston. Apr. 24, 1961, 36p. incl. illus. diagrs. tables, refs. (Technical note no. 1) (AFOSR-915) (AF 49(638)565) AD 260407 Unclassified

A study was initiated of the changes in conditions near the surface of burning liquid ethyl nitrate following the impact of a weak plane shock wave (amplitude 0.5 psi) moving in a direction normal to the surface. The technique employed the schlieren photography of a plane probe wave introduced in a direction parallel to the burning surface. The preliminary data obtained suggest an influence on the flame structure by the normal wave between 109 and 230/μ sec following the impact. (Contractor's abstract)

2684

Stanford Research Inst. [Poulter Labs.] Menlo Park, Calif.

DISTURBANCES IN BURNING SOLID PROPELLANTS (Abstract), by G. A. Agoston. [1961] [1]p. [AF 49-(638)565] Unclassified

Presented at Third AFOSR Contractors' meeting on Combustion of Solid Propellants, Utah U., Salt Lake City, Jan. 30-31, 1961. (AFOSR-980)

Originally the objective of this research emphasized observations of the amplification or attenuation of shock waves (or pressure pulses) occurring within the zone of high temperature and concentration gradients close to a burning propellant surface. Recently a shift of emphasis has developed which allows a more direct approach to the experimental elucidation of the mechanisms of combustion instability. The new approach involves a study of (1) the over-all change of the pressure-time profile of an incident shock wave upon reflection from a burning surface and (2) local changes in conditions following the impact of a plane shock wave moving to a surface. From phase 1 it is possible not only to demonstrate amplification or attenuation but also to calculate the acoustic admittance of the burning propellant as a function of frequency. An analysis has been performed which indicates that the determination of the acoustic admittance is feasible even when appreciable random noise is superimposed upon the pressure-time profiles. Phase 2 has been pursued with the utilization of the schlieren photographic technique employed principally in the early stages of this program. The temperature profile can be estimated from the sonic velocity profile determined from the photographs and from values of the specific heat ratio applicable to the flame. From such experiments it has been hoped that detailed time-dependent temperature profiles would be obtained which in turn would yield time lag information peculiar to the characteristics of the incident normal shock wave and the combustion system.

2685

Stanford Research Inst. Poulter Labs., Menlo Park, Calif.

ACOUSTIC ADMITTANCE OF BURNING SOLID PROPELLANT SURFACE. Apr. 1-June 30, 1961, 18p. (Technical operating rept. no. 10) (AF 49(638)565) AD 609885 Unclassified

Progress is being made in perfecting the proposed single pulse method to a point where it can be employed to obtain the admittance-frequency curve for assorted materials (without combustion in this initial phase of the study). A spark is used to generate a weak shock wave which becomes planar in its travel down a long tube of rectangular cross section. At the end of the tube the wave meets the surface of the solid being tested and is reflected back up the tube. A transducer flush-mounted in the tube picks up the pressure-time profiles of the incident and reflected waves. This information in the form of photographs of the oscilloscope traces is used in the machine calculation of the complex acoustic admittance.

2686

Stanford Research Inst. [Poulter Labs.] Menlo Park, Calif.

THE STUDY OF THE ORIGIN AND PROPAGATION OF DISTURBANCES IN THE BURNING OF SOLID PROPELLANTS, by G. A. Agoston and G. M. Muller. Quarterly narrative progress rept. no. 11, July 1-Sept. 30, 1961. 4p. (AF 49(638)565) AD 609889 Unclassified

Work was devoted to the development of a recording system which will allow the reading of the (filtered) pressure signal at accurate time intervals of as little as 10 micro sec, to an accuracy of about 0.5 per cent of peak pressure.

2687

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. Quarterly narrative progress rept. no. 12, Oct. 1-Dec. 31, 1961, 8p. (AF 49(638)565) AD 609890 Unclassified

Progress in the following areas is summarized: instrumentation, amplitude effect, preparation of standard sample, measurements in a moving air stream, preparations for measurements on burning surfaces.

2688

Stanford Research Inst. Poulter Labs., Menlo Park, Calif.

ON THE POSSIBILITY OF DETECTING SHOCK-INDUCED SECOND-ORDER PHASE TRANSITIONS IN SOLIDS. THE EQUATION OF STATE OF INVAR, by D. R. Curran. [1961] [4] p. incl. illus. diagrs. table, refs. (AFOSR-2000) [AF 49(638)625] Unclassified

Also published in Jour. Appl. Phys., v. 32: 1811-1814, Oct. 1961.

First-order phase changes in shock-loaded solids have been previously detected from the formation of multiple wave structures in the solids. It is shown theoretically that a multiple-shock structure under shock loading also may be produced by a second-order phase transition. Accordingly, the possibility of detecting shock-induced demagnetization of ferromagnetic metals and alloys is discussed and an experimental attempt to detect such a demagnetization in shock-loaded Invar (64 Fe, 36 Ni) is reported. Extrapolation of data by Patrick suggests a Curie point transition in Invar in the neighborhood of 50 kbar. The Hugoniot equation of state of Invar has been obtained over a pressure range of 35 to 160 kbar. No double-shock structure was observed, but a decrease in compressibility observed in the neighborhood of 60 kbar is thought to be evidence of demagnetization. (Contractor's abstract)

2689

Stanford Research Inst. Poulter Labs., Menlo Park, Calif.

SHOCK WAVE STABILITY IN SOLIDS, by G. E. Duvall. [1961] [18]p. incl. illus. diagrs. table, refs. (AFOSR-3659) [AF 49(638)625] Unclassified

Also published in Les Ondes de Detonation; Proc. Coll. Internat'l. du Centre Nat'l. de la Recherche Sci. Gif-sur-Yvette (France) (Aug. 28-Sept. 2, 1961), Paris, Edit. du Centre Nat'l. de la Recherche Sci., No. 109: 337-352, 1962.

Extensive measurements of shock wave parameters in solids have been made in various laboratories and the results converted into information about stress-strain relations; this conversion is based on assumptions of shock wave stability. In this paper conditions for shock wave stability are derived dynamically and the adiabatic stress-strain relations are classified according to their curvatures. A distinction is made between complete shock stability and restricted stability, and procedures are described for constructing the form of the finite amplitude wave corresponding to any stress-strain curve which is time-independent. These are found to be made of compression shocks, rarefaction shocks, simple compression waves and simple rarefaction waves joined by simple continuity conditions. Illustrations are given and some experimental results are discussed in the light of these ideas. (Contractor's abstract)

2690

Stanford U. Applied Mathematics and Statistics Labs., Calif.

A VARIABLE THRESHOLD MODEL SIGNAL DETECTION, by R. C. Atkinson. Nov. 17, 1961, 24p. incl. illus. (Technical note no. 42) (AFOSR-1589) (AF 49-(638)1037) AD 267254 Unclassified

An analysis of some simple detection experiments in terms of Stimulus Sampling Theory is presented. The type of study to be considered is a choice experiment for which the experimenter has established, and explained to the subject, a one-to-one correspondence between the response set (A1, A2, ..., Ar) and the stimulus presentation set (S1, S2, ..., Sr). On each trial a stimulus is presented and the subject attempts to identify the stimulus by making the appropriate response (Contractor's abstract)

2691

Stanford U. Applied Mathematics and Statistics Labs., Calif.

AN ASYMPTOTIC EXPANSION FOR A CLASS OF MULTIVARIATE NORMAL INTEGRALS, by H. Ruben. May 2, 1961, 21p. incl. refs. (Technical rept. no. 69) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22552) AD 255657 Unclassified

Also published in Jour. Australian Math. Soc., v. 2: 253-264, 1961/62.

The author obtains the probability that n identically distributed normal variates which are equally correlated and have a zero means and unit standard deviations all exceed a given quantity $h > 0$. The result is given in terms of the product of the density of the joint distribution at the point $(h, \ldots, h)$ and an asymptotic series in h^{-1}, thus generalizing the usual asymptotic series of Mill's ratio. Upper bounds for the error resulting when a finite number of terms of the series are taken are also given. (Math. Rev. abstract)

2692

Stanford U. Applied Mathematics and Statistics Labs., Calif.

ASYMPTOTIC MULTIVARIATE OCCUPATION TIME DISTRIBUTIONS FOR SEMI-MARKOV PROCESSES, by R. G. Miller, Jr. May 15, 1961, 25p. (Technical rept. no. 70) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22552) AD 256670 Unclassified

Asymptotic bivariate normality is established for the cumulative occupation times of two states in a semi-Markov process with countable state space and also for the cumulative sums of functions defined on the occupation

times. The asymptotic moments are given explicitly for a general semi-Markov process with three possible states and a semi-Markov process with countable state space in which $F_{ij} = F_i$, i.e., F_{ij} independent of j. These results are applied to the zero and one states in a simple M/M/1 queue. (Contractor's abstract)

2693

Stanford U. Applied Mathematics and Statistics Labs., Calif.

STORAGE POLICY FOR INCOMPLETE RECORD-KEEPING, by H. Chernoff and G. Schwarz. July 2, 1961 [18]p. incl. diagrs. (Technical rept. no. 71) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22552) AD 261409 Unclassified

A depot is considered which stores and supplies a certain item. When a demand or request for this item is submitted, it is met by the depot. The transaction is recorded and the balance (the amount recorded to be in storage) is diminished by the amount supplied. However, it is possible that, by oversight, the transaction fails to be recorded. Because of possible failures to record transactions it may be that the stock is considerably less than the balance. In that case the stock is reordered but the inability to supply the demand leads to a loss whose average value c may be substantial. If the reorder point is low, the unfilled demand may prove costly. On the other hand, if it is high, there will be unnecessarily frequent inventories and reorderings which also lead to considerable cost. It is desirable to evaluate the expected cost per transaction and to see how it depends on the choice of the reorder point. This evaluation can then be applied to an optimal reorder point. The problem of finding an optimal reorder point is presented formally and the graphs which indicate approximations to the solution are described. Two distinct cases are treated in the derivations: the case where the demand is constant and the case where it is a random variable with known mean and variance.

2694

Stanford U. Applied Mathematics and Statistics Labs., Calif.

THE SELECTION OF AN OPTIMUM SAMPLING PARTITION, by A. F. Goodman. Aug. 3, 1961, 46p. incl. diagrs. refs. (Technical rept. no. 72) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22552) AD 261895 Unclassified

The statistical problem concerned with the selection of an optimum sampling partition to use with a specified statistical test is analyzed. The statistical test used is a Wald sequential probability ratio test. An asymptotic property of this test suggests a measure for the quality of a sampling partition upon which a definition of an optimum one is based. (Contractor's abstract)

2695

Stanford U. [Dept. of Aeronautical Engineering] Calif.

THE EFFECTS OF TEMPERATURE AND TIME ON AIRCRAFT AND MISSILE STRUCTURES, by N. J. Hoff. Jan. 1961, 88p. incl. illus. tables. (SUDAER no. 99) (AFOSR-646) (AF 49(638)223) AD 259372 Unclassified

A survey is made of the new problems introduced in the structural analysis of airplanes and missiles by the high temperatures caused by aerodynamic heating. Thermal stresses, thermal buckling, the effect of creep on stress distribution and stability, and ablation are discussed and special attention is paid to the behavior of the pure shells used in missiles. It is concluded that the modern structural analyst must acquire a knowledge of many disciplines that were of no interest to his predecessor working before World War II. Among these disciplines are thermodynamics, metallurgy, and the physics of the solid state. In all the new problems 2 parameters appear that did not enter classical structural analysis. The first is temperature which is the cause of all the difficulties of the modern structural designer and analyst. The second is time, because at high temperatures no structure can carry loads for indefinitely long periods. One of the most important tasks of the analyst of missiles is the determination of the lifetime of the structure. (Contractor's abstract)

2696

Stanford U. [Dept. of Aeronautical Engineering] Calif.

DEFORMATION OF HEATED SHELLS, by W. S. Hemp. Apr. 1961, 94p. incl. illus. (SUDAER no. 103) (AFOSR-770) (AF 49(638)223) AD 259373 Unclassified

Methods were investigated for the analysis of deformation and stresses induced by heating of thin shells. The general theory of thin shells is reviewed. The shell is defined in terms of its middle surface and thickness and its properties, both before and after deformation, are defined by metric and curvature tensors which satisfy the Gauss and Codazzi equations of surfaces. The state of strain is defined in terms of these quantities and equations are derived for membrane strains and curvature changes. This kinetic basis may be combined with either the principle of stationary free energy or with the equilibrium equations to form a complete theory of shells Extensional solutions which are found to be stress-free are first investigated and then departures from these solutions are considered. The special problem of buckling induced by compressive stresses in an edge effect is investigated, and an energy method of solution is given.

2697

Stanford U. [Dept. of Aeronautical Engineering] Calif.

THERMAL BUCKLING OF CENTRALLY HEATED CIRCULAR PLATES, by A. Queinec. June 1961, 29p. incl. illus. tables. (SUDAER no. 106) (AFOSR-989) (AF 49(638)223) AD 264493 Unclassified

The behavior of a centrally heated flat circular plate with axisymmetric temperature distribution and free edge conditions is investigated theoretically and checked experimentally. Thermal stresses occur when the temperature is not uniform and cause buckling if the temperature rise is sufficiently large. The buckling mode is axisymmetric. Large deflections are obtained for temperatures above the critical value. Theoretical calculations include solutions of the buckling problem as well as the post-buckling behavior of the plate. Attempts are made to introduce the effect of initial irregularities in the plate and to solve the large deflection problem. Experimental data give temperature distributions and deflected shapes. The results obtained from the theory are checked with a satisfactory degree of accuracy. (Contractor's abstract)

2698

Stanford U. [Dept. of Aeronautical Engineering] Calif.

DAMPING DUE TO CREEP IN A VIBRATING HELICAL SPRING, by R. C. Meiner. Aug. 1961, 15p. incl. illus. (SUDAER no. 113) (AFOSR-1421) (AF 49(638)223) AD 267858 Unclassified

The development of suitable and reliable equipment for measurements of static and vibratory properties of helical aluminum springs at high temperatures is described. The results of a test series of preliminary character and of a series under improved conditions are given in graphic representations. The orders of magnitude involved for series I and II are (approximate values) temperature, 350° and 560°F; and damping per cycle, 13 and 5%, respectively, at spring constants of 2 lb/in., loads up to 1.4 lb, creep rates of 0.001 to 0.1 in./sec, and frequencies of vibrations of 4 c. (Contractor's abstract)

2699

Stanford U. Dept. of Aeronautical Engineering, Calif.

BUCKLING OF THIN SHELLS, by N. J. Hoff. [1961] 86p. incl. illus. diagrs. tables, refs. (Rept. no. 114) (AFOSR-1422) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)223 and National Aeronautics and Space Administration) AD 264495 Unclassified

Also published in Proc. of Aerospace Scientific Symposium of Distinguished Lecturers in honor of Dr. Theodore von Kármán on his 80th anniversary, Washington, D. C. (May 11, 1961), New York, Inst. of Aerospace Sci., 1962, p. 1-86.

A historic review of the development of our ideas on buckling is presented. It continues with a report of work on the stability of thin shells now under way at Stanford U. The results obtained so far in this investigation can be presented under 3 headings: First, a new solution is found to the classical small-deflection equations of the stability of thin-walled circular cylindrical shells. The second part deals with the large displacements developing when the thin circular cylindrical shell suddenly snaps through into a polyhedral buckled shape often designated as the diamond shape. In the final part the transmission of the axial load through the fully buckled circular cylindrical shell is studied. (Contractor's abstract)

2700

Stanford U. [Dept. of Aeronautics and Astronautics] Calif.

SECOND-ORDER COMPRESSIBLE BOUNDARY LAYER THEORY WITH APPLICATION TO BLUNT BODIES IN HYPERSONIC FLOW, by M. Van Dyke. July 1961, 50p. incl. diagrs. refs. (SUDAER no. 112) (AFOSR-1270) (AF 49(638)965) AD 267859 Unclassified

Presented at ARS Internat'l. Hypersonic Conf., Cambridge, Mass., Aug. 16-18, 1961.

Also published in Prog. in Astronaut. and Rocketry, v. 7: 37-76, 1962.

Viscous hypersonic flow near the nose of a blunt body is considered on the basis of the Navier-Stokes equations. Conventional boundary-layer theory is embedded in a systematic expansion scheme. The general theory of the second approximation is developed. Seven second-order effects are identified: longitudinal curvature, transverse curvature, slip, temperature jump, entropy gradient, stagnation enthalpy gradient, and displacement. Their evaluation for a blunt body is outlined, and numerical results given for the stagnation region of a cooled sphere at infinite Mach number. In that example the increase in heat transfer due to entropy gradient is reduced one third by the other second-order effects. (Contractor's abstract)

2701

Stanford U. [Dept. of Aeronautics and Astronautics] Calif.

THEORY OF ENTROPY LAYERS AND NOSE BLUNTNESS IN HYPERSONIC FLOW, by J. K. Yakura. July 1961 77p. incl. diagrs. refs. (SUDAER no. 110) (AFOSR-1271) (AF 49(638)965) AD 264494 Unclassified

Presented at ARS Internat'l. Hypersonic Conf., Cambridge, Mass., Aug. 16-18, 1961.

Also published in Prog. in Astronaut. and Rocketry, v. 7: 421-470, 1962.

The method of inner and outer expansions was used in obtaining uniformly-valid solutions far downstream from the blunt nose of slender bodies in hypersonic flow. Application of this technique on the inverse problem, which prescribes the shock wave leaving the body to be determined, results in a unique treatment of the flow field. The influence of nose (shock) bluntness on the flow field and body shape is found to be significant due to the formation of a layer of low density, high entropy air enveloping the body. This entropy layer is in many respects analogous to Prandtl's viscous boundary layer. Analytical solutions, which assume an inviscid perfect gas and infinite Mach number were obtained for hyper-

bolic and power-law shock wave shapes. The hyperbolic shocks correspond to flows past blunted wedges and cones in 2 and 3 dimensions, respectively. The second-order results for these 2 cases yield a displacement thickness due to the entropy layer. The blunt body that produces a paraboloidal shock is found to grow as a small power of the distance. (Contractor's abstract)

2702

Stanford U. Dept. of Chemical Engineering, Calif.

AN X-RAY DIFFRACTION STUDY OF LIQUID STRUCTURE, by H. H. Paalman and C. J. Pings. Final rept. June 1961, 143p. incl. illus. diagrs. tables, refs. (AFOSR-811) (AF 49(638)469) AD 261731
Unclassified

A comprehensive program is presented for the study of liquid-state structure. Through the application of x-ray diffraction techniques, the pair distribution function may be obtained for a given state of a liquid system. This information is basic to the theoretical treatment of liquids by statistical mechanical methods. Experimental apparatus was fabricated for carrying on diffraction experiments over an extensive range of pressure and temperature. A cylindrical beryllium cell, capable of withstanding several hundred psi, was used. The components were designed for the study of condensed low atomic weight elements at cryogenic temperatures. Control systems maintained the desired pressure and temperature within 0.5 psi and 0.2°C, respectively. The theory for the interpretation of liquid diffraction data was critically reviewed. A synthesis of the important recent developments is presented in a general analytical scheme. Liquid nitrogen was studied at 100 psia and -193.5°C. The results compared favorably with earlier work reported in the literature. (Contractor's abstract)

2703

[Stanford U. Dept. of Chemistry, Calif.]

HEAT OF ISOMERIZATION OF PEROXYNITRITE TO NITRATE AND KINETICS OF ISOMERIZATION OF PEROXYNITROUS ACID TO NITRIC ACID, by J. D. Ray. [1959] [4]p. incl. diagr. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)286 and National Science Foundation) Unclassified

Published in Jour. Inorg. and Nuclear Chem., v. 24: 1159-1162, Dec. 1962.

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 it was possible to determine the rate constant for isomerization to be 0.099 sec^{-1} at 1°. The heat of isomerization of the peroxynitrite ion to the nitrate ion was deduced to be -38.8 ± 2 kcal/mol in dilute aqueous solution at 1°.

2704

Stanford U. Dept. of Chemistry, Calif.

KINETICS OF THE THERMAL DECOMPOSITION OF NITRIC ACID VAPOR. IV. A SHOCK TUBE STUDY BETWEEN 800-1200°K, by H. Harrison, H. S. Johnston, and E. R. Hardwick. [1961] [5]p. incl. diagrs. tables, refs. (AF 49(638)306) Unclassified

Published in Jour. Amer. Chem. Soc., v. 84: 2478-2482, July 5, 1962.

The decomposition of nitric acid vapor in excess argon was studied in a shock tube between 800 and 1200°K. The reaction was followed in terms of the appearance of nitrogen dioxide and of the appearance and disappearance of the intermediate, NO_3. At total concentrations near 10^{-5} mol/cc the decomposition is controlled by the unimolecular reaction $M + HNO_3 \xrightarrow{a} HO + NO_2 + M$ near its second order limit, with

$$\log a = (15.2 \pm 1.0) - \frac{30.6 \pm 1.8}{2.303\,R} \cdot \frac{1000}{T} \text{ (mol/cc)}^{-1}\ \text{sec}^{-1}.$$

The presence in this system of NO_3 and its rate of disappearance are consistent with previous work on the decomposition kinetics of nitric acid and nitrogen pentoxide. (Contractor's abstract)

2705

Stanford U. [Dept. of Chemistry] Calif.

ELECTRON SPIN RESONANCE OF ALKYLATED BENZENE ANIONS, by E. Pier and T. R. Tuttle, Jr. July 1961, 14p. incl. illus. tables, refs. (Technical note no. 482-5) (AFOSR-428, (AF 49(638)482) AD 262847
Unclassified

Electron spin resonance absorption spectra are recorded and partially analyzed for potassium toluenide, ethylbenzenide and isopropylbenzenide. The effect of methyl group substitution on spin distribution in the aromatic ring is shown to be small but measurable. A correlation between electronic structure and reactivity is pointed out. The relationship between spin and charge distribution is discussed. (Contractor's abstract)

2706

Stanford U. Dept. of Materials Science, Calif.

SOME ASPECTS OF DEFORMATION IN SINGLE CRYSTALS AND BICRYSTALS OF ALUMINUM AT ELEVATED TEMPERATURES, by R. H. Bush, A. N. Lord and others. Final rept. June 1961, 141p. incl. illus. diagrs. tables, refs. (AFOSR-1073) (AF 18(603)-66) AD 262462 Unclassified

A study was made to evaluate the kinematics of grain boundary shear and to compare the results pertaining to crystallographic deformation with those reported in the literature. Melt-grown single crystals and bicrystals of high purity Al were tested in tension at extension rates

of 8.20×10^{-6} to 10^{-4} cm/sec (strain rates of approximately 2.3 to 230%/hr) and at temperatures of 538 to 650°C. The bicrystal samples contained pure, symmetrical tilt or twist boundaries of 10, 32, 40, 88, and 90°. Continuous stress and total extension and intermittent shear displacement data were obtained as a function of time. A yield point phenomenon which is caused by a small amount of pre-test deformation was observed for single crystals and to a reduced extent for bicrystals. Its presence is explained by a model based upon dislocation multiplication and the stress dependent velocity of dislocations. A yield stress for grain boundary shear which is associated with a thermally activated process was also observed.

2707

Stanford U. [Dept. of Mechanical Engineering] Calif.

THEORETICAL AND EXPERIMENTAL INVESTIGATION OF FLOW OVER SINGLE AND DOUBLE BACKWARD FACING STEPS, by D. E. Abbott and S. J. Kline. June 1961, 106p. incl. illus. tables, refs. (Rept. no. MD-5) (AFOSR-890) (AF 49(638)201) AD 262145
Unclassified

A semi-empirical analysis is developed for the over-all flow pattern of subsonic turbulent flow over backward facing steps. Good agreement is found between theory and experiment for the prediction of 2-dimensional reattachment length for small values of step height to throat width ratio; an asymptotic solution for large values of step height is also given and discussed. Mean velocity profiles calculated by the present analysis are shown; they require an empirical fit at one point. Good agreement with experiment is found in the region near the step face, but agreement is poor near the reattachment region. Experimental results are represented for flow patterns over backward facing steps covering a wide range of geometric variables. Velocity profile measurements are given for both single and double steps. The stall region is shown to consist of a complex pattern involving 3 distinct regions. The double step contains an asymmetry for large expansions, but approaches the single-step configuration with symmetric stall regions for small values of area ratio. No effect on flow pattern or reattachment length is found for a wide range of Reynolds numbers and turbulence intensities, provided the flow is fully turbulent before the step.

2708

Stanford U. [Dept. of Mechanical Engineering] Calif.

A VISUAL STUDY OF THE FLOW MODEL IN THE LATER STAGES OF LAMINAR-TURBULENT TRANSITION ON A FLAT PLATE, by K. A. Meyer and S. J. Kline. Dec. 1961, 68p. incl. illus. table, refs. (Rept. no. MD-7) (AFOSR-1875) (AF 49(638)201) AD 271175
Unclassified

A number of aspects of transition from laminar to turbulent flow were investigated on a flat plate with free stream water velocities between .75 ft/sec and 1.2 ft/sec. The study was primarily visual, using dye techniques, although some measurements were made using a hot film anemometer. Also investigated were the later stages of natural transition. Dye patterns associated with the chain of events leading from laminar to turbulent flow in natural transition were analyzed. (Contractor's abstract)

2709

Stanford U. Dept. of Physics, Calif.

EXCHANGE-ORDERING AND OBSERVATION OF FORBIDDEN SPIN RESONANCE TRANSITIONS IN CRYSTALLINE ORGANIC RADICALS, by R. S. Rhodes, J. H. Burgess, and A. S. Edelstein. [1961] [2]p. incl. diagrs. refs. (Technical note no. 10) (AFOSR-34) [AF 18(603)-131] AD 256310
Unclassified

Also published in Phys. Rev. Ltrs., v. 6: 462-463, May 1, 1961.

In examining the ESR (electron spin resonance) spectrum of polycrystalline samples of the organic free radicals picryl-n-amino carbazyl (PAC), 1-3-bisdiphenylene-2-phenyl allyl (BDPA), and Wurster's blue perchlorate (WB) at low temperatures and low frequencies, a resonance was observed at g = 4. This line may have arisen from a forbidden transition made possible by the dipolar interaction between spins. In the frequency range from 20 mc to 200 mc the g-value is 4 to within 3% independent of temperature. At fixed temperature the ratio of the peak intensity of the g = 4 resonance absorption to that of the g = 2 absorption decreases with the increasing frequency. At fixed frequency the intensity ratio decreases with increasing temperature and vanishes above a temperature T characteristic of the particular free radical. The intensity ratio decreases with increasing values of the radio-frequency power. The width of the g = 4 resonance appears to be essentially independent of temperature and is of the same order of magnitude as that of the g = 2 resonance. In some cases there is evidence for a g = 6 resonance in the form of a weak bump on the low field side of the g = 4 resonance.

2710

Stanford U. Dept. of Physics, Calif.

STEADY STATE NUCLEAR POLARIZATION VIA ELECTRONIC TRANSITIONS, by R. H. Webb. Jan. 1961, 49p. incl. diagr. refs. (Technical note no. 11) (AFOSR-157) (AF 18(603)131) AD 251923
Unclassified

Also published in Amer. Jour. Phys., v. 29: 428-444, July 1961.

Nuclear polarization schemes are surveyed. Special attention is given to those involving saturation of either the direct electronic transitions (Overhauser and Underhauser effects) or the weakly forbidden electron-nuclear cross transitions (Jeffries and Solid effects). Rate equations are used to find the power dependence of these effects. The physical systems allowing each of the effects are considered in terms of the various types of electron-nuclear coupling. (Contractor's abstract)

2711

Stanford U. Dept. of Physics, Calif.

DYNAMIC POLARIZATION ANOMALIES IN ORGANIC FREE RADICALS, by R. H. Webb. [1961] [9]p. incl. diagrs. (Technical note no. 12) (AFOSR-725) [AF 18-(603)131] AD 261506 Unclassified

Also published in Phys. Rev. Ltrs., v. 6: 611-613, June 1961.

As a part of a broader study of exchange effects in various paramagnetic substances, an organic free radical in which the Overhauser effect gives way to a Solid effect at low temperature has been found, and1 in which the 2 effects are present simultaneously. The Overhauser effect is produced by saturation of the electronic transition (ESR) in a system in which the nuclei are coupled to the electrons by a hyperfine interaction. The Solid effect, on the other hand, depends on dipole-dipole coupling between the electrons and nuclei in a solid and requires the saturation of the forbidden transition at $\nu = (|\gamma_e \pm \gamma_n)H_0$, where ν is the microwave frequency and γ_e and γ_n are the electronic and nuclear gyromagnetic ratios. The Overhauser effect is relatively well known in the organic free radical diphenylpicryl hydrazyl (DPPH). Picryl amino carbazyl (PAC) resembles DPPH and Wursters' Blue perchlorate (WB) in its electron spectrum at room temperature. It has one of the larger g-factor anisotropies among the organic free radicals. It exhibits both Solid and Overhauser effects at 300°K and 77°K, with a pure Solid effect at 4.2°K and below. PAC and WB differ from DPPH in the temperature dependence of their susceptibilities. They also are known to show g = 4 satellite lines below a characteristic temperature T* which is higher in WB. The transition between the 2 types of dynamic polarization which is observed comes above T* in PAC below it in WB. However, the existence of the g = 4 lines is apparently due to the presence of dipolar coupling, which is in turn related to the decrease in susceptibility and its consequent effective magnetic dilution. It is this effective magnetic dilution which is suggested as providing for the nuclear-electron dipolar coupling which gives rise to the Solid effect.

2712

Stanford U. [Dept. of Physics] Calif.

PROTON RESONANCE SHIFTS AND ELECTRON SUSCEPTIBILITIES IN 1,3-BISDIPHENYLENE 2-PHENYL ALLYL, by M. E. Anderson, R. S. Rhodes, and G. E. Pake. [1961] [6]p. incl. diagr. (Technical note no. 13) (AFOSR-929) [AF 18(603)131] AD 261506 Unclassified

Also published in Jour. Chem. Phys., v. 35: 1527-1528, Oct. 1961.

The proton resonance shifts in polycrystalline samples of the organic free radical, 1,3-bisdiphenylene 2-phenyl allyl (BDPA) have been measured and both the hyperfine constant and the temperature dependence of the electron susceptibility have been obtained. In the liquid helium temperature range 2 components are observed. At a fixed frequency of 22.8 mc/sec the more intense component occurs at a field $H_0 = \frac{\omega_0}{\gamma_p}$, the proton Larmor field. The other component is shifted upfield and occurs at $H = H_0 + \Delta H$. The sign of the hyperfine constant, A, for these shifted protons is negative. Integration of the derivative spectrum and resolution into components gives a ratio of 68:32 for the intensities of the unshifted components. From ESR in BDPA in liquid solution a 9 line spectrum with relative intensities characteristic of a splitting by 8 equivalent unidentified protons is reported. If these protons are tentatively identified with the shifted component of the proton spectrum, the intensity of this component is expected to be 8/(21 + 6) of the total intensity. The intensity ratio of unshifted components would then be 19/27 : 8/27 = 70:30. In order to obtain the magnitude of A, one needs to know the temperature dependence of the electron susceptibility. A is obtained as equal to 3.7 ± 0.5 mc/sec or 1.3 ± 0.3 oe. It is seen that the hyperfine constants of liquids and solids do not differ greatly. At room temperature the proton-proton dipole interaction appears to be the main source of line broadening. As exchange ordering sets in, the rate of electron spin fluctuation decreases and the hyperfine contribution to the width becomes more important. The shape of the shifted component is approximately Lorentzian, suggesting that the hyperfine contribution is dominant. For temperatures down to 1.4°K the unshifted component does not change appreciably in width nor deviate from a short-tailed lineshape.

2713

Stanford U. Dept. of Physics, Calif.

ANTIFERROMAGNETIC TO FERROMAGNETIC TRANSITIONS IN ORGANIC FREE RADICALS, by A. S. Edelstein and M. Mandel. July 1961, 5p. incl. diagrs. table. (Technical note no. 15) (AFOSR-1076) (AF 18-(603)131) AD 261506 Unclassified

Also published in Jour. Chem. Phys., v. 35: 1130-1131, Sept. 1961.

The dependence of the magnetic susceptibility on temperature for picrylaminocarbazyl and Wurster's blue perchlorate was determined at -100° to 300°K and 1-4°K. The manner in which the reciprocal of the relative magnetic susceptibility varied from a linear dependence upon temperature was in keeping with antiferromagnetic behavior at high temperatures and ferromagnetic behavior at low temperature.

2714

Stanford U. Dept. of Physics, Calif.

THERMODYNAMIC PROPERTIES OF FINITE CHAINS OF EXCHANGE-COUPLED ATOMS, by R. B. Griffiths. Dec. 1961 [39]p. incl. diagrs. tables, refs. (Technical note no. 17) (AFOSR-1934) (AF 18(603)131) Unclassified

The energy, entropy, specific heat, and susceptibility (all in the limit of zero external magnetic field) are

computed for finite chains (actually closed "rings") of spin 1/2 atoms coupled by an isotropic exchange interaction between nearest neighbors. The calculations are carried out for chains containing 2, 3, 4, ..., 10 atoms, and for both ferro- and antiferromagnetic coupling. The convergence as the number of atoms (N) in the chain increases suggests that the thermodynamic quantities obtained for a 9 or 10 spin chain provide a fairly good approximation to the same quantities in the limiting case of an infinite chain, at temperatures above $|J|/k$ (J = exchange integral), and in some cases even for slightly lower temperatures. Also, it is found that at any fixed temperature, the energy, Helmholtz free energy, and susceptibility as a function of N are monotone increasing (ferromagnetic case) or monotone increasing for N even and monotone decreasing for N odd (antiferromagnetic case). A similar monotone behavior is found for the antiferromagnetic entropy and specific heat (the latter only for N odd). Numerical values for energy, entropy, specific heat, and susceptibility are given for N = 9, 10. Finite chains with Ising interaction are also briefly discussed, and the thermodynamic quantities are shown to exhibit several of the monotonicity properties found for the isotropic interaction. (Contractor's abstract)

2715

Stanford U. Dept. of Physics, Calif.

THEORY OF MAGNETIC EXCHANGE-LATTICE RELAXATION IN TWO ORGANIC FREE RADICALS, by R. B. Griffiths. July 1961 [8]p. incl. diagr. tables, refs. (Technical note no. 16) (AFOSR-1971) (AF 18(603)131) Unclassified

Also published in Phys. Rev., v. 124: 1023-1030, Nov. 15, 1961.

A calculation of the spin-lattice relaxation rate is made for conditions appropriate to certain organic free radicals with exchange-narrowed paramagnetic resonance lines, at temperatures well above the Néel temperature. The relaxation is supposed to be a 2-step process: 1. Energy is transferred from the "Zeeman" system to the "exchange" system by spin-spin relaxation. 2. The energy is then transferred from the "exchange" system to the lattice. It is the rate of energy transfer in the latter process which is here computed, assuming that the exchange-lattice coupling is due to (a) the variation of exchange energy when the distance between 2 adjacent spins is changed or (b) the corresponding variation of magnetic dipolar energy. The calculation shows that in the case of diphenyl picryl hydrazyl (DPPH) and bisdiphenylene phenyl allyl (BDPA) the exchange-lattice relaxation rate above liquid nitrogen temperatures is rapid enough (under the usual experimental conditions) to make the experimental spin-"lattice" relaxation time equal to the Zeeman-exchange relaxation time and hence temperature independent, as experimentally observed. (Contractor's abstract)

2716

Stanford U. Dept. of Physics, Calif.

MAGNETIC SUSCEPTIBILITIES AND EXCHANGE EFFECTS IN FOUR ORGANIC FREE RADICALS, by J. H. Burgess, R. S. Rhodes and others. [1961] [2]p. incl. table. (AFOSR-25?9) (AF 18(603)131) Unclassified

Presented at Seventh Conf. on Magnetism and Magnetic Materials, Phoenix, Ariz., Nov. 13-16, 1961.

Also published in Jour. Appl. Phys., Suppl., v. 33: 1352-1353, Mar. 1962.

Studies of EPR intensity and linewidth in 4 free radicals at temperatures between 300° and 1.5°K have shown the presence of antiferromagnetic exchange coupling. In 2 cases a low-temperature paramagnetism occurs following a Curie-Weiss law with positive Weiss constant. A model involving isolated spins in a magnetically dilute system is proposed to explain these results. (Contractor's abstract)

2717

Stanford U. Dept. of Physics, Calif.

MODIFIED CW TECHNIQUE FOR SPIN-LATTICE RELAXATION TIME MEASUREMENTS, by M. Mandel. [1961] [2]p. incl. diagrs. (AFOSR-2772) [AF 18(603)-131] Unclassified

Also published in Rev. Scient. Instr., v. 33: 247-248, Feb. 1962.

A modulated continuous wave (CW) method is described in which the microwave power remains on for more than ample time for the electrons to reach equilibrium with the microwaves. This characteristic time, obtained by solving the rate equations for a spin 1/2 system is given by $T_1/(1 + {}^2H_1{}^2T_1T_2)$. An X-band bridge spectrometer is used. The technique has been used to measure the relaxation time of pol. crystalline α,α-diphenyl β-picryl hydrazyl (DPPH) and α,γ-bisdiphenylene β-phenyl allyl (BDPA). At 300 and 77°K, both the usual and the modulated CW methods gave the same results; $T_1 \sim 5 \times 10^{-8}$ sec for DPPH and $\sim 1 \times 10^{-7}$ sec for BDPA. Previous microwave measurements on DPPH and BDPA at 1.5°K, using both CW and high power pulse techniques, had given values of T_1 around 10^{-6} sec. The modulated method gives $T_1 \sim 10^{-8}$ sec.

2718

Stanford U. [Dept. of Physics, Calif.]

LATTICE HEATING EFFECTS IN SPIN-LATTICE RELAXATION TIME MEASUREMENTS (Abstract), by M. Mandel, G. E. Pake, and J. P. Goldsborough. [1961] [1]p. [AF 18(603)131] Unclassified

Presented at meeting of the Amer. Phys. Soc., Monterey, Calif., Mar. 20-23, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 141, Mar. 20, 1961.

In the measurement of paramagnetic relaxation times by CW methods at liquid helium temperatures, one is often faced with the problem of lattice heating. A modulated CW method is developed to study this effect. The microwave power remains on for a time long compared to that necessary to saturate the electrons, but the duty cycle is such that the average power is not sufficient to appreciably heat the lattice. This method is particularly appropriate in cases of short T_1 for which high rf power is required for saturation. This technique has been applied to measure the realxation time of DPPH. At 300°K, both the usual CW and the modulated CW methods give the same result, $T_1 \sim 5 \times 10^{-8}$ sec. However, at 1.5°K, where the lattice specific heat is very small, CW saturation and the recovery time of Mz from a high power pulse give a T_1 of $\sim 10^{-6}$ sec, while the modulated CW method gives $T_1 \sim 10^{-8}$ sec. Similar decreases in apparent T_1 of $Cu(SO_4) \cdot 5H_2O$ on reducing the average power are also observed.

2719

Stanford U. [Dept. of Physics, Calif.]

OBSERVATION OF ELECTRON SPIN RESONANCE AT g = 4 IN CRYSTALLINE ORGANIC RADICALS (Abstract), by J. H. Burgess and R. S. Rhodes. [1961] [1]p. [AF 18(603)131] Unclassified

Presented at meeting of the Amer. Phys. Soc., Monterey, Calif., Mar. 20-23, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 151, Mar. 20, 1961.

A transition is observed at g = 4 at low temperatures and low frequencies in the ESR spectrum of each of the free radicals picryl-n-amino-carbazyl, 1,3-bisdiphenylene-2-phenyl allyl and Wurster's blue. In a frequency range from 20-200 mc/sec the g value is 4 within 3% and is independent of temperature. However, at a fixed frequency the intensity of the absorption decreases at higher temperatures and vanishes above a temperature T* characteristic of the particular free radical. Because of antiferromagnetic exchange coupling, the static susceptibility of the free radicals exhibits a max as a function of temperature. In all cases T* falls below the temperature of this max indicating that "exchange motion" is effective in averaging out the interactions responsible for the g = 4 transition. At fixed temperature the resonance decreases in intensity of higher frequencies and has not been observed above 200 mc/sec. In all cases, there is an indication of an unresolved resonance at g = 6. Since the dipolar interaction between electron spins is of the order of 200 mc/sec these resonances may be related to the satellite lines discussed by Van Vleck (see Phys. Rev., v. 74: 1168, 1948).

2720

Stanford U. Dept. of Physics, Calif.

PERIPHERAL CONTRIBUTIONS TO HIGH-ENERGY INTERACTION PROCESSES, by S. D. Drell. Feb. 1961, 37p. incl. diagrs. refs. (Technical note no. 35) (AFOSR-427) (AF 49(638)388) AD 256885 Unclassified

Presented at Conf. on Strong Interactions, Berkeley, Calif., Dec. 27-29, 1960.

Also published in Rev. Modern Phys., v. 33: 458-466, July 1961.

Interaction processes at high energies and low momentum transfers are analyzed and reviewed in terms of the peripheral collision approximation. Experimental results are analyzed, new experiments are proposed, and practical consequences of some of the results for high-energy accelerators are discussed.

2721

Stanford U. Dept. of Physics, Calif.

MAGNETIC DISPERSION CORRECTIONS TO ELASTIC ELECTRON SCATTERING, by A. Goldberg. Mar. 1961 [24]p. incl. tables, refs. (Technical note no. 33) (AFOSR-662) (AF 49(638)388) AD 451538 Unclassified

Also published in Nuovo Cimento, Series X, v. 20: 1191-1204, June 16, 1961.

The scattering of high energy electrons by He^4 may be used as a test of quantum electrodynamics if the approximate calculation of the cross section, i.e., Born approximation, is correct. This is examined by evaluating the next order approximation in which the He^4 nucleus is virtually excited for a short time during the scattering. This next approximation is found to contribute a 5% correction to the cross section, which is within the limit of experimental accuracy. (Contractor's abstract)

2722

Stanford U. Dept. of Physics, Calif.

TRANSFER OF HELICITY IN RADIATION AND ABSORPTION OF HIGH-ENERGY PHOTONS, by R. H. Pratt. Mar. 1961 [13]p. incl. refs. (Technical note no. 37) (AFOSR-663) (AF 49(638)388) AD 258208 Unclassified

Also published in Phys Rev., v. 123: 1508-1510, Aug. 15, 1961.

Nearly complete transfer of momentum between a high-energy electron (or positron) and a photon in a Coulomb field implies that helicity is also transferred. This is not a consequence of conservation of total angular momentum but, rather, of spin angular momentum, and follows from a demonstration that it is possible to use free-particle spinors (though not free wave functions) for the high-energy particles. Polarization correlations of the lower-energy particle in such a process are discussed. Applications are made to bremsstrahlung, pair production, photo-effect, and one-photon pair annihilation. (Contractor's abstract)

2723

Stanford U. Dept. of Physics, Calif.

ANALYTIC PROPERTIES AND RESCATTERING CORRECTION TO THE BORN APPROXIMATION FOR TRANSITION MATRIX ELEMENTS, by B. Bosco. Mar. 1961 [23]p. incl. diagr. refs. (Technical note no. 38) (AFOSR-664) (AF 49(638)388) AD 258209 Unclassified

Also published in Phys. Rev., v. 123: 1072-1076, Aug. 1, 1961.

The analytic properties of a matrix element of a general operator between a bound state and a scattering state are studied in the framework of Schrödinger theory. It is shown that the singularities of such a matrix element are easily inferred from those of the Born approximation. Using the fact that the possible singularities which are not contained in the Born approximation are located far apart from those included in the lowest approximation, a simple formula is derived which allows one to obtain the rescattering correction to the Born approximation using explicitly the phase shifts. (Contractor's abstract)

2724

Stanford U. Dept. of Physics, Calif.

THE GROUND STATE OF SOLID He^3, by E. M. Saunders. May 1961, 58p. incl. diagrs. refs. (Technical note no. 39) (AFOSR-783) (AF 49(638)388) AD 258210 Unclassified

Also published in Phys. Rev., v. 126: 1725-1736, June 1, 1962.

A ground-state wave function for solid He^3 in the body centered cubic phase is calculated in the form of a product of single-particle orbitals and pair correlations. The correlation part is an eigenfunction of the Pluvinage Hamiltonian with each pair in a state of zero energy in a frame in which their center of mass is at rest. Assuming that exchange effects are small, an approximate single-particle probability function from this wave function is obtained. The many-body energy is obtained from this single-particle probability function from basic principles by a plausibility argument, and leads to a pressure-volume relation that is in good agreement with observation. Exchange effects arise from the original wave function, when suitably antisymmetrized. This predicts an exchange energy of about 0.005 °K near the melting curve. This exchange energy favors antiferromagnetic alignment. (Contractor's abstract)

2725

Stanford U. Dept. of Physics, Calif.

ROTATIONAL SPECTRA IN THE NUCLEAR SHELL MODEL, by R. S. Willey. May 1961, 28p. incl. refs. (Technical note no. 40) (AFOSR-832) (AF 49(638)388) AD 260929 Unclassified

The relation between 2 different models used to explain the properties of complex nuclei at low energies is treated. One is the nuclear shell model which starts from the picture of nucleons moving independently of each other in a central potential which represents the average effect of all the interactions between the different nucleons. The second is the collective rotational model which pictures the nucleus as a rigid body deformed from spherical shape. The free rotation of this rigid body leads to rotational spectra $E = \text{constant} + L(L+1)/2I$. The problem is solved of how to introduce an extra (residual) interaction between particles into the shell model Hamiltonian to obtain rotational spectra within the framework of a shell model calculation. (Contractor's abstract)

2726

Stanford U. Dept. of Physics, Calif.

COHERENT PHOTOPRODUCTION OF π^0 FROM DEUTERIUM, by F. T. Hadjioannou. [1961] [8]p. incl. diagrs. table. (AFOSR-919) [AF 49(638)388] Unclassified

Also published in Phys. Rev., v. 125: 1414-1421, Feb. 15, 1962.

The calculation of elastic photoproduction of π^0 from deuterium, $\gamma + d \rightarrow \pi^0 + d$, is carried out in the impulse approximation at photon energies around 500 mev. The single nucleon photoproduction amplitudes are taken from dispersion formulas and are corrected for kinematic effects due to internal momentum of the nucleons in the deuteron. The D-state part of the deuteron wave function is included and different models are used with Yukawa type or repulsive core wave functions. Formulas connecting the cross section with the dueteron form factors are given. For small momentum transfers the formulas are model independent and reduce to the usual ones. The presence of a 7% D state in a repulsive-core model leads to a cross section which falls typically more slowly at high momentum transfers, e.g., at a momentum transfer 2.74 f^{-1}, the cross section is larger by about 40% than the cross section calculated in the absence of the D state. The experimental points favor this model. (Contractor's abstract)

2727

Stanford U. Dept. of Physics, Calif.

THEORETICAL CONSIDERATIONS CONCERNING QUANTIZED MAGNETIC FLUX IN SUPERCONDUCTING CYLINDERS, by N. Byers and C. N. Yang. June 1961, [12]p. incl. diagrs. (Technical note no. 41) (AFOSR-920) (AF 49(638)388) AD 260931 Unclassified

Also published in Phys. Rev. Ltrs., v. 7: 46-49, July 15, 1961.

A brief theoretical discussion of the observed quantization is given. Quantization in units of $hc/2e$, instead of hc/e as originally predicted by London, is attributed to the pairing of superconducting electrons.

2728

Stanford U. Dept. of Physics, Calif.

QUASI-ELASTIC PEAK IN HIGH ENERGY NUCLEON-NUCLEON SCATTERING, by S. D. Drell and K. Hida. Aug. 1961 [16]p. incl. diagrs. refs. (Technical note no. 43) (AFOSR-1218) (AF 49(638)368) AD 262850 Unclassified

Also published in Phys. Rev. Ltrs., v. 7: 199-202, Sept. 1, 1961.

In the scattering of very high-energy protons from the nucleons within target nuclei, it is found that the scattered protons have a distribution of energies. These experiments, performed at CERN, show a sharp peak in the energy distribution which corresponds to elastic scattering of the incident protons, and also a broader peak at somewhat lower energy which corresponds to nearly elastic scattering of the incident protons. An explanation of this latter quasi-elastic peak is offered in terms of the diffraction scattering of one of the pions in the cloud of the target nucleon. This diffraction scattering of the pion by the incident nucleon results in a moderate energy loss of the nucleon, so that it emerges in the quasi-elastic peak.

2729

Stanford U. Dept. of Physics, Calif.

THE EFFECT OF THE 3π RESONANCE ON THE 2π RESONANCE, by R. Blankenbecler. Aug. 1961 [27]p. incl. diagrs. refs. (Technical note no. 45) (AFOSR-1385) (AF 49(638)388) AD 264805 Unclassified

Also published in Phys. Rev., v. 125: 755-760, Jan. 15, 1962.

It is shown that the 4π intermediate state in π-π scattering plays an important role in determining the position and perhaps even the existence of the π-π resonance. This large effect occurs by virtue of the 3π resonance. Quantitative estimates are given. The effect of this result on the nucleon form factors is briefly discussed and a simple model for these functions is proposed. The possibility of higher energy pion resonances is also considered.

2730

Stanford U. Dept. of Physics, Calif.

PARTICLE THEORY APPROACH TO THE TWO-PION AND THREE-PION SYSTEMS, by L. I. Schiff. Aug. 1961, 21p. incl. diagrs. refs. (Technical note no. 46) (AFOSR-1398) (AF 49(638)388) AD 264806 Unclassified

Also published in Phys. Rev., v. 125: 777-781, Jan. 15, 1962.

The relation between the 2-pion and 3-pion resonances is discussed in terms of a model in which the motion of the pions is described by a partially relativistic Schrödinger-type wave equation, and the interaction between them is represented by a static potential. An attractive square-well potential that is almost strong enough to bind the di-pion gives a satisfactory account of the observed P-wave pion-pion scattering. If this potential is assumed to be additive between all pairs in the 3-pion $I = 0$, $J = 1^-$ state, it produces far too much binding to agree with observation. As an alternative to additivity, the interaction may be assumed to saturate, so that the total potential never exceeds that between any pair of pions. It is found that the model provides a qualitatively consistent explanation both of pion-pion scattering and the 3-pion system if the pair interactions saturate or nearly saturate. (Contractor's abstract)

2731

Stanford U. Dept. of Physics, Calif.

EXTRAPOLATION TO CUTS AND THE SCATTERING OF ELECTRONS AND POSITRONS, by S. D. Drell and R. H. Pratt. Aug. 1961, 21p. incl. diagrs. tables, refs. (Technical note no. 42) (AFOSR-1408) (AF 49(638)388) AD 264804 Unclassified

Also published in Phys. Rev., v. 125: 1394-1399, Feb. 15, 1962.

The low momentum transfer region of strong interaction processes may be discussed in terms of 1-pion-exchange graphs. This success of extrapolation to poles suggests, as an extension, extrapolation to cuts corresponding to low mass intermediate states containing two or more particles. It is found that this extrapolation may be performed in the case of electromagnetic interactions, owing to the vanishing photon mass. For small-angle scattering of relativistic electrons in a pure Coulomb field $(\sin^4\theta/2)(d\sigma/d\Omega) = a_0 + a_1 \sin\theta/2 + \ldots$, where a_0 is given precisely by one photon pole and a_1 (obtained exactly to all orders in $Z\alpha$) comes from the many photon terms. For scattering by finite nuclei it is further found that, for fixed momentum transfer, the ratio of second to first Born approximation decreases as $(\text{energy})^{-1}$ at high energies. This leads to a simple approximate formula for the ratio $R = (\sigma_- - \sigma_+)/(\sigma_- + \sigma_+)$ of electron and positron scattering, and to a simple method of determining the charge form factors of intermediate Z nuclei. (Contractor's abstract)

2732

Stanford U. Dept. of Physics, Calif.

NON-ABELIAN GAUGE FIELDS. COMMUTATION RELATIONS, by J. Schwinger. Aug. 1961, 26p. (Technical note no. 44) (AFOSR-1409) (AF 49(638)388) AD 264803 Unclassified

Also published in Phys. Rev., v. 125: 1043-1048, Feb. 1, 1962.

The question is raised for non-Abelian vector gauge fields whether gauge invariance necessarily implies a

massless physical particle. As a preliminary to studying this problem, the action principle is used to discover the independent dynamical variables of such gauge fields and construct their commutation relations. (Contractor's abstract)

2733

Stanford U. Dept. of Physics, Calif.

ELECTRON SCATTERING FROM A QUANTIZED LIQUID DROP, by J. D. Walecka. Aug. 1961 [43]p. incl. diagrs. table, refs. (Technical note no. 48) (AFOSR-1498) (AF 49(638)388) AD 265566 Unclassified

Also published in Phys Rev., v. 126: 653-662, Apr. 15, 1962.

The theory of an electron interacting with a quantized liquid drop is examined, the Hamiltonian being consistently written to second order in the parameters describing the distortion. When second-order terms are kept, some care is necessary in defining the observable value of the radius. Form factors, calculated in Born approximation, for all of the transitions in the drop model are given, as well as the probabilities for real photon emission. The correction to Coulomb scattering coming from the exchange of a transverse photon is also calculated. A model is made of the contribution of the nuclear magnetization to the transverse photon exchange. In general, the Coulomb scattering will dominate. Spherically symmetric compressional oscillations of a drop with surface tension are also discussed and the form factors for transitions are calculated. (Contractor's abstract)

2734

Stanford U. Dept. of Physics, Calif.

ELECTROMAGNETIC PROPERTIES OF THE LOW-LYING STATES OF $_6C_6^{12}$ IN THE OSCILLATING DROP MODEL, by J. D. Walecka. Aug. 1961 [34]p. incl. diagrs. table, refs. (Technical note no. 49) (AFOSR-1499) (AF 49(638)388) AD 265567 Unclassified

Also published in Phys. Rev., v. 126: 663-670, Apr. 15, 1962.

The electromagnetic properties of the first 4 states of $_6C_6^{12}$ are discussed within the framework of the incompressible drop model. The radius of the drop is determined by the elastic electron scattering from the ground state. By adjusting the mass and surface tension of the drop to fit the energy and lifetime for γ-decay of the first excited state, one obtains agreement with the inelastic scattering cross sections from both the first and second excited states. The third excited state is interpreted as an octupole vibration through the inelastic electron scattering cross section. The total electromagnetic decay width of the second excited state, which is of astrophysical interest, is also calculated. (Contractor's abstract)

2735

Stanford U. Dept. of Physics, Calif.

A PHENOMOLOGICAL APPROACH TO THE ELECTRODISINTEGRATION OF THE DEUTERON, by B. Bosco. Oct. 1961 [12]p. incl. diagr. table, refs. (Technical note no. 50) (AFOSR-1579) (AF 49(638)388) AD 266682 Unclassified

Also published in Nuovo Cimento, Series X, v. 23: 1028-1040, Mar. 16, 1962.

Using the analytic properties of the matrix elements established in a previous paper (item no. 2723), a phenomenological analysis of the results of Kendall and coworkers on the disintegration of the deuteron by electron impact is carried out. It is shown that it is possible to approximate the unphysical cuts with constants and obtain very good agreement with the experiments. This fact will enable one to evaluate the rescattering corrections in the case of Hofstadter's experiments. (Contractor's abstract)

2736

Stanford U. Dept. of Physics, Calif.

EFFECT OF π-K INTERACTION ON NUCLEON FORM FACTORS; THE PROCESSES $\pi\pi \to KK$ AND $\pi\pi \to \pi\pi$, by M.-C. Chen. Oct. 1961 [24]p. incl. diagrs. (Technical note no. 47) (AFOSR-1683) (AF 49(638)388) AD 266681 Unclassified

Also published in Phys. Rev., v. 125: 2125-2129, Mar. 15, 1962.

An evaluation is made of the relative contributions of 2K and 2π intermediate states to the isovector part of the nucleon's electromagnetic form factor. Dispersion theory is used, and spin and unphysical branch cuts are neglected. It is assumed that the K meson and the nucleon N, are coupled indirectly through the K-π and π-N couplings only. Approximate integrations are carried out for different limiting cases. With the exception of situations where there is not a well-defined trend, all cases show that the 2K-state contribution to the nucleon vector form factor is small. Maximum cross sections and resonance energies for the processes $\pi\pi \to \pi\pi$ and $\pi\pi \to KK$ are also evaluated. (Contractor's abstract)

2737

Stanford U. Dept. of Physics, Calif.

RADIATIVE CORRECTIONS TO ELECTRON-PROTON SCATTERING, by A. S. Krass. Oct. 1961 [29]p. incl. diagrs. refs. (Technical note no. 51) (AFOSR-1684) (AF 49(638)388) AD 266683 Unclassified

Also published in Phys. Rev., v. 125: 2172-2178, Mar. 15, 1962.

The radiative corrections to electron-proton scattering are calculated for an experiment in which the recoil proton is detected instead of the scattered electron. The

emission of very hard photons by the scattered electrons is taken into account in the phase space integration. This calculation is intended for high-energy experiments (up to 5 bev) but is applicable whenever the momentum resolution of the spectrometer is small. Mesonic contributions to the 2-photon exchange diagrams are neglected. (Contractor's abstract)

2738

Stanford U. Dept. of Physics, Calif.

A CALCULATION OF THE LEVEL SPECTRUM O^{18} FROM THE FREE TWO-NUCLEON POTENTIAL, by J. F. Dawson, I. Talmi, and J. D. Walecka. Jan. 1962 [56]p. incl. diagrs. tables, refs. (Technical note no. 54) (AFOSR-2203) (AF 49(638)388) AD 276243
Unclassified

Presented at meeting of the Amer. Phys. Soc., Los Angeles, Calif., Dec. 27-29, 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 504, Dec. 27, 1961. (Title varies)

The 2-neutron binding energy and excitation spectrum of O^{18} are computed using the free nucleon-nucleon potential of Brueckner-Gammel-Thaler (which contains a hard core). The problem is discussed within the framework of the Bethe-Goldstone theory using harmonic oscillator wave functions as the unperturbed solutions. The interaction is diagonalized among the degenerate states and matrix elements are computed by a transformation to relative and center-of-mass coordinates. The energies in relative s-states are obtained by a numerical integration of the relative s-wave Schrödinger equation and then corrected for the presence of the filled levels. The ordering of the first 5 states of O^{18} is given correctly and the binding energy and level spacings are quite close to the experimental values. (Contractor's abstract)

2739

Stanford U. [Dept. of Physics] Calif.

IS ISOTOPIC SPIN A GOOD QUANTUM NUMBER FOR THE NEW ISOBARS?, by S. L. Glashow. [1961] 7p. (Technical note no. 52) (AFOSR-2205) (AF 49(638)388)
Unclassified

Also published in Phys. Rev. Ltrs., v. 7: 469-470, Dec. 15, 1961.

Several relatively long-lived "elementary particles" have recently been discovered. Some of these particles have very nearby masses (whether coincidentally or for some deep reason is not now known). In either case, the existence of 2 particles identical in essential quantum numbers and with neighboring masses can cause a novel enhancement of electromagnetic effects. These effects are estimated for the system of neutral vector mesons, ρ^0 and ω, and for neutral hyperon resonances, $Y_0^{(1)}$ and $Y^{(0)}$, a measurable breakdown of the law of isotopic spin conservation in the decays of these particles is predicted.

2740

Stanford U. Dept. of Physics, Calif.

NUCLEAR ROTATIONAL SPECTRA, THE ELLIOTT, AND THE P_2 FORCE, by R. S. Willey. [1961] [12]p. incl. diagrs. table, refs. (AFOSR-3713) [AF 49(638)-388]
Unclassified

Also published in Phys. Rev., v. 126: 1127-1138, May 1, 1962.

The essential features of the Elliott model with the momentum-dependent quadrupole-quadrupole operator which leads to L(L+1) rotational spectra are reviewed. The operator is reduced to a momentum-independent residual interaction which differs somewhat from the P_2 interaction. The model Hamiltonian is separated into a rotational Hamiltonian, a deformed "intrinsic" Hamiltonian, and a perturbation term. The eigenfunctions and eigenvalues of the "intrinsic" Hamiltonian are found and used in Inglis' cranking model formula to calculate the moment of inertia. The model is modified, in a simple configuration, by taking a mixture of the long-range "P_2" interaction with the short-range δ-function force. For an intermediate mixture the spectrum obtained resembles the spectrum predicted by the collective vibrational Model. Finally, the implications of a P_2 residual interaction for direct-interaction inelastic scattering processes are considered. The question is discussed whether one can actually see the P_2 residual interaction in rotational nuclei, and, if so, whether the strength of the P_2 interaction determined from such scattering experiments is consistent with the strength determined from the observed rotational spectra. Within the rough approximations made, the few experimental results available are not inconsistent with the calculation. (Contractor's abstract)

2741

Stanford U. Dept. of Physics, Calif.

E-E COLLIDING BEAM EXPERIMENT (THEORETICAL), by Y.-S. Tsai. [1961] [4]p. incl. diagrs. tables. (AFOSR-J672) [AF 49(638)388] AD 415104
Unclassified

Also published in Proc. Tenth Annual Conf. on High Energy Nuclear Physics, Rochester, N. Y. [1961], New York, Interscience Publishers, 1961, p. 771-774.

The primary object of this experiment is to test the validity of QED at small distances, or to find out if an electron has any finite size. The calculations are based upon the following conditions: The experiment was done with 2 intersecting 500 mev electron beams. The detectors for the scattered electrons are Cerenkov counters facing each other with equal apertures subtending the same solid angle and arranged for coincidence. The possible effects due to the breakdown of QED at small distances is investigated. The radiative corrections are calculated. The results indicate that the calculations need a careful analysis of the experimental conditions.

2742

Stanford U. Dept. of Physics, Calif.

RADIATIVE CORRECTIONS TO THE ELECTRON-ELECTRON SCATTERING, by Y.-S. Tsai. [1960] [3]p. (AFOSR-J675) [AF 49(638)388] AD 413462 Unclassified

Also published in Nuovo Cimento, Series X, v. 16: 370-372, Apr. 16, 1960.

For abstract see item no. 2564, Vol. IV.

2743

Stanford U. [Dept. of Physics] Calif.

SYMMETRY OF THE ND^{-1} SOLUTIONS FOR COUPLED SCATTERING AMPLITUDES, by J. D. Bjorken and M. Nauenberg. [1960] [1]p. (AFOSR-J677) [AF 49(638)-388] AD 413625 Unclassified

Also published in Phys. Rev., v. 121: 1250, Feb. 15, 1961.

It is proven that the ND^{-1} matrix solutions for coupled scattering amplitudes are symmetric provided the given discontinuity of the scattering matrix across the unphysical cut is symmetric. (Contractor's abstract)

2744

Stanford U. [Dept. of Physics] Calif.

EQUIVALENCE PRINCIPLE "PARADOX" IN THE MOTION OF A GYROSCOPE, by L. I. Schiff. [1960] [2]p. (AFOSR-J678) [AF 49(638)388] AD 415775 Unclassified

Also published in Nuovo Cimento, Series X, v. 17: 124-125, July 1, 1960.

Investigations are described of the magnetically supported gyroscope, to verify previous predictions that an electromagnetic gyroscope was within the present state of the art. The objective of the program was to develop an airborne model of an electromagnetically supported gyro, utilizing a nonuniform field, for use in long-time-of-flight vehicles. A prototype gyroscope has been designed and constructed which employs a gimbal structure as a test table. The support servo has been tested and found to be satisfactory for the pseudo 3D gyro. The spin axis orientation servo tested in a static mode has the required characteristics; testing in the dynamic mode has not been completed. It has been concluded that the concept of a magnetically supported gyro is sound; however, it is recommended that studies be initiated to develop a method, other than optical, for determination of rotor position and spin axis orientation. In addition, further research is necessary to fully characterize the rotor performance in a nonuniform magnetic field. (Contractor's abstract)

2745

Stanford U. Dept. of Physics, Calif.

THE BINDING ENERGY OF Λ-PARTICLES IN NUCLEAR MATTER, by J. D. Walecka. [1960] [8]p. incl. diagr. refs. (AFOSR-J679) [AF 49(638)388] AD 413624 Unclassified

Also published in Nuovo Cimento, Series X, v. 16: 342-349, Apr. 16, 1960.

From an analysis of the existing data on the binding energy of Λ particles in hyperfragments a fairly reliable value of the binding energy of Λ particles in nuclear matter can be obtained. This value is $V_0 \approx 22$ mev. It is proposed that this number gives an independent check on the validity of potentials deduced from the very light hyperfragments. Some simple calculations using the techniques of Brueckner et al are carried out with the potential of Lichtenberg and Kovacs (which contains a hard core). It is found that if only s wave interactions are considered one finds good agreement with the above number. If higher partial waves are included one obtains far too much binding energy and it is suggested that the Λ-nucleon interaction may be weakened by an exchange force in these states. (Contractor's abstract)

2746

Stanford U. [Dept. of Physics] Calif.

EXCHANGE ENERGY OF A PAIR OF He^3 ATOMS IN AN ELONGATED POTENTIAL WELL (Abstract), by E. M. Saunders. [1961] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)388] and Office of Naval Research) Unclassified

Presented at meeting of the Amer. Phys. Soc., Monterey, Calif., Mar. 20-23, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 121, Mar. 20, 1961.

By calculating the exchange energy of an idealized model, and then applying a perturbation to represent the effects of neighbors, the exchange energy of solid He^3 is studied semiquantitatively. At zero temperature, because of the zero-point energy inherent in systems of weakly interacting particles of small mass, interparticle correlation plays an essential role in the exchange energy calculation. The problem of 2 atoms held in a volume of appropriate size by an ellipsoidal harmonic oscillator potential is considered, by using a 2-particle separation of the wave function. The interparticle coordinate is introduced in a fashion similar to that described by Walsh and Borowitz (Phys. Rev., v. 119: 1274, Aug. 15, 1960). The idealized system shows ferromagnetism. A first-order perturbation is applied to distort the model so as to include correlation effects of neighbors in the solid. The result is an antiferromagnetic alignment.

2747

Stanford U. [Dept. of Physics] Calif.

THEORY OF ELECTRON SPIN RESONANCE OF FREE RADICALS IN SOLUTION (Abstract), by J. D. Currin. [1961] [1]p. [AF 49(638)388] Unclassified

Presented at meeting of the Amer. Phys. Soc., Monterey, Calif., Mar. 20-23, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 151, Mar. 20, 1961.

The electron spin resonance spectrum of the free radical 1,3-biindiphenylene 2-phenyl allyl exhibits, in solution, a hyperfine structure due to the coupling of an unpaired electron with 8 equivalent protons. Hausser has found that the resolution, proceeding from a temperature at which the lines are well separated, becomes progressively poorer as the temperature is increased, until the hyperfine structure dtsappears altogether. The total width of the spectrum remains constant throughout. A calculation of the spectrum has been made under the assumption of random flipping of the proton spins, as in the random frequency modulatton theory of Anderson and Weiss (Jour. Phys. Soc. Japan, v. 9: 888, 1954). The computed specira for increasing values of the proton sptn flip rate agree quite well with those obtained by Hausser for increasing temperatures. Ordinary mechanisms of nuclear spin relaxation in solutions of paramagnetic ions do not, however, appear to provide relaxation times short enough to account for the effect.

2748

[Stanford U. Dept. of Physics, Calif.]

QUASI-ELASTIC PEAKS IN HIGH-ENERGY NUCLEON-NUCLEON AND PION-NUCLEON SCATTERINGS (Abstract), by S. D. Drell and K. Hiida. [1961] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)388] and Atomic Energy Commission) Unclassified

Presented at meeting of the Amer. Phys. Soc., Chicago, Ill., Nov. 24-25, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 434, Nov. 24, 1961.

A bump in the energy spectrum of inelastically scattered protons emerging from proton-nucleus collisions for incident energies in the range 9-25 bev and for scattering angles of 20-60 mrad has been reported by Cocconi et al. at CERN. Their recent experiment on C and CH_2 shows a possible structure in the inelastic peak in the form of camel humps. The present aim is to suggest a mechanism giving rise to the bump. This mechanism is the diffraction scattering of a pion in the cloud of the target nucleon. The main results of calculations for the conditions of observation at CERN are presented. Further, it is suggested that there should be a quasi-electric diffraction peak in the process $\pi + N \rightarrow \pi + \pi + N$. The results of calculations will be compared with an experiment at CERN.

2749

Stanford U. [Dept. of Physics] Calif.

HIGH-FREQUENCY REGION OF THE BREMSSTRAHLUNG SPECTRUM (Abstract), by R. J. Jabbur and R. H. Pratt. [1961] [1]p. [AF 49(638)388] Unclassified

Presented at meeting of the Amer. Phys. Soc., Los Angeles, Calif., Dec. 27-29, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 514, Dec. 27, 1961.

Special techniques are required to calculate the cross section σ_{tip} for a bremsstrahlung process in which most of the energy of the incident electron is transferred to the photon. Fano noted that this process is closely related to atomic photoeffect, and it has since been shown that, neglecting contrtbutions to the cross section of relattve order $a^2 \equiv (Z\alpha)^2$, σ_{tip} can be obtained from the photoeffect cross section σK (see item no. 2550, Vol. IV). A more accurate calculation for the high-energy limit of σK is available (see item no. 449, Vol. IV). Here, similar techniques are used to obtain the cross section σ_{tip} from high-energy electrons, neglecting only relative order a^4. This requires a summation over final s and p electrons, but neglects d, f, etc., states. Results will be compared with the recent experiments of Hall and Hanson. Applications to photoeffect and pair production will be noted.

2750

Stanford U. Dept. of Physics, Calif.

SCATTERING OF WAVES AND PARTICLES BY INHOMOGENEOUS REGIONS, by L. I. Schiff. [1961] [5]p. incl. diagrs. [AF 49(638)388] Unclassified

Published in Jour. Opt. Soc. Amer., v. 52: 140-144, Feb. 1962.

A review is given of the classification of several different kinds of wave motion that are of physical interest. Effects of the wave medium, nonlinearity, transformation properties, interaction between wave systems, and quantization, are discussed briefly. Examples are given of the analogy between electromagnetic and Schrödinger waves, and of the calculation methods used in normal mode and in scattering problems. (Contractor's abstract)

2751

Stanford U. Div. of Engineering Mechanics, Calif.

THE OPTIMUM RESPONSE OF FULL THIRD ORDER SYSTEMS WITH CONTACTOR CONTROL, by I. Flügge-Lotz and H. A. Titus, Jr. Mar. 15, 1961. 34p. incl. diagrs. tables. (Technical rept. no. 129) (AFOSR-442) (AF 49(638)513) AD 256061 Unclassified

Presented at Winter annual meeting of the Amer. Soc. Mech. Engineers, New York, Nov. 26-Dec. 1, 1961.

Also published in Jour. Basic Eng., v. 84: 554-558, Dec. 1962.

In the full third order problem it was desirable to modify the iteration procedure used in the periodic approximation method that was developed in solving the optimum problem of the second-order velocity controlled system. A number of examples illustrate the new method. The examples were first constructed in reverse time by employing the true optimum switching times satisfying the optimum switching function which was developed by the methods of Pontrjagin. The obtained final values of error and error derivatives gave the initial values for the approximate method. Periodic approximations of the optimum switching times were then obtained. It was found that for less than 3 switchings the approximate method leads to identical results. Reasonably small differences occur when 3 or more switchings are needed to reduce the initial disturbance to zero.

2752

Stanford U. Div. of Engineering Mechanics, Calif.

PONTRYAGIN'S MAXIMUM PRINCIPLE AND OPTIMAL CONTROL, by I. Flügge-Lotz and H. Halkin. Sept. 15, 1961, 65p. incl. diagrs. refs. (Technical rept. no. 130) (AFOSR-1489) (AF 49(638)513) AD 267860
Unclassified

The mathematical formulation of the most general problem of Optimal Control can be considered as a problem of Mayer subjected to unilateral constraints, i.e., to certain restrictions expressible in terms of inequalities. Results of the classical calculus of variations in their usual forms cannot give a general solution to this problem because, among other things, the fundamental relation of the calculus of variations, i.e., the equation of Euler-Lagrange, is valid only in the case of points interior to the set of admissible points. The most general solution is given by the Maximum Principle of Pontryagin, but in its present form this principle cannot be applied in certain situations, and its validity has been proved in particular cases only. A derivation of this principle for the most general case is given.

2753

Stanford U. High-Energy Physics Lab., Calif.

[STUDY OF Nb^{93} PHOTOPROTONS] Etude des photoprotons de ^{93}Nb, by W. C. Barber and V. J. Vanhuyse. [1960] [3]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [N6onr-25116])
Unclassified

Published in Jour. Phys. et Radium, v. 21: 299-301, May 1960.

A magnetic spectrometer has been used, together with the Stanford 40-mev linear electron accelerator, to study photoprotons from Nb^{93}. Energy and angular distributions and an excitation curve are presented and discussed. (Contractor's abstract)

2754

Stanford U. High-Energy Physics Lab., Calif.

ELECTRON-ELECTRON SCATTERING AT 500 MEV, by E. B. Dally. Mar. 31, 1961 [41]p. incl. diagrs. table, refs. (Rept. no. HEPL-235) (AFOSR-1452) (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. 123: 1840-1850, Sept. 1, 1961.

The electron-electron differential scattering cross section was measured with the use of a 500-mev electron beam from the Stanford Mark III linear electron accelerator. Deviations were sought from the theoretical cross section as calculated in first-order perturbation theory. (Møller scattering). The experimental results were compared with the Møller formula as corrected to the next order in perturbation theory by the work of Tsai. Atomic electrons in a beryllium target foil constituted the target for the electron-electron scattering. The scattered electrons passed through a slit system which defined the angle of scattering and the solid angle. After the particles passed through the slit system, they entered a double-focusing magnetic spectrometer, which analyzed the scattered particles in momentum. The electrons emerging from the spectrometer were detected by a liquid Čerenkov counter. The incident beam was monitored with the use of a Faraday cup and an electronic current integrator. In order to enhance the accuracy of the experiment, the experimental electron-electron scattering was compared to the elastic electron scattering from the target nuclei (Mott scattering). The cross section was measured at approximately 2.6, 3.5, and 4.5 degrees in the laboratory system. These angles correspond to approximately 90°, 107°, and 120° in the center-of-mass system, respectively. The theoretical magnitude of the radiative corrections is -5.5, -4.9, and -4.9% for the scattering angles 2.6, 3.5, and 4.5°, respectively. The average experimental deviation from the Møller formula found for the above angles was -3.0 (±2.3)%, -3.5 (±2.9)%, and -5.9(±2.3)%, respectively, where the error cited is total statistical error. In addition to the statistical error there is a max estimated ±2% possible systematic error. (Contractor's abstract)

2755

Stanford U. High-Energy Physics Lab., Calif.

PION PHOTOPRODUCTION AT BACKWARD ANGLES NEAR THE SECOND NUCLEON-PION RESONANCE, by L. N. Hand and C. Schaerf. [1961] [3]p. incl. 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. 6: 229-231, Mar. 1, 1961.

The present experiment measures with good statistics the photoproduction cross sections under the following 2 conditions: (1) photon energy 500-820 mev, laboratory angle 180°; (2) photon energy 500-770 mev, laboratory

angle 135° (i.e., cm angle from 149° to 152°). The results are presented graphically and the following conclusions are drawn: At 180° there is strong evidence for a peak at a photon energy of 700 ± 7 mev (corrected for ionization energy loss in the target). The width of the peak observed at 180° could be instrumental. At 135° the peak is larger and broader than at 180°; the width is approximately 50 mev. It appears shifted upwards, relative to the 180° data, by 10 mev.

2756

Stanford U. High-Energy Physics Lab., Calif.

ELECTRON SCATTERING STUDY OF NUCLEAR LEVELS IN COBALT, NICKEL, LEAD, AND BISMUTH, by H. Crannell, R. Helm and others. Mar. 8, 1961 [70]p. incl. diagrs. tables, refs. (Rept. no. HEPL-219) (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [N6onr-25116]) Unclassified

Published in Phys. Rev., v. 123: 923-938, Aug. 1, 1961.

Inelastic scattering of 183-mev electrons has been observed through angles of 35°-90° leading to excitation of discrete nuclear excited states in Ni^{58}, Co^{59}, Ni^{60}, Pb^{208}, and Bi^{209}. The excitation energies were below 8 mev. Born-approximation analysis of the measured inelastic form factors was used to deduce the multipolarities λ, and by extrapolation, the transition rates, for 15 corresponding gamma transitions. A number of groups of electric transitions for $\lambda = 2$, 3, and 4 were observed, each group having strikingly similar form factors. In all but 1 of these groups the ratios G of the observed gamma transition rates to the single-particle predictions were greater than 15, and for some transitions from 30 to over 100. One of the groups, in cobalt and the nickels, contains the 1.33-mev E2 transition to the first excited state of Ni^{60}. Another group consists of fast E3 transitions, seen in all 5 nuclei, from states known as the anomalous levels. They included the transition to the first excited state of Pb^{208} and a transition in Bi^{209} identical in energy and form factor. Among 3 slow E4 transitions in cobalt and the nickels was the 2.50-mev $4^+ \rightarrow 0^+$ transition in Ni^{60}. The E4, E3, and an E2 transition in Co^{59} identify states analogous to the 4^+, 3^-, and 2^+ seen in the neighboring even-even nuclei. The last 2 transitions are strongly enhanced. A pair of fast 4.30-mev transitions was observed in Pb^{208} and Bi^{209}; their speed (G = 37) indicates they may constitute the lowest-energy configuration of 16-pole mode of excitation of the nuclear surface. Values of the collective vibrational parameters C_λ and B_λ and the degree to which some of the transitions exhaust ordinary sum rules support the conclusion that the inelastic scattering process is strongly exciting nuclear collective excitations. Some of the observed results are expected on the basis of the theory of collective vibrational excited states; some are the consequence of unidentified configurations. (Contractor's abstract)

2757

Stanford U. [High-Energy Physics Lab.] Calif.

DIRAC AND PAULI FORM FACTORS OF THE NEUTRON, by R. Hofstadter, C. de Vries and R. Herman. [1961] [4]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [N6onr-25116]) Unclassified

Published in Phys. Rev. Ltrs., v. 6: 290-293, Mar. 15, 1961.

Measurements of the inelastic electron scattering cross section of the deuteron at two sets of values of ene. gy (E) and angle (θ) of the scattered electron for the same value of q^2 were combined. The chief result is the independent experimental determination of the two form factors of the neutron (F_{1n}, F_{2n}) and a verification that $F_{1n} \neq 0$.

2758

Stanford U. [High-Energy Physics Lab.] Calif.

ELECTRIC AND MAGNETIC STRUCTURE OF THE PROTON AND NEUTRON, by R. Hofstadter and R. Herman. [1961] [4]p. incl. diagrs. 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. 6: 293-296, Mar. 15, 1961.

A unified interpretation is given of the presently known experimental data on the electromagnetic form factors of the 2 fundamental particles: the proton and the neutron. The main features of the experimental behavior of the Dirac form factors (F_{1p}, F_{1n}) and the Pauli form factors (F_{2p}, F_{2n}) of the proton (p) and neutron (n) as functions of the momentum-transfer invariant (q^2) is explained.

2759

Stanford U. [High-Energy Physics Lab.] Calif.

PRELIMINARY RESULTS ON NEUTRON FORM FACTORS (Abstract), by R. Hofstadter, C. de Vries, and D. Aitken. [1961] [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., Monterey, Calif., Mar. 20-23, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 149, Mar. 22, 1961.

High-energy inelastic electron scattering experiments were made recently on the dueteron in conjunction with

comparison elastic scattering measurements on the proton. In this way absolute values can be assigned to the deuteron peak cross sections at pairs of energies and angles at the same value of the momentum transfer (q). The results have been analyzed in terms of the modified Jankus theory, incorporating Dirac (F_{1N}, F_{1P}) and Pauli (F_{2N}, F_{2P}) form factors of the neutron and proton. The values of F_{1N} and F_{2N} were found by the method of intersecting ellipses assuming known values of F_{1P} and F_{2P}. Meson-exchange effects and final-state interactions have been neglected in the analysis. Preliminary results are that $F_{1N} \neq 0$ at large values of q^2, is negative and is approximateiy -0.40 at $q^2 = 15\ f^{-2}$. These preliminary results also indicate that F_{2N} is close to, but lies below F_{2P} and that F_{2N} goes to zero near $q^2 = 17\ f^{-2}$. An ambiguity in the signs and values of F_{1N} and F_{2N} will be discussed. Since final state interactions and other corrections have been evaluated only approximately, the results are approximate and should be used only to indicate trends of the neutron form factors. Further work is in progress.

2760

Stanford U. [High-Energy Physics Lab.] Calif.

ELECTROMAGNETIC FORM FACTORS OF THE PROTON AND NEUTRON (Abstract), by R. Herman and R. Hofstadter. [1961] [1]p. [Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under N6onr-25116] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 288, Apr. 24, 1961.

The new information on the electromagnetic form factors of the neutron taken together with the split form factors of the proton form a consistent body of data from which the structure of the proton and neutron can be deduced. Using the idea that the proton and neutron correspond to 2 orientations of the z component of the isotopic spin of the nucleon we have developed 4 basic isotopic form factors, namely, F_{1S}, F_{1V}, F_{2S}, and F_{2V}. Taking sums and differences of the basic isotopic form factors one can obtain proton and neutron charge distributions. The latter prove to be consistent with known experimental facts including the rms radii of the 2 fundamental particles. The neutron appears to have a positive outer fringe of charge. We have developed also the density distributions of the magnetic moments of the proton and neutrons, which again are consistent with known experimental facts.

2761

Stanford U. [High-Energy Physics Lab.] Calif.

NEW INFORMATION ABOUT THE ELECTROMAGNETIC STRUCTURE OF THE NEUTRON (Abstract), by C. de Vries and R. Hofstadter. [1961] [1]p. [Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under N6onr-25116] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 288, Apr. 24, 1961.

Inelastic electron-deuteron scattering experiments have been made at values of the momentum transfer q, ranging from $q^2 = 8.5\ f^{-2}$ to $q^2 = 21\ f^{-2}$. Absolute peak cross sections for the deuteron are obtained by comparison measurements on the proton, employing absolute cross sections for the proton. Meson exchange effects have been neglected. The modified Jankus theory, incorporating the Dirac (F_{1N}, F_{1P}) and Pauli (F_{2N}, F_{2P}) form factors of the neutron and proton, has been applied. Combining data taken at different energies and angles but at the same q value, absolute values of F_{1N} and F_2N are obtained. Inherent in the analysis are 4 possible choices of these form factors. All choices indicate that the charge distribution of the neutron is not identically zero. The arguments given in the accompanying paper favor 1 of the 4 possible cases as the natural choice.

2762

Stanford U. High-Energy Physics Lab., Calif.

ELECTROMAGNETIC FORM FACTORS OF THE PROTON, by F. Bumiller, M. Croissiaux and others. July 1961 [39]p. incl. diagrs. tables, refs. (Rept. no. HEPL-243) (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. 124: 1623-1631, Dec. 1, 1961.

The experimental results of the Dirac (F_1) and Pauli (F_2) form factors of the proton are described. The form factors are obtained by means of using the Rosenbluth formula and the method of intersecting ellipses in analyzing the elastic electron-proton scattering cross sections. A range of energies covering the interval 200-1000 mev for the incident electrons is explored. Scattering angles vary from 35° to 145°. Values as high as $q^2 = 31\ f^{-2}$ (q = energy-momentum transfer) are investigated, but form factors can be reliably determined only up to about $q^2 = 25\ f^{-2}$. Splitting of the form factors is confirmed. The newly measured data are in good agreement with earlier Stanford data on the form factors and also with predictions of a recent theoretical model of the proton. Consistency in determining the values of the form factors at different energies and angles gives support to the techniques of quantum electrodynamics up to $q^2 = 25\ f^{-2}$. At the extreme conditions of this experiment (975 mev, 145°) the behavior of the form factors may be exhibiting some anomaly. (Contractor's abstract)

2763

Stanford U. High-Energy Physics Lab., Calif.

PHOTOPROTONS FROM CARBON, by V. J. Vanhuyse and W. C. Barber. [1961] [17]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [N6onr-25116]) Unclassified

Published in Nuclear Phys., v. 26: 233-249, Aug. 1961.

Energy and angular distributions of protons ejected from C^{12} targets bombarded by the beam of the Stanford Mark II accelerator have been measured by means of a magnetic spectrometer. The energy distributions, which are peaked at 6.0 mev, show a structure that cannot be explained by a single resonance. Supposing that all transitions leave the residual nucleus in the ground state, the analysis of the proton distributions leads to a cross section which has a peak value of (12.7 ± 2.5)mb and values of (41 ± 9)mev·mb and (77 ± 18)mev·mb when integrated from 0 to 24 and 40 mev, respectively. Except for the peak value, the cross section curve is very similar to that of the $C^{12}(\gamma, n)$ reaction. The angular distributions of the (γ, p) and $(e, e'p)$ reactions have been measured for different proton energy groups at an electron energy of 40 mev. Except for a $\cos\theta$ term, the distributions are in agreement with the independent particle picture of the giant resonance, p- to d-wave transitions being the important ones. The results are also a confirmation of the theory of electron induced reactions. Yield curves as a function of electron energy were measured up to 40 mev for different proton energy groups and at different angles. Analysis of the yield curves leads to differential cross sections as a function of photon energy. The main property of these cross sections is to support to some extent the assumption of exclusively ground state transitions. (Contractor's abstract)

2764

Stanford U. High-Energy Physics Lab., Calif.

INELASTIC ELECTRON SCATTERING FROM THE DUETERON, by G. A. Peterson and W. C. Barber. [1961] [2]p. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [N6onr-25116]) Unclassified

Published in Proc. Rutherford Jubilee Internat'l. Conf., Manchester (Gt. Brit.) (Sept. 4-8, 1961), New York, Academic Press, 1961, p. 831-832.

The magnetic dipole disintegration of the deuteron has been studied by the inelastic scattering of 41.4 mev electrons from C, CD_2, and CH_2 targets at 132°, 160°, and 180°. The measurements at 180° were made by using a new technique with minimizes the background radiative tail arising from elastic scattering. The magnitude of the deuteron inelastic cross section was obtained by finding the ratio of the inelastic scattering from the deuteron to the elastic scattering from the proton. Near threshold the results are in agreement with the theory of Jankus, but at high excitation energies a discrepancy is observed. (Contractor's abstract)

2765

Stanford U. High-Energy Physics Lab., Calif.

HIGH-ENERGY INTERFERENCE EFFECT OF BREMSSTRAHLUNG PRODUCTION IN A SINGLE CRYSTAL OF SILICON, by A. N. Saxena. Sept. 5, 1961 [26]p. incl. diagrs. refs. (Rept. no. HEPL-244) (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [N6onr-25116]) Unclassified

Published in Phys. Rev., v. 125: 1720-1726, Mar. 1, 1962.

In an experiment performed to look for the interference effect of the bremsstrahlung production by 575-mev electrons in a single crystal of silicon, the ratio of the charges collected in the two halves of a double ion chamber were used to detect the enhancement of the soft component of the bremsstrahlung. The data, presented in the form of a 3-dimensional plot of the ratio vs the angles of rotation between the lattice normal and the electron beam about the horizontal and the vertical axes, clearly showed the enhancement. Comparison of the experimental result and the theory showed good agreement. The resolution of this experiment was poor; hence the central minimum predicted by the theory could not be observed. (Contractor's abstract)

2766

Stanford U. High-Energy Physics Lab., Calif.

MEASUREMENT OF THE NEUTRON-PROTON FINAL-STATE INTERACTION IN THE ELECTRODISINTEGRATION OF DEUTERIUM, by H. W. Kendall, J. I. Friedman and others. [1961] [6]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [N6onr-25116]) Unclassified

Published in Phys. Rev., v. 124: 1596-1601, Dec. 1, 1961.

Measurements have been made of the inelastic differential cross sections for electrodisintegration of deuterium for ϵ in the range from 0-12 mev, where ϵ is the energy in the n-p center-of-mass system in the final state. Primary electron energies were in the range from 204-500 mev. The process was studied for momentum transfers from 1.8–2.8 f^{-1}. The n-p interaction in the unbound state gives rise to a peak in the differential cross sections for ϵ near zero for transitions to the ^1S and ^3S states of the n-p system. The high momentum transfers available make the results sensitive to the short range structure of the unbound n-p wave functions. The results fail to agree with the predictions of Jankus even at the lowest momentum transfers, when a central attractive force is assumed from the n-p force. At the highest

momentum transfers the predicted cross sections are approximately 50% greater than the measured ones. The experimental results agree with theory if a repulsive core of the radius required to fit the elastic scattering data is used both in the bound and unbound n-p states. The extent to which relativistic corrections alter this conclusion is not known at present. (Contractor's abstract)

2767

Stanford U. [High-Energy Physics Lab.] Calif.

π^0 PHOTOPRODUCTION WITH POLARIZED BREMSSTRAHLUNG (Abstract), by D. Drickey and R. F. Mozley. [1961] [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., Los Angeles, Calif., Dec. 27-29, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 523, Dec. 27, 1961.

Measurements have been made of the asymmetry of π^0 photoproduction along and perpendicular to the electric field vector using a polarized bremsstrahlung beam. Measurements have been made at 2 points corresponding to the conditions 330-mev photon energy, 90° pion cm angle and 235-mev photon energy, 120° pion cm angle. The resonant energy point (330mev) can be used to determine the bremsstrahlung polarization using a purely phenomenological analysis and known photoproduction cross sections measured with unpolarized bremsstrahlung. The measurement at 235 mev tests the need for additional terms in the dispersion theory due to the 2-pion and 3-pion resonances.

2768

Stanford U. High-Energy Physics Lab., Calif.

PRODUCTION OF POSITRONS WITH THE STANFORD MARK III ACCELERATOR, by D. Yount and J. Pine. [1961] [17]p. incl. diagrs. refs. (Rept. no. HEPL-249) (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [N6onr-25116]) Unclassified

Published in Nucl. Instr. and Methods, v. 15: 45-50, Feb. 1962.

As a result of this work it is possible to attain a beam intensity of 7×10^6 positrons/pulse (60 pulses/sec) through a ½ in. collimator at the end of the accelerator. This is for a positron energy of 300 mev with an energy spread of ± 1% defined by the analyzing magnet system. A typical electron beam under these conditions is about 5×10^{10} electrons/pulse, while the electron beam incident on the positron radiator is about 1.5×10^{11} electrons pulse. The net conversion efficiency from electrons to relatively mono-energetic positrons is thus about 5×10^{-5}, while the ratio of energy-analyzed beams is about 1.4×10^{-4}. (Contractor's abstract)

2769

Stanford U. Microwave Lab., Calif.

IRREVERSIBLE PROCESSES IN CONSERVATIVE DYNAMICAL SYSTEMS, by P. A. Sturrock. Jan. 1961, 10p. incl. refs. (ML rept. no. 784) (AFOSR-216) (AF 49(638)342) AD 254552 Unclassified

A model of a conservative dynamical system with a very large number of degrees of freedom is set up in the linear approximation and discussed by the methods of classical mechanics. One may associate with an external force an admittance function (with frequency as argument); there is in general a real part to this function which represents a generalization of the dissipation process known as Landau damping. The assumption of equipartition of energy among the normal modes now leads to the fluctuation-dissipation theorem which is a generalization of Nyquist's theorem. Analysis of this system also brings out the fact that the admittance function satisfies the Kramers-Kronig relations, and that, if one considers a number of forces and currents, the resulting admittance matrix satisfies the Onsager relations. (Contractor's abstract)

2770

Stanford U. Microwave Lab., Calif.

STATISTICAL MECHANICAL BASIS FOR THE SECOND LAW OF THERMODYNAMICS, by R. A. Nelson. Apr. 1961, 58p. incl. diagrs. refs. (ML rept. no. 805) (AFOSR-630) (AF 49(638)342) AD 262101 Unclassified

Work is conducted which shows that irreversible macroscopic behavior can result from reversible microscopic mechanics or, more specifically, how the second law of thermodynamics can be a consequence of the Schrödinger equation. (Contractor's abstract)

2771

Stanford U. Microwave Lab., Calif.

ON THE THERMAL GENERATION OF TOROIDAL MAGNETIC FIELDS IN ROTATING STARS, by L. Mestel and I. W. Roxburgh. Aug. 1961, 22p. (ML rept. no. 837) (AFOSR-1386) (AF 49(638)342) AD 266323 Unclassified

Also published in Astrophys. Jour., v. 136: 615-626, Sept. 1962.

It has been shown that in a rotating star without any initial magnetic field, the electron partial pressure slowly generates a toroidal magnetic field of considerable strength. The problem is here reconsidered, assuming the star to have a primeval magnetic field, with its

poloidal component very much weaker than the toroidal field. It is shown that the interaction of the magnetic torque and the rotation field is sufficient to ensure that the electron pressure has negligible effect, whether or not there is meridian circulation of matter inside the star. (Contractor's abstract)

2772

Stanford U. Microwave Lab., Calif.

GENERATION OF RADIO NOISE IN THE VICINITY OF THE EARTH, by P. A. Sturrock. Sept. 1961, 12p. incl. refs. (ML rept. no. 840) (AFOSR-1427) (AF 49-(638)342) AD 266321 Unclassified

Also published in Jour. Research Nat'l. Bur. Stand., v. 66D: 153-157, Mar.-Apr. 1962.

A tentative classification of possible sources of radio noise in the vicinity of the earth may be obtained by examining separately available source of power and known mechanisms for conversion of this power. Among the former we may list high-energy electrons such as those trapped in the Van Allen belts; the solar wind; bursts of high-energy particles ejected by the sun; shock waves in the interplanetary medium originating on the sun; and the rotational energy of the earth. Mechanisms of conversion may be classified as direct, such as synchrotron and Cerenkov radiation, and indirect. Indirect conversion involves the excitation of an intermediate state by the available sources of power and subsequent radiation by this state. This intermediate state may be localized heating, the formation of unstable current patterns, the acceleration of particles, or the generation of waves which are themselves nonradiative, such as plasma oscillations. The following mechanisms which are relevant to the generation of radio noise receive special attention: Cerenkov radiation, 2-stream instability, and the coupling of waves by inhomogeneity and nonlinearity. (Contractor's abstract)

2773

Stanford U. Microwave Lab., Calif.

SPECTRAL CHARACTERISTICS OF TYPE II SOLAR RADIO BURSTS, by P. A. Sturrock. [1961] [3]p. (ML rept. no. 838) (AFOSR-J22) (AF 49(638)342) AD 297428 Unclassified

Also published in Nature, v. 192: 58, Oct. 1961.

It has been recognized for some time that Type II solar radio bursts are due to the excitation of plasma oscillations in the solar corona by some exciting agency which moves through the corona. Roberts (Austral. Jour. Phys., v. 12: 327, 1959), in reviewing observations and theories of these phenomena, leaves unexplained 2 salient characteristics: (1) the appearance of radiation at the fundamental and second harmonic at comparable powers and the lack of radiation at all higher harmonics; (2) the frequent splitting of each of these 2 lines into a pair of lines, the fractional splitting of each of these 2 pairs being the same, typically a few percent. In a homogeneous plasma, such coupling occurs only through nonlinearity of the field and dynamical equations. It has pointed out that the dominant coupling process is between 2 plasma-oscillation modes and 1 electromagnetic wave, which leads to radiation at $2\omega_p$, that is, twice the plasma frequency ω_p, where $\omega_p^2 = 4\pi ne^2/m$, and that this is the key to understanding of point (1). In order to understand point (2), the plasma to be permeated by a magnetic field should be considered. In the electrostatic approximation, $\omega/k \ll c$, the dispersion relation has the from: $\omega^2 = \frac{1}{2}\left[\omega_p^2 + \omega_g^2 \pm (\omega_p^4 + \omega_g^4 - 2\omega_p^4 \omega_g^2 \cos 2\theta)^{\frac{1}{2}}\right]$ where θ is the angle between the wave vector k and the magnetic field vector B, and ω_g is the electron gyrofrequency eB/mc. For $\omega_g < \omega_p$, this separates into 2 bands, one extending from 0 to ω_g and the other from ω_p to $(\omega_p^2 + \omega_g^2)^{\frac{1}{2}}$, the former of which one would not expect to radiate through the corona. Considering only the upper band, it is expected that the frequencies ω_p and $(\omega_p^2 + \omega_g^2)^{\frac{1}{2}}$ would be preferentially excited. It is proposed that these are the 2 frequencies of the observed spectrum when it is split. The separation is seen to be approximately $\frac{1}{2}\omega_g^2/\omega_p$. The observed frequency ratio of first harmonic is slightly less than 2:1.

2774

Stanford U. [Microwave Lab.] Calif.

PROPAGATION AT MICROWAVE FREQUENCIES ALONG A FLUCTUATING PLASMA COLUMN (Abstract), by M. A. Allen and G. S. Kino. [1960] [1]p. [AF 49-(638)415] Unclassified

Presented at Thirteenth Annual Gaseous Electronics Conf., Monterey, Calif., Oct. 12-15, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 388, June 22, 1961.

Random fluctuations of plasma number density, which are present as standing or traveling waves in an arc discharge plasma column, affect the dispersion characteristics of a microwave signal propagating along the column. The examination on a spectrum analyzer of the signal, as it propagates along the column, reveals a transfer of energy into sidebands of the original frequency. This degradation of the microwave signal is shown to be due to phase modulation of the signal caused principally by the strong fluctuation which occurs in mercury-arc discharges at about 100 kc/sec. The phase modulation was examined in detail, both with this internally produced modulation and an externally applied modulation of the number density. The results obtained were explained by the theory of phase modulation, with the depth of modulation being independently measured by means of cavity resonator techniques.

2775

Stanford U. Microwave Lab., Calif.

MEASUREMENTS ON A CESIUM PLASMA (Abstract), by M. A. Allen, G. S. Kino, and J. S. Lawson. [1960] [1]p. [AF 49(638)415] Unclassified

Presented at Second annual meeting of the Div. of Plasma Physics, Gatlinburg, Tenn., Nov. 2-5, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 191, Mar. 20, 1961.

A plasma has been found with positive ions being produced by conversion of cesium atoms to cesium ions at tungsten surfaces and electrons being produced by thermionic emission from the same surfaces. Plasma densities of over 10^{11}/cc have been measured in columns 25 cm long. Low-frequency impedance measurements of the columns yield impedance within a factor of 2 of the Spitzer- Härm values for a fully ionized plasma. External capacitative probe measurements show that fluctuations occur within the plasma columns, mainly in the range of 10 kc to 100 kc.

2776

Stanford U. Microwave Lab., Calif.

INTERACTION OF MICROWAVES WITH MATTER. Technical status rept. no. 10, Aug. 1-Oct. 31, 1960. Nov. 1960, 30p. incl. illus. (ML rept. no. 769) (AF 49(638)415) AD 249008 Unclassified

This status report reviews progress made to date under this contract. Subjects discussed include ferrimagnetic resonance in ferrites, plasma physics studies including plasma properties, and studies of nonlinear dielectrics.

2777

Stanford U. Microwave Lab., Calif.

PLASMA SHEATH FORMATION BY RF FIELDS, by H. S. Butler. Apr. 1961, 84p. incl. illus. diagrs. table, refs. (ML rept. no. 820) (AFOSR-673) (AF 49(638)415) AD 260088 Unclassified

It has been observed experimentally that the application of a radiofrequency voltage (10 kc/sec - 30 mc/sec) to any 1 of several electrode configurations around the outside of a plasma discharge tube results in a constriction of the light-emitting portion of the plasma away from the inner walls of the glass tube. This phenomenon was initially thought to be the result of the rf confinement mechanism. However this investigation has established that the phenomenon is not rf confinement but rather the result of an interaction between the externally applied rf voltage and the plasma which leads to the formation of a dc positive ion sheath. Four experimental measurements together with a description of the equipment utilized in obtaining them are presented. It is shown how results of experiments using square waves instead of sine waves for the input signal suggests that the whole system—plasma, glass wall and generator—can be reduced to a simple circuit. The key step in this reduction is the representing of the plasma as the resultant of 2 voltage-dependent current sources, 1 relating to the dc probe characteristic of the plasma, the other to the physical movement of a body of electrons toward and away from the wall. This recognition of the plasma as a current source together with the knowledge that there must be no average net current flowing to an insulator (the wall) provides the basis of a physical mechanism which explains how the interaction occurs and why it leads to the visual observations. This physical mechanism is described mathematically in terms of a differential equation. An approximation to the differential equation is derived whose solution is shown to fit qualitatively all the general characteristics of the phenomenon with regard to its dependence on arc current and on the frequency and amplitude of the applied rf voltage. Finally the differential equation is solved in its most general form and the solution is shown to fit the experimental observations quantitatively for both square and sine wave inputs. An application of this phenomenon as a possible external diagnostic probe technique is proposed.

2778

Stanford U. Microwave Lab., Calif.

MICROWAVE PROPERTIES OF CERAMIC NON-LINEAR DIELECTRICS, by D. A. Johnson. July 1961, 118p. incl. illus. diagrs. refs. (ML rept. no. 825) (AFOSR-1149) (AF 49(638)415) AD 263393 Unclassified

This investigation was undertaken to develop and apply new measurement techniques for obtaining the small-signal and large-signal microwave characteristics of ceramic nonlinear dielectrics. A transmission method for measuring the small-signal complex dielectric constant was derived and is described in detail. Measurements were made on representative ceramics in the x-band frequency range, and the results are given as curves of the real part of the relative dielectric constant and of the loss tangent as functions of temperature with dc bias levels up to 32 kv/cm. An experimental curve of the relative dielectric constant of a 73% barium titanate-27% strontium titanate ceramic was obtained for the frequency range of 3 kmc to 270 kmc. A curve showing the per cent change of the relative dielectric constant over the temperature range from 95°F to 123°F (the Curie temperature is approximately 72°F) was also obtained. The large-signal microwave characteristics of a non-linear dielectric were measured at 3 kmc by using a re-entrant coaxial cavity in which a cylindrical post of the ceramic was placed in the region of high electric field intensity. (Contractor's abstract)

2779

Stanford U. Microwave Lab., Calif.

NON-LINEAR EFFECTS IN ELECTRON PLASMAS, by P. A. Sturrock. [1961] [6]p. incl. refs. [AF 49(638)-415] Unclassified

Published in Plasma Physics, Accelerators, Thermonuclear Research, v. 2: 158-163, Jan. 1961.

Two theorems concerning wave interaction are proved. The first relates energy-transfer between a group of interacting waves to the frequency of these waves. The second theorem relates the frequency-displacements of a group of interaction waves to the energies of these waves. The properties of electron plasmas undergoing longitudinal oscillations are re-examined in the light of the preceding theorems. Interaction terms may be classed as coherent and incoherent: the former do not result in energy transfer but only frequency displacement which may be characterized by a dispersion relation. The second group leads to transfer of energy between waves and hence to spectral decay. The interaction between longitudinal (electrostatic) and transverse (electromagnetic) waves in plasmas is considered and it is shown that in a uniform plasma in the absence of magnetic fields, the dominant interaction couples 2 longitudinal waves with 1 transverse wave. Hence, one would anticipate that the dominant non-linear mechanism for radiation from excited plasmas leads to emission at twice the plasma frequency. (Contractor's abstract)

2780

Stanford U. Microwave Lab., Calif.

HARMONIC GENERATION BY MEANS OF MULTIPLE QUANTUM TRANSITIONS, by J. Fontana, R. [H.] Pantell, and R. Smith. [1961] [7]p. (Sponsored jointly by [Air Force Office of Scientific Research], Office of Naval Research, and Signal Corps under [N6onr-25123] and National Science Foundation) Unclassified

Presented at Second Internat'l. Conf. on Quantum Electronics, Berkeley, Calif., Mar. 23-25, 1961.

Published in Advances in Quantum Electronics, ed. by J. R. Singer, New York, Columbia U. Press, 1961, p. 612-618.

The use of multiple quantum transitions is considered as a procedure for producing high-power, high-efficiency harmonic generation, and one which would be applicable at very short wavelengths. The method of solution presented is valid over a range of pumping levels sufficient for all the required effects to appear and to be calculated numerically. It is shown that the equations have to be completed by introducing loss terms and by including an appropriate circuit equation. A frequency-shifting effect is encountered in the solution: the output frequency (harmonic of the pump) and the natural transition frequency are not the same, and the difference can be considerable at the large pump amplitudes required for good efficiency. An example given indicates the possibility of generating several watts of cw power using the 3,3, line in ammonia. The model considered is a two-energy level system with an applied rf signal at a submultiple of the natural transition frequency.

2781

Stanford U. Microwave Lab., Calif.

FIELD-THEORY ANALOGS OF THE LAGRANGE AND POINCARE INVARIANTS, by P. A. Sturrock. [1960] [8]p. incl. refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [Nonr-22548]) Unclassified

Published in Jour. Math. Phys., v. 3: 43-50, Jan.-Feb. 1962.

The Lagrange differential invariant and the Poincare integral invariant of classical dynamics have as their analogs in Lagrangian field theory "a differential divergence-free vector" and an "integral divergence-free vector". The former, which is expressible as a divergence-free vector-bracket expression, may be used to derive conservation relations associated with the transformation properties of a given system. It is not necessary that these transformations should be infinitesimal; by way of example, conservation theorems are established for systems which are periodic and for systems which are invariant under spatial inversion. The differential divergence-free vector may also be used to establish reciprocity and orthogonality relations: simple examples which are here discussed are Betti's reciprocal theorem of elasticity and Lorentz's reciprocal relation of electromagnetic theory. An extended form of the differential divergence-free vector allows for variation not only of the dependent variables but also of the independent variables. The integral divergence-free vector associates a conserved quantity with any closed 1-parameter family of solutions of the field equations. The theorem of classical dynamics relating a complete set of Poisson brackets to a complete set of Lagrange brackets cannot be extended to the present formalism. The formula which represents the obvious extension of the classical formula for the Poisson bracket is of no interest since it can be shown not to be canonically invariant.

2782

Stanford U. Microwave Lab., Calif.

USE OF THE DISPLACEMENT VECTOR IN ELECTROMAGNETIC THEORY, by K. G. Dedrick and R. N. Wilson. Apr. 1961, 33p. incl. diagr. (ML rept. no. 814) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22548) AD 258550 Unclassified

Also published in Jour. Math. Phys., v. 3: 97-105, Jan.-Feb. 1962.

Problems in the electrodynamics of charged fluids often require calculation of the charge and current densities, given prior knowledge of the initial distributions and the displacement vector field. In this paper, solutions are obtained for these new distributions, with the property that if the initial distributions have a sharply defined boundary, terms arise which can be interpreted as distributions of electric charge and current multipoles located on the initial boundary surface. These solutions can not be considered valid near the initial boundary, but prove to be useful in that many of their properties are given correctly. The electromagnetic potentials due to the charge and current densities in the displaced configuration are calculated, and form the basis for a discussion of the complicated boundary value problem

encountered in the description of the electrodynamics near the boundary surface. The results are directly applicable to the theory of high frequency electron tubes, and certain formulae are of use in hydrodynamics and elasticity. (Contractor's abstract)

2783

Stanford U. Microwave Lab., Calif.

BEAM PLASMA AMPLIFIERS, by M. A. Allen and G. S. Kino. July 1961, 19p. incl. diagrs (ML rept. no. 833) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22548) AD 263390 Unclassified

Presented at Wescon, San Francisco, Calif., Aug. 22-25, 1961.

Recent experiments on electron beam-plasma interaction have been performed using a thermally generated cesium plasma. The experimental results obtained are in excellent agreement with the theoretical predictions. These experiments show that the possibilities of using this interaction for the amplification of microwaves may, in the future, provide significant advantages over the existing devices now available. There is a possibility of obtaining high efficiencies at high-power levels. Because no circuit is used, and because it may be possible to couple to the beam in radically new ways, millimeter wavelength amplifiers and oscillators based on beam-plasma interaction look extremely promising. The problems involved in the design of such devices are discussed. (Contractor's abstract)

2784

Stanford U. Microwave Lab., Calif.

PARAMETRIC EFFECTS IN A TWO-LEVEL ELECTRIC DIPOLE SYSTEM, by J. Fontana, R. H. Pantell, and R. Smith. Oct. 1961, 11p. incl. refs. (ML rept. no. 849) (Sponsored jointly by Air Force [Office of Scientific Research], Office of Naval Research, and Signal Corps under [Nonr-22548]) AD 267027 Unclassified

Also published in Jour. Appl. Phys., v. 33: 2085-2088, June 1962.

In a 2-level system with induced electrical dipole properties the relationship between an externally applied electric field and the expectation value of the dipole moment is expressed by a differential equation in which one coefficient is proportional to the instantaneous system energy. The nonlinear properties arising from this relationship allow parametric amplification of signals by pumping at another frequency, in the presence of a material containing active systems of this type. No population inversion is necessary. For optimum operation, both the pump and the signal should be within a few per cent of the natural frequency of the system. The electromagnetic Q required for parametric oscillations in a device of this sort is inversely proportional to the on-frequency absorption coefficient for the material. A numerical example shows that, at 1 mm wavelength, parametric oscillations will occur with a Q of 12,000 and a pump field of 10 kv/cm in the gas.

2785

Stanford U. Microwave Lab., Calif.

PARAMETRIC EXCITATION OF ELASTIC MODES IN YTTRIUM IRON GARNET, by R. L. Comstock. Nov. 1961, 155p. incl. illus. diagrs. refs. (ML rept no. 850) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22548) Unclassified

One aspect of the magnetostrictive coupling between the magnetization and the elastic strain in ferrimagnetic insulators is investigated. When the nonlinear part of the magnetostrictive coupling is driven with a large amplitude time-varying pump magnetization, the elastic and magnetostatic modes of a ferrimagnetic sample can be parametrically excited. The conditions under which this excitation is possible are discussed and in particular the threshold pump magnetization is calculated. The result can be expressed as $(A_p)_{th}^2 = \frac{M_s^2}{Q_a Q F^2}$, where A_p is the amplitude of the pump magnetization at frequency ω_p, M_s is the saturation magnetization, Q_a and Q are the quality factors of the elastic mode (ω_2) and magnetostatic mode (ω_1) and F is an appropriate filling or overlap factor between modes satisfying $\omega_p = \omega_1 + \omega_2$. Experiments were performed to measure the elastic mode Q, the results being used in the theoretical threshold calculation. Measurements were also made of the effects of nonlinearities in the elastic and magnetostatic modes. Amplitude jumps and oscillation hysteresis were observed and compared to theoretical predictions. An analysis of the parametric coupling between longitudinal elastic and electromagnetic waves in an infinite ferrite medium is discussed. The parametric coupling is predicted to be much smaller than in the resonant case. A traveling-wave elastic amplifier is proposed using this interaction, and the gain for an idealized version is calculated. (Contractor's abstract, modified)

2786

Stanford U. [Microwave Lab.] Calif.

INTERACTION OF AN ELECTRON BEAM WITH A CESIUM PLASMA (Abstract), by M. A. Allen, G. S. Kino and others. [1961] [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., Colorado Springs, Colo., Nov. 15-18, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 7: 158, Feb. 23, 1962.

An experimental and theoretical study of the interaction of an rf modulated electron beam with a highly ionized plasma is described. The theory takes into account the finite diameters of both the electron beam and the plasma column in the presence of a finite magnetic field. It is assumed that the velocity of the beam is much greater than the mean thermal velocity of the plasma electrons. Under these conditions, the finite nature of the system provides the main limitations on the magnitude of the rf gain. The working medium used in the experiment, is a highly ionized thermal cesium plasma. The measured rf gain is in good agreement with the theory over a wide range of values of the parameters.

2787

Stanford U. Microwave Lab., Calif.

FERROELECTRIC HARMONIC GENERATOR AND THE LARGE-SIGNAL MICROWAVE CHARACTERISTICS OF A FERROELECTRIC CERAMIC, by M. DiDomenico, Jr., D. A. Johnson, and R. H. Pantell. [1961] [10]p. incl. illus. diagrs. refs. (Sponsored jointly by Air Force [Office of Scientific Research], Office of Naval Research, and Signal Corps under [Nonr-22548]) Unclassified

Published in Jour. Appl. Phys., v. 33: 1697-1706, May 1962.

At microwave frequencies, ferroelectric ceramics behave as nonlinear dielectrics and exhibit large signal scalar nonlinear characteristics in both the dielectric constant and the rf conductivity. The nonlinear behavior of a ceramic of 73% $BaTiO_3$-27% $SrTiO_3$ has been used to construct a harmonic generator operating from 3 kmc to 9 kmc. An efficiency of 8.5% for a peak input power of 2200 w was attained. In addition, a new measurement technique has been developed for measuring the large signal properties of this ceramic as well as for other nonlinear materials. This technique makes explicit use of the anharmonic response of a resonant system that contains a nonlinear element. The analysis of both the harmonic generator and the nonlinear resonant system takes into account nonlinear reactance as well as nonlinear resistance. Measurements of the large signal dielectric constant and rf conductivity are given for temperatures about 30° above the Curie temperature. The results obtained at 3 kmc were found to be valid up to field strengths of 20 kv/cm. (Contractor's abstract, modified)

2788

Stanford U. [Radio Propagation Lab.] Calif.

STANFORD MICROWAVE SPECTROHELIOGRAMS FOR 1960 MAY, by G. Swarup. Jan. 15, 1961, 34p. incl. illus. diagrs. (Scientific rept. no. 10; Stanford Radio Astronomy Inst. publ. no. 10) (AFOSR-264) (AF 18-(603)53) AD 252914 Unclassified

A series of maps of the sun are presented showing the disk distribution of solar radio emission at a wavelength of 9.1 cm 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; a correction has been applied for the variation of the sun's semidiameter, so that the photospheric circle is reproduced with a constant diameter of 15 cm.

2789

Stanford U. [Radio Propagation Lab.] Calif.

STUDIES OF SOLAR MICROWAVE EMISSION USING A HIGHLY DIRECTIONAL ANTENNA, by G. Swarup. Feb. 6, 1961, 110p. incl. diagrs, tables, refs. (Scientific rept. no. 13) (AFOSR-265) (AF 18(603)53) AD 252915 Unclassified

The brightness distribution across the sun has been studied at a wavelength of 9.1 cm using a highly directional antenna. The antenna, which consists of 32 10-ft paraboloids in the form of a Mills cross, provides pencil beams which are only 1/10th of the size of the sun. With the rotation of the earth, these scan the solar disk in a television fashion providing a 2-dimensional map of the sun in a period of about an hr. In spite of a high level of activity during the period of observations, the quiet sun component could be identified because of the high resolution of the pencil-beam antenna. The quiet sun at 9.1-cm wavelength has a marked deviation from circular symmetry, the brightness temperature being about 3×10^4° K at the poles. The sources of the slowly varying component of solar radio emission are closely associated with the chromospheric plages, as has been shown. But in contrast, present observations indicate that the peak of 9.1 cm emission lies above the center of gravity of a support group and not that of the plage. Also the size of the region is smaller at 9.1 than at longer wavelengths. It is concluded that the electron density distribution above a plage region is non-uniform, with higher density in the vicinity of sunspots. At 9.1 cm, a typical source of slowly varying component during the period of observation had a diameter of about 3.5 min of arc, a brightness temperature of 4.5×10^5° K and a height of 20,000 km. The variation of the radio emission as the region moved with rotation of the sun from the center to the limb was broader than the cosine variation expected for a disk-shaped emitting region. Observations suggest that the electron densities above an active region are about 10 times the normal values above the quiet sun, and are about 2 times the values assumed by Newkirk in his model of an active region.

2790

Stanford U. [Radio Propagation Lab.] Calif.

TRANSMISSION SYSTEM OF THE STANFORD MICROWAVE SPECTROHELIOGRAPH, by K. S. Yang. Mar. 20, 1961, 91p. incl. diagrs. table, refs. (Scientific rept. no. 14) (AFOSR-481) (AF 18(603)53) AD 254800 Unclassified

The Microwave Spectroheliograph is an instrument for obtaining pictures of monochromatic electromagnetic radiation of the sun. Operating at 9.1 cm, it provides a family of pencil beams of 2.3 min of arc for scanning the solar disk in a television-like fashion. The aerial system consists of thirty-two 10-ft paraboloidal reflectors, arranged in the form of a cross. The transmission system provides the microwave link between the reflector feed-horns and the input to the receiver. A rectangular S-band copper waveguide constitutes the bulk of the transmission system. The waveguide is arranged in a branched system which permits equal electrical path length from all aerials to the receiver, thus offering superior phase stability and wider operating-frequency band. The techniques for measurement and adjustment of amplitude and phase of each aerial are described. A newly developed scheme of phase measurement is given for rapid comparison of aerials thousands of wave-lengths apart by using modulated gas discharge tubes. Attention is given to choice of broadband components for the entire transmission system. Final evaluation of the transmission line system was made through actual observations of the sun. (Contractor's abstract)

2791

Stanford U. [Radio Propagation Lab.] Calif.

STANFORD MICROWAVE SPECTROHELIOGRAMS FOR 1960 JUNE, by G. Swarup. Apr. 28, 1961, 31p. incl. illus. diagrs. table. (Scientific rept. no. 11; Stanford Radio Astronomy Inst. publ. no. 11) (AFOSR-1600) (AF 18(603)53) AD 257820 Unclassified

By means of a microwave spectroheliograph, maps were made of the sun which show the disk distribution of solar radio emission at a wavelength of 9.1 cm 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.

2792

Stanford U. [Radio Propagation Lab.] Calif.

PROPOSAL LEADING TO FUTURE LARGE RADIO TELESCOPES, by R. N. Bracewell. May 12, 1961, 31p. incl. diagrs. (Scientific rept. no. 15; Stanford Radio Astronomy Inst. publ. no. 14) (AFOSR-1601) (AF 18-(603)53) AD 257821 Unclassified

Investigations were concerned with the design of a radio telescope with a one-minute-of-arc beam. The feasibility of a one-minute-of-arc in one dimension was established. However, only a relatively small collecting area was used. To increase the area and to form a pencil beam, while keeping the structure close to the ground, one is led to consider echelon configurations. A multifocus arrangement of tiltable cylinders, stacked like the slats of a venetian blind was studied. The suppression of grating responses can be accomplished by a new tilt-independent technique in which a staggered pair of elements is switched against the remaining elements. The collecting area of a system in which some of the elements are switched, proves to be reasonable. Problems of interconnecting the tiltable elements so as to counteract the jump in path from one element to the next were partly met in achieving a one-minute fan beam. Multibeaming, a technique of halving observing time by doubling the investment in electronic equipment, is justified when the antenna cost is high and the beamwidth extremely narrow. (Contractor's abstract)

2793

Stanford U. [Radio Propagation Lab.] Calif.

INTERFEROMETRY OF CENTAURUS A, by R. N. Bracewell. June 30, 1961, 14p. incl. illus. tables. (Scientific rept. no. 16; Stanford Radio Astronomy Inst. publ. no. 15) (AFOSR-1602) (AF 18(603)53) AD 261737 Unclassified

Fan beam observations with a beamwidth of 2.3 min have revealed 2 distinct components to the central concentration of Centaurus A. Earlier interferometric data had shown an equivalent elliptical distribution oriented with the major axis in position angle 130°, and it seemed possible that the 2-dimensional arrangement of the 2 components might be determined by the earlier data. The expected complex visibility has been calculated for different models that are compatible with the fan beam observations, and compared with interferometric data of Mills (Austral. Jour. Phys., v. 6: 452-470, 1952) and Twiss, Carter and Little (The Observatory, v. 80: 153-159, 1960), and Moffet. The possible arrangements of the components have been narrowed down to 2, each quite plausible on other grounds. The validity of interferometry for unraveling source distribution is confirmed, especially if a wise choice of spacings and azimuths is made. The calculated visibilities furnish a guide to future observations. (Contractor's abstract)

2794

Stanford U. [Radio Propagation Lab.] Calif.

A STUDY OF RADIO-ASTRONOMY RECEIVERS, by R. S. Colvin. Oct. 31, 1961, 136p. incl. diagrs. tables, refs. (Scientific rept. no. 18; Stanford Radio Astronomy Inst. publ. no. 18A) (AFOSR-1603) (AF 18(603)53) AD 268503 Unclassified

A study was made of radio-astronomy receivers to furnish a consistent basis for predicting and comparing the performance of different systems. This basis is provided by clearly defining the important factors and by analyzing a variety of receivers and comparing their performance with a total-power receiver. The concepts developed are used to analyze and evaluate the performance of the Stanford microwave spectroheliograph receiver, which is described in detail, and to establish the relationship of the instrument to its antenna and its observational requirements.

2795

Stanford U. [Radio Propagation Lab.] Calif.

9-CM OBSERVATIONS OF TAU A, VIR A, CEN A, SAG A, AND THE ORION AND OMEGA NEBULAS, by A. G. Little. Nov 1961, 31p. incl. diagrs. tables, refs. (Scientific rept. no. 17; Stanford Radio Astronomy Inst. publ. no. 16) (AFOSR-1605) (AF 18(603)53) AD 285869 Unclassified

Fan-beam observations of Tau A, Vir A, Cen A and the Orion and Omega nebulas were made using a wideband parametric amplifier connected to the Stanford microwave spectroheliograph. For all sources, meridian transit observations were made with the E-W arm of the instrument. In the case of Taurus A and Virgo A, additional observations were made with the N-S antenna as the sources rose and set through its prime-vertical fan beam. Hence, for these sources, diameter measurements were made for 3 different position angles. Source widths and flux densities were derived and are given along with the derived transit times. (Contractor's abstract)

2796

Stanford U. Stanford Electronics Labs., Calif.

EXTENSION OF NOSE WHISTLER ANALYSIS, by R. L. Smith and D. L. Carpenter. Apr. 26, 1961, 11p. incl. illus. table. (Technical rept. no. 8) (AFOSR-615) (AF 18(603)126) AD 256955 Unclassified

A method is outlined for obtaining F_N and T_N, the nose frequency and the time delay to the nose, for whistlers that do not exhibit a nose on the spectrographic records. The method is based upon a universal whistler dispersion function which is a function of f/F_N only. Two time-delay measurements, at widely separated frequencies, are made on a whistler trace, and from this information and the universal dispersion function, F_N and T_N are obtained. Results of applying the method to actual nose whistlers are tabulated and show good agreement between calculated and measured values of F_N and T_N. A method of whistler-source identification is outlined which utilizes approximate information on nose frequency and is particularly useful for middle-latitude whistlers. (Contractor's abstract)

2797

Stanford U. Stanford Electronics Labs., Calif.

THE EFFECT OF THE EARTH-IONOSPHERE WAVEGUIDE ON WHISTLERS, by J. H. Crary. July 17, 1961, 172p. incl. illus. diagrs. tables, refs. (Technical rept. no. 9) (AFOSR-1092) (AF 18(603)126) AD 262348 Unclassified

The possibility of locating the point at which the energy enters the waveguide (the exit point) by direction-finding (d-f) measuements at spaced stations is investigated by expressing the theoretical intensity, polarization, and apparent direction of arrival of the received signal as the sum of multiply-reflected rays propagating in the earth-ionosphere waveguide. Curves (parametric in frequency, distance, and waveguide parameters) of the response of a vertical monopole and of crossed loops are shown. The ratio of the crossed-loop voltages and the null-bearing errors are determined for comparison with experimental data. Qualitative agreement is found between the calculated and the previously unexplained experimental data on crossed-loop voltage ratios. From the theoretical work it was found that apparent lateral deviation of bearing can be caused by the presence of multiple rays, even though all the rays travel in the great-circle plane containing the source and the receiver. Another new result is that either a normal vertical loop or vertical monopole may receive a higher field strength when multiple rays are present. A 2-station d-f experiment was performed, using crossed vertical loops, a vertical monopole, and a goniometer device. The individual latitude differences between the geomagnetic latitudes and the latitudes calculated independently from whistler-dispersion data were as great as 18°, although the average difference is only 3.1°. (Contractor's abstract, modified)

2798

Stanford U. Stanford Electronic Labs., Calif.

THE STANFORD UNIVERSITY REAL-TIME SPECTRUM ANALYZER, by R. A. Helliwell, J. H. Crary and others. Nov. 10, 1961, 20p. incl. illus. diagrs. (Technical rept. no. 10) (AFOSR-1804) (AF 18(603)126) AD 269747 Unclassified

The selection of the best method for analysis of VLF phenomena, such as whistlers and VLF emissions, is discussed. The most common and probably the most useful measurement required in the analysis of VLF phenomena is the frequency-vs-time characteristic. A comb-filter measurement arrangement is readily adapted to real-time spectrum analysis. A particularly effective instrument of this type is called the Rayspan. In the analysis system developed at Stanford the commutator-output intensity modulates an oscilloscope. The beam is swept at the proper rate to provide a frequency axis in 1 direction. A continuously moving film or photosensitive paper photographs the resulting trace and provides a real-time sweep.

2799

Stanford U. [Stanford Electronics Labs.] Calif.

WHISTLER DATA ON THE CHANGE OF BASE-LEVEL IONIZATION IN THE WHISTLER MEDIUM FOLLOWING MAGNETIC STORMS (Abstract), by D. L. Carpenter. [1961] [2]p. (AF 18(603)126) Unclassified

Abstract published in Program Joint Meeting of the Internat'l. Scientific Radio Union, U.S.A. Nat'l. Committee, and Inst. of Radio Engineers, Georgetown U., Washington, D. C., May 1-4, 1961, p. 20-21.

Using nose whistler theory, it is possible to calculate

the nose frequency and nose frequency time delay of ordinary whistler traces. From these data information is obtained on the locations of the paths corresponding to particular whistler traces and on base-level ionization in the whistler medium as a function of latitude and time. Recent measurements show that whistler time delays drop substantially following sudden commencement magnetic storms, with the onset of the drop occurring roughly 3-24 hr after the sudden commencement. This decrease may last from 1-3 or possibly more days following the end of the storm. (Contractor's abstract, in part)

2800

Stanford U. [Stanford Electronics Labs.] Calif.

SYNOPTIC OBSERVATIONS OF WHISTLER-MODE SIGNALS FROM VLF TRANSMITTERS (Abstract), by R. A. Helliwell, J. Katsufrakis, and G. Carpenter. [1961] [2]p. (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)126 and Office of Naval Research under Nonr-22527) Unclassified

Abstract published in Program Joint Meeting of the Internat'l. Scientific Radio Union. U.S.A. Nat'l. Committee, and Inst. of Radio Engineers, Georgetown U., Washington, D. C., May 1-4, 1961, p. 21-22.

Various receiving sites which have obtained whistler-mode signals from Navy VLF stations are given. Whistler-mode activity is highest at night and at middle latitude receiving stations in agreement with whistler results. Marked asymmetries are found in some of the diurnal curves. An explanation is advanced based on the different rates of attenuation over land and sea paths. NPG echo time delays observed at Stanford are compared with whistlers from Stanford and Seattle. The agreement is better with the Stanford whistlers suggesting that the important ducts were closer to the receiver than to the transmitter. A detailed theory of coupling between the magneti-ionic ducts and the earth-ionosphere waveguide provides an explanation for this result. Echo amplitude fading is often regular with a modal value of about 40 sec. The fading is explained in terms of interference between multiple paths. NSS observations at Greenbank, Ushuaia, and Byrd are presented to show the influence of season on time delays and activity. (Contractor's abstract)

2801

Stanford U. [Stanford Electronics Labs.] Calif.

CALCULATION AND INTERPRETATION OF VLF FIELD STRENGHTS, POLARIZATIONS AND ANGLES OF ARRIVAL (Abstract), by J. H. Crary and R. A. Helliwell. [1961] [2]p. (AF 18(603)126) Unclassified

Abstract published in Program Joint Meeting of the Internat'l. Scientific Radio Union, U.S.A. Nat'l. Committee, and Inst. of Radio Engineers, Georgetown U., Washington, D. C., May 1-4, 1961, p. 40-41.

Recent studies of whistlers and VLF emissions indicate that these signals travel in ducts of enhanced ionization in the outer ionosphere. They propagate by means of multiple reflections between earth and ionosphere over the path between the antenna and the duct termination in the lower ionosphere. A system of equations has been developed, by the use of the QL approximation and other simplifying assumptions, which utilizes the principles of geometrical optics to calculate some of the properties of transmitted fields of VLF signals. Two different problems have been studied: (1) the total field transmitted into a whistler "duct" from a transmitting antenna at a ground distance D km away, and (2) the voltage induced in an antenna system on the ground resulting from a wave traveling in the whistler mode. These calculations may be used to determine a value for the transmission loss over an entire whistler path, and a measure for the "effective area" of a whistler. The results are interpreted in terms of experimental data on field strength, polarization, direction of arrival, etc. (Contractor's abstract)

2802

Stanford U. [Stanford Electronics Labs.] Calif.

PROPAGATION CHARACTERISTICS OF WHISTLERS TRAPPED IN FIELD-ALIGNED COLUMNS OF ENHANCED IONIZATION, by R. L. Smith. [1961] [9]p. incl. illus. diagrs. table, refs. (AF 18(603)126) Unclassified

Published in Jour. Geophys. Research, v. 66: 3699-3707, Nov. 1961.

Evidence from whistlers shows that the outer ionosphere contains columns or ducts of enhanced ionization. The theory of propagation in these ducts shows an upper cutoff frequency at one-half the gyrofrequency. The average propagation velocity for whistlers trapped in the ducts can be approximated by assuming that the energy follows along the ionization maximum with wave normals aligned with the magnetic field. (Contractor's abstract)

2803

Stanford U. [Stanford Electronics Labs.] Calif.

NEW EXPERIMENTAL EVIDENCE OF THE EFFECT OF MAGNETIC STORMS ON THE MAGNETOSPHERE, by D. L. Carpenter. [1961] [11]p. incl. diagrs. tables. (AF 18(603)126) Unclassified

Published in Jour. Geophys. Research, v. 67: 135-145, Jan. 1962.

New methods of whistler analysis have recently been developed and have been used to study the effect of magnetic storms on the magnetosphere. It is found that whistler observations preceded within 72 hr by a 3-hr K_p level of 6 or more show relatively low values of time delay at typical whistler nose frequencies. During the main phase and recovery phase of several severe magnetic storms, depressions in nose frequency time delays on the order of 2:1 are observed. Evidence is presented that the depressions in whistler delays may be interpreted as reductions in electron density in the magnetosphere. The depression in electron density during several severe storms is then on the order of 4:1.

2804

Stanford U. Stanford Electronics Labs., Calif.

INSTABILITY OF ELECTRONS DRIFTING THROUGH IONS ACROSS A MAGNETIC FIELD, by O. Buneman. [July 20, 1961] [15]p. incl. diagrs. (Technical rept. no. 251-1) (AFOSR-878) (AF 49(638)660) AD 261898 Unclassified

Also published in Plasma Phys., Accelerators, Thermonuclear Research, v. 4: 111-117, Apr. 1962.

It is shown that the drift motion of the electrons across the ions results in the usual 2-stream instability and that the magnetic field, while reducing the growth rate to some extent, is unable to inhibit the instability effectively. The time scale is lengthened like $B^{1/3}$ and not as in collisional diffusion theory, like B^2. Typically, it can be predicted that if an electric field were applied to a plasma in a magnetic field, to reach its full value within a time rather less than an ion gyro-period, the ions would never complete such a period; their interaction with the drifting electrons would have led to a state in which the ions and electrons shared their mean momentum. It is suggested that, in the case of shock or sheath models, the instability and resulting turbulence would account for the entropy change across the shock, while in PIG-type discharges it might account for the observed enhanced cross-field diffusion.

2805

Stanford U. Stanford Electronics Labs., Calif.

DIRECT OBSERVATION OF MICROWAVE-FREQUENCY BEATS DUE TO PHOTOMIXING OF RUBY-OPTICAL-MASER MODES, by B. J. McMurtry and A. E. Siegman. Aug. 25, 1961, 5p. incl. illus. (Technical rept. no. 177-1) (AFOSR-1350) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)660 and Signal Corps under DA 36-039-sc-85387) AD 264455 Unclassified

Observations were made of microwave signals produced by photomixing of near-neighbor axial-mode components in the output spectrum of a ruby optical maser (laser). The observations were made by focusing the laser output onto the oxide cathode of an operating 2500-4000 mc traveling-wave tube. Mixing (heterodyning) between the simultaneous, discrete optical frequencies in the laser output occurs in the TWT cathode, producing microwave amplitude modulation of the beam current. This amplitude modulation is amplified in the helix section, producing easily observable microwave signals in the TWT output. Within the TWT bandwidth, discrete signals were observed at 1800 ± 20, 2140 ± 3, 3000 ± 20, and 3600 ± 20 mc, representing the 'photo-beats' between third- through sixth-nearest neighbors in the laser-mode spectrum. This method of observation is a powerful tool for study of optical masers, and also has significant implications for communications employing microwave-modulated light. It verifies a number of suggestions for constructing microwave phototubes outlined by the authors at a recent conference (Phys. Rev., v. 99: 1691, 1955). (Contractor's abstract)

2806

Stanford U. Stanford Electronics Labs., Calif.

A FAR-INFRARED SPECTROMETER FOR MASER STUDIES, by R. A. Soref. Dec. 8, 1961, 35p. incl. illus. refs. (Technical rept. no. 156-7) (AFOSR-2298) (AF 49(638)660) AD 274757 Unclassified

A description is given of the design, construction, and performance of a grating spectrometer designed to measure the emission and absorption spectra of solid-state maser materials. The spectrometer covers the wavenumber region from 1/65 to 1/195 cm, and a resolution of 10/11 cm at 1/105 cm was achieved under typical operating conditions, as is evident from absorption spectra of atmospheric water vapor. The spectrometer employs a photoconductive Ge:Sb radiation detector whose detectivity D* (88 microns, 1000, 0.009) was estimated to be the order of magnitude of 10^9 cm cps 1/2 per w at 4.2°K. (Contractor's abstract)

2807

Stanford U. Stanford Electronics Labs., Calif.

PHOTOMIXING EXPERIMENTS WITH A RUBY OPTICAL MASER AND A TRAVELING-WAVE MICROWAVE PHOTOTUBE, by B. J. McMurtry and A. E. Siegman. [1961] [3]p. incl. illus. (AFOSR-J75) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)660 and Signal Corps under DA 36-039 sc-85387) AD 400084 Unclassified

Also published in Appl. Opt., v. 1: 51-53, Jan. 1962.

Also published in Appl. Opt. Suppl. on Optical Masers, No. 1: 133-135, 1962.

A standard oxide-cathode S-band traveling-wave tube has been used as an improvised microwave phototube to study the coherent light output from a ruby optical maser (laser). The laser's output consists of simultaneous, discrete optical components separated by the mode interval of 600 mc/s between axial modes in the 12.5 cm laser rod. These components heterodyne in the TWT cathode to produce easily observed microwave outputs within the TWT bandwidth, corresponding to photobeats between third- through seventh-nearest-neighbor axial modes. This technique is a powerful tool for the study of optical masers, and also has important implications for communications via microwave-modulated light. (Contractor's abstract)

2808

Stanford U. Stanford Electronics Labs., Calif.

A CODING CRITERION FOR CONTINUOUS CHANNELS DERIVED FROM LIKELIHOOD ESTIMATION, by T. L. Grettenberg. Feb. 17, 1961, 32p. incl. illus. (Technical rept. no. 2004-1) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 253548 Unclassified

The divergence between hypotheses is investigated as a criterion for signal selection, and is shown to be useful whenever the probability of error cannot be directly evaluated. After a brief discussion of the divergence in hypothesis-testing problems, the relation between the divergence and the information transfer of the channel is determined. As an illustration of the use of the divergence as a coding criterion, the criterion is applied to a finite set of known signals in additive noise. The divergence is evaluated for this example and compared with the probability of error in a maximum-likelihood receiver. (Contractor's abstract)

2809

Stanford U. Stanford Electronics Labs., Calif.

MACHINE LEARNING AND AUTOMATIC PATTERN RECOGNITION, by D. J. Braverman. Feb. 17, 1961, 83p. incl. illus. refs. (Technical rept. no. 2003-1) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 253925 Unclassified

The machine recognition of the class of an object when objects in each class possess a common property which is unknown to the machine is discussed. The recognition is based upon the measurement of a set of characteristics of the object to be recognized and a collection of learning observations. Optimum, or Bayes, decision rules for recognition minimize the expectation of an arbitrary, preassigned function which measures the consequences of errors in recognition. Optimum decision rules are obtained as functions of the measurements of the characteristics of the object to be recognized and the learning observations with the aid of Statistical Decision Theory. The manner in which the learning observations must be used in optimum recognition systems, the inductive properties of optimum recognition systems, and the method of extraction of relevant information from the learning observations are also discussed. Examples of recognition systems for the minimization of the probability of incorrect recognition of one of a set of unknown, fixed signals in the presence of noise are presented to illustrate the theoretical development. The probability of incorrect recognition is obtained as a function of the number of learning observations, in order to evaluate the learning rate. (Contractor's abstract)

2810

Stanford U. Stanford Electronics Labs., Calif.

AN INVESTIGATION OF SURFACE STATES AT A SILICON-OXIDE INTERFACE EMPLOYING M-O-S DIODES, by L. M. Terman. Feb. 23, 1961, 96p. incl. illus. table, refs. (Technical rept. no. 1655-1) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 253926 Unclassified

Also published in Solid-State Electron, v. 1, 285-299, 1932.

An investigation was made of the densities and time constants of surface states at a silicon silicon-oxide interface. The tool used for this investigation was the M-O-S diode, a new solid-state device which, besides being useful for fundamental research of the type presented, also offers at least some potential as a circuit device due to its highly voltage-sensitive capacitance. Since an understanding of the M-O-S diode is essential, a general picture is given of its mode of operation and characteristics. The description given of the operation of the device is intuitive rather than mathematical, to enable the reader to obtain a physical feel for its operation. A comparison of the capacitance-vs-voltage curves of an idealized M-O-S diode and p-n step junction is presented, and reasons are given for the more rapid change of capacitance with voltage in the M-O-S diode. The effect of the possible existence of surface states at the silicon/silicon-oxide interface is discussed. (Contractor's abstract)

2811

Stanford U. Stanford Electronics Labs., Calif.

EXPERIMENTAL INQUIRY INTO THE PRODUCTION OF LOW-NOISE MICROWAVE ELECTRON BEAMS, by W. R. Turner. Mar. 24, 1961, 103p. incl. illus. tables, refs. (Technical rept. no. 401-3) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 254866 Unclassified

The investigation was concerned with the production of low-noise electron beams by the use of low-potential drift regions. Methods of calculating the noise current as a function of distance along the beam are indicated. Experimental attempts were made to use a virtual cathode in the establishment of a low-noise beam. It was found possible to reduce the beam noisiness to a value below that of full shot noise. However, more conventional operation of the gun, in which the beam was gradually accelerated away from the cathode, was even more successful. Noise experiments for a total of eight traveling-wave tubes at L-band and two traveling-wave tubes at C-band are presented. Noise figures of 4.1 db at L-band (1200 mc) and 5.2 db at C-band (5160 mc) were obtained. The design of a readily interchangeable cathode for studies of the relation of noise figure to cathode activity is described. (Contractor's abstract)

2812

Stanford U. Stanford Electronics Labs., Calif.

HOW CAN SOLID-STATE ELECTRONICS MATURE WITHOUT LOSING ITS YOUTH, by J. G. Linvill. Apr. 21, 1961 [3]p. (Bound with its Technical rept. no. 1507-2) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) Unclassified

Presented at Internat'l. Solid-State Circuits Conf., Philadelphia, Pa., Feb. 1961.

The young state of solid-state electronics is described. Its achievements and present trends are pointed out. Some suggestions are presented for implementation of increased research in solid-state electronics.

First, new people are needed in this field. The most thorough and stimulating preparation possible is need for those students who show the capabilities and inclinations for advanced work and independent research. The university must recognize and establish contact with the industrial world which utilizes the research applications.

2813

Stanford U. Stanford Electronics Labs., Calif.

THE NEURISTOR, by H. D. Crane. Apr. 21, 1961 [2]p. incl. diagrs. (In cooperation with Stanford Research Inst., Menlo Park, Calif.) (Bound with its Technical rept. no. 1507-2) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524 and Nonr-22551; Office of Naval Research under Nonr-32100, and Wright Air Development Division under AF 33(616)7567) Unclassified

Presented at Internat'l. Solid-State Circuits Conf., Philadelphia, Pa., Feb. 1961.

Neuristor, derived from neuron, is a term assigned to a class of structures that exhibits attenuationless signal propagation, as in the attenuationless propagation of the chemical burning zone along a simple fuse, or the attenuationless propagation of the ionic discharge along the axon of a nerve fiber. There appear to be 2 fundamental methods of interconnection of lines in order to form neuristor networks. In a T-junction, connected portions of 2 or more lines become simultaneously activated, or triggered, as in a knitted bundle of fuses, so that as a discharge zone arrives at the junction on any line, a corresponding signal is generated on each of the other connecting lines. In an R-junction, connected portions exhibit mutual refractoriness, but not mutual triggering. Although primary interest is with totally distributed electronic lines, the basic line technique and methods of interconnection are demonstrated here in terms of simple relay lines.

2814

Stanford U. Stanford Electronics Labs., Calif.

INVESTIGATIONS OF MAGNETICALLY TUNABLE NARROW BANDPASS NONRECIPROCAL FILTERS USING FERRIMAGNETIC RESONATORS, by C. N. Patel. Apr. 24, 1961, 141p. incl. illus. refs. (Technical rept. no. 411-1) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 255743 Unclassified

The possibility of a narrow-bandwidth, small-insertion-loss microwave filter with nonreciprocal characteristics is studied, and the findings are reported. The discussion is limited to single-resonance transmission-type filters. In order to obtain tunability over a wide band of frequencies, samples of ferrimagnetic materials such as crystals of yttrium iron garnet, are used as high-Q microwave resonators. An analysis is presented of an equivalent circuit for coupling between 2 microwave circuits using a YIG sphere as the coupling element when the RF magnetic fields due to the 2 circuits are circularly or, in general, elliptically polarized. The experimental device consisted of a cross guide coupler, like a Bethe hole coupler, with only one off-axis aperture which contained the YIG sphere. The experimental results on various filters with different off-axis locations of the aperture are reported. The filters are tunable over the entire x-band by changing the dc magnetic field. The experimental results obtained are in good agreement with those predicted from the theory. (Contractor's abstract)

2815

Stanford U. Stanford Electronics Labs., Calif.

JACOBIAN ELLIPTIC AND OTHER FUNCTIONS AS APPROXIMATE SOLUTIONS TO A CLASS OF GROSSLY NONLINEAR DIFFERENTIAL EQUATIONS, by A. C. Soudack. Apr. 24, 1961, 114p. incl. illus. refs. (Technical rept. no. 2054-1) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 255856 Unclassified

Research is concerned with grossly non-linear systems, the characteristics of which are lost in the process of linearization or quasi-linearization. To this end, methods are here developed for approximating directly the solution to differential equations of the $CH'' + GH' + F(H) = 0$ or $Lq'' + Rq' + g(q) = 0$ where C = capacitance, G = conductance, L = inductance, R = resistance, H = flux, q = charge, and f(H) and g(q) are polynomials with constant coefficients. These equations represent, respectively, electric circuits with non-linear inductor and non-linear capacitor. Conservative systems are considered where R or G = 0. The approximate solution emerges in the form of Jacobian elliptic functions. The approximations are compared quantitatively with those obtained by the Ritz averaging method. Dissipative systems are also considered wherein R or $G \neq 0$. A study of the machine solutions led to some tentative approximations in which f(H) or g(q) contains a linear term and a cubic term only. (Contractor's abstract)

2816

Stanford U. Stanford Electronics Labs., Calif.

OPTIMUM DESIGN OF SAMPLED-DATA SYSTEMS WITH RANDOM PARAMETERS, by T. L. Gunckel, II. Apr. 24, 1961, 70p. incl. illus. tables, refs. (Technical rept. no. 2102-2) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 255857 Unclassified

Three problem areas associated with the design of linear sampled-data systems are considered. The first arises from having the transition and distribution matrices of the system be random variables, i.e., the random parameter problem; the second, having multiplicative noise at the input to the system. this being a special case of the first problem area; and the third from being unable to measure the state vector of the system exactly. In each of these 3 areas, the performance of the system is measured by using either a generalized sum-squared-error, a final-value, or a minimum-time criterion. The design procedures are based either upon minimizing the expected

value of the performance index or upon minimizing the performance index in the presence of worst-case variations within the system, e.g., minimizing the expected value of the sumsquared-error. In general, the results are in the form of feedback coefficients which relate the value of the optimum input to the value of the state vector of the system. (Contractor's abstract)

2817

Stanford U. Stanford Electronics Labs., Calif.

CHANNEL UTILIZATION BY INTERMITTENT TRANSMITTERS, by F. F. Fulton, Jr. May 12, 1961, 91p. incl. illus. tables, refs. (Technical rept. no. 2004-2) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 258998 Unclassified

The usual method of allocating spectrum space to various users does not take into account the extent to which the allocations are actually utilized. If only a fraction of the transmitters are simultaneously active, calculation of the possible signaling rates, assuming mutually interfering operation, shows that better methods of spectrum utilization certainly exist if the fraction is small enough, and some systems can be implemented to retain a portion of this advantage while reducing the coding problem to manageable proportions. By studying the theoretical limit of channel utilization, however, it is shown that in fact better utilization is possible if the active fraction of the transmitters is merely less than one. The limit of channel utilization is studied by postulating a model of a band-limited, noisy channel that incorporates the feature of random selection of a subset of transmitters to be multiplexed within the bandwidth. It is shown by a random coding argument that sets of waveforms certainly exist that can provide operation without interference for any finite number of transmitters assigned to the channel, provided only that the total information transmitted by any subset of transmitters be appropriate for the signal powers involved. (Contractor's abstract)

2818

Stanford U. Stanford Electronics Labs., Calif.

APPLICATION OF THE POTENTIAL ANALOGY TO BODE'S LINEAR-PHASE FILTER DESIGN, by E. H. Luthman. May 26, 1961, 61p. incl. illus. tables, refs. (Technical rept. no. 097-1) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 257941 Unclassified

The design of linear-phase filters has assumed a role of increasing importance to the network synthesizer. Research is concerned with the design techniques for such filters by investigating the possibility of applying the potential analogy to Bode's well-known method of parameter determination for linear-phase filters. The potential analogy is applied to 2 typical Bode filters: the first has 3 critical frequencies in the transmission band and 1 in the transition region, while the second has 5 critical frequencies in the transmission band and 1 in the transition region. Flux plots for a negatively charged plate lying in the passband region of the frequency axis, and positive charges located in the finite p-plane, are drawn. The method of quantizing the negative charges on an equipotential is employed, from which a quantized image transfer function for each filter is obtained. The phase and attenuation characteristics of these transfer functions are studied and compared with similar characteristics of other linear-phase filter designs. Several realizing techniques are applied to these transfer functions and the resulting networks are shown. (Contractor's abstract)

2819

Stanford U. Stanford Electronics Labs., Calif.

BIRTH, LIFE, AND DEATH IN MICROELECTRIC SYSTEMS, by B. Widrow, W. H. Pierce, and J. B. Angell. May 30, 1961, 33p. incl. illus. diagrs. refs. (Technical rept. no. 1552-2) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 259538 Unclassified

An adaptive vote-taker is proposed which compares the outputs of paralleled redundant system parts in a binary system and determines the most probable answer based on past performance of the separate parts. Initially, the vote-taker assigns equal significance to each redundant part, and (in a binary system) requires that a simple majority of the parts be correct. With experience, the vote-taker continually reduces the weight (significance) of the outputs from those parts that makes mistakes, thereby gradually eliminating the defective parts. Thus the vote-takers (which may also be paralleled if they are unreliable) as as automatic repairmen which delete defective parts of a system. System dependability and life expectancy can be made to exceed the dependability and average life expectancy of the component parts. The heart of an adaptive vote-taker is an element providing variable gain with memory. A variable resistor with memory (memistor) which uses electrochemical deposition or removal of copper to achieve the variable memory was successfully appied to this function.

2820

Stanford U. Stanford Electronics Labs., Calif.

THE USE OF WEIGHT FUNCTIONS IN THE TRANSIENT ANALYSIS OF LIGHTLY DAMPED NONLINEAR SYSTEMS, by C.-S. Yen. [June 8, 1961] [82]p. incl. tables, refs. (Technical rept. no. 2052-1) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 257943 Unclassified

Also published in part in Proc. Fourth U.S. Nat'l. Cong. of Appl. Mech., California U., Berkeley (June 18-21, 1962), New York, Amer. Soc. Mech. Engineers, v. 1: 433-439, 1962.

Light damping is described by a second-order differential equation for a nonlinear electric circuit. Using the principle of variation of parameters, a reduction is made of

given equation to 2 first-order differential equations. A weight function method is applied to these 2 equations. The result of this analysis is presented by 2 transient-response curves. Three systems of equations are studied. For the first 2 systems, the results obtained are either better or comparable to those of Kryloff and Bogoliuboff's method. Some improvement of Kryloff and Bogoliuboff's method, using the results of the weight function method, is considered, and excellent results are obtained. The third system is an example of use of the undamped frequency in the assumed solution, which is a generalization of the Kryloff and Bogoliuboff method. For the single-term approximation, error increases with increasing nonlinearity due to the presence of higher harmonics. (Contractor's abstract)

2821

Stanford U. Stanford Electronics Labs., Calif.

ADAPTIVE BINARY DETECTORS, by R. F. Daly. June 26, 1961, 25p. incl. illus. (Technical rept. no. 2003-2) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 258861 Unclassified

A sequential binary detection problem is considered in which it is required to detect the presence or absence of a stochastic signal in each member of a sequence of observations perturbed by additive noise. The problem is formulated so that the decision rule for the (k1) observation depends on a memory function of the previous k observations. The resulting decision rule which minimizes the probability of making a detection error is complicated by the fact that it is not known which of the past observations actually contain the unknown signal. A time-varying linear predictor of the unknown signal is introduced as the memory function, and a binary detector with a variable structure depending on the linear predictor is discussed. (Contractor's abstract)

2822

Stanford U. Stanford Electronics Labs., Calif.

THE TRANSIENT BEHAVIOR OF CONDUCTIVITY IN PHOTOCONDUCTORS, by I. Wunderman. June 28, 1961, 34p. incl. illus. (Technical rept. no. 1511-1) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 261112 Unclassified

Research was concerned with measuring and understanding the variations of electrical conductivity with time in a sintered-layer cadmium-sulfoselenide photoconductor. Primary interest was focused on the decay of conductivity after a known illuminating source is suddenly removed. Suitable apparatus was assembled to perform the necessary measurements. The techniques employed and the associated limitations are discussed. A study of the basic photoconductivity mechanism in photoconductors was undertaken, and several theories were tested. A physical model was found which can explain the salient characteristics of the data. The theory differs from the one currently favored in the literature in that the conventional concepts of free carrier lifetime and traps are avoided. Instead, a rigorous solution to equations describing the free-electron recombination rate was derived. Several observations, based upon the evolved concepts, were made and correlated to the measured data. The most surprising of these is the implication that the hole concentration does not reach equilibrium when light is removed, for perhaps as long as a year. (Contractor's abstract)

2823

Stanford U. Stanford Electronics Labs., Calif.

RANDOM SIGNAL CODING FOR FINITE MESSAGE SETS, by T. L. Grettenberg. June 30, 1961, 65p. (Technical rept. no. 2004-3) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 262357 Unclassified

The divergence between statistical hypotheses is used as a criterion for selection of a finite transmitter alphabet in a communications system. The members of the transmitter alphabet are sample functions from 1 of a finite set of normally distributed random processes. The receiver uses a maximum-likelihood decoding procedure, and the probability of error is evaluated for this receiver for a class of codes having orthogonal covariance functions. The codes with maximum divergence between alternate hypotheses are shown to be a special case of the codes with orthogonal covariance functions. The error probabilities of the maximum-divergence codes are then compared with the other codes having orthogonal covariance functions. (Contractor's abstract)

2824

Stanford U. Stanford Electronics Labs., Calif.

IMPROVING RELIABILITY OF DIGITAL SYSTEMS BY REDUNDANCY AND ADAPTION, by W. H. Pierce. July 17, 1961, 121p. incl. illus. tables, refs. (Technical rept. no. 1552-3) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 261113 Unclassified

Redundancy and adaption will have engineering value in improving the reliability of digital systems if they can provide reliability not otherwise attainable, or if they can provide reliability more economically than other methods. The specific methods of using linearly separable decision elements proposed in this thesis show promise of value by both of the above criteria. Decision elements provide a means of overcoming the non-zero failure probability which will always be associated with every component of a digital system. They also permit systems with various amounts of component reliability to meet the same system reliability specifications by using appropriate amounts of redundancy and adaption. A given system reliability may be attained most economically by a redundancy greater than one. The examples calculated for system yield and lifetime show that the factor of increase in system yield or lifetime can be considerably more than the factor by which the redundancy is increased. The examples also indicate the possibility

that the factor of increase in reliability of adaptive circuits over unadaptive ones could exceed the cost factor of the adaptive circuits. (Contractor's abstract)

2825

Stanford U. Stanford Electronics Labs., Calif.

THE SELECTION PROBLEM FOR MINIMAL-STATE SEQUENTIAL CIRCUITS, by W. H. Davidson. July 20, 1961, 22p. incl. illus. tables. (Technical rept. no. 1901-2) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 260782 Unclassified

A technique is discussed that will select from the set of minimal-state circuits those which will have the lowest expected logic cost. The relation between information content and the expected cost of the logic is clearly demonstrated for the cases discussed. This indicates that if circuits can be designed that have small information contents, they will also have inexpensive associated logic. It may be possible to find design procedures that will generate circuits with small information contents and thus with low-cost logic. Also, it seems reasonable to expect that a relation should exist between an appropriately defined information content for the circuit's input-output sequences and its information content. (Contractor's abstract)

2826

Stanford U. Stanford Electronics Labs., Calif.

RATE OF ADAPTATION IN CONTROL SYSTEMS, by B. Widrow. [1961] [8]p. incl. illus. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) Unclassified

Presented at ARS Guidance, Control, and Navigation Conf., Stanford, Calif., Aug. 7-9, 1961.

Published in ARS Jour., v. 32: 1378-1385, Sept. 1962.

Adaptive control systems are capable of giving near optimum performance in the face of changing input command and noise characteristics, changing dynamics of the controlled processes, and changing goal or mission requirements. The principles of feedback control are used by the adaptation mechanism to control the structure of systems. The quality of adaptation is given by the system "misadjustment," the ratio of the mean increase in mean square error (from adjustments based on finite statistical data) divided by the minimum mean square error. A control system can adapt to a major change in process statistics in about 10 times the impulse response time of the system itself, with a misadjustment of only 20%. Faster adaptation is possible with pattern-recognizing adaptive control systems that use longer term experiences. Pattern-recognizing filters may be composed of adaptive Adaline "neurons." A new electric circuit element called the "memistor" (a resistor with memory) has been devised to facilitate the realization of the Adaline neuron. It is a compact rugged electrochemical element whose resistance can be controlled reversibly by electroplating. The experiences of the neuron are stored in resistance values in a simple and directly usable form. (Contractor's abstract)

2827

Stanford U. Stanford Electronics Labs., Calif.

ANALYSIS OF A NONLINEAR TRANSMISSION LINE, by R. B. Riley. Apr. 21, 1961 [2]p. incl. diagrs. (Bound with its Technical rept. no. 1507-2) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22531) Unclassified

Presented at Internat'l. Solid-State Circuits Conf., Philadelphia, Pa., Feb. 1961.

A transmission line is shown which includes non-constant capacitance which is voltage-dependent. It can be shown, for a wave propagating in 1 direction, that each voltage value propagates with velocity given by $v = 1/\sqrt{LC(V)}$. In case there are waves propagating in both directions, the situation is much more complex. However, the nonlinear transmission line equations can be transformed into a set of 4 characteristic equations which can be interpreted in terms of the conditions described. Methods of analyzing a nonlinear transmission line in terms of its properties are described.

2828

Stanford U. Stanford Electronics Labs., Calif.

STANFORD PAPERS [PRESENTED] AT 1961 INTERNATIONAL SOLID-STATE CIRCUITS CONFERENCE, Philadelphia, Pa., Feb. 1961, by H. D. Crane, J. F. Gibbons and others. Apr. 21, 1961, 9p. incl. diagrs. (Technical rept. no. 1507-2) (Nonr-22524 and Nonr-22531) AD 257942 Unclassified

This report consists of 4 Stanford U. papers which were delivered at 1961 International Solid-State Circuits Conference. All are reviewed separately in this volume. They are (1) The Neuristor, by H. D. Crane, (2) Supersaturated Transistor Switches, by J. F. Gibbons, (3) How Can Solid-State Electronics Mature Without Losing Its Youth, by J. G. Linvill, and (4) Analysis of a Nonlinear Transmission Line, by R. B. Riley.

2829

Stevens Inst. of Tech. Dept. of Physics, Hoboken, N. J.

GENERAL AREA OF PLASMA DYNAMICS IN MAGNETIC FIELDS, by W. H. Bostick. Final rept. Jan. 1961, 1v. incl. illus. diagrs. refs. (AFOSR-55) (AF 49(638)156) AD 265302 Unclassified

The final report on work pursued in the general area of plasma dynamics in magnetic fields is covered mainly by previously published papers. These reports can be noted in earlier volumes of the AFOSR Bibliography. Reports from which the following abstracts have been

taken reappear in this final report: item nos. 2034, 2035, Vol. III and item nos. 2650, 2652-2655, Vol. IV. Further work is proceeding in the study of the coaxial crater gun and on the interaction of plasmas projected at one another along a magnetic field in mirror and cusp geometries.

2830

Stevens Inst. of Tech. [Dept. of Physics] Hoboken, N. J.

EXPERIMENTAL STUDY OF RAYLEIGH-TAYLOR INSTABILITY IN PLASMA, by H. Dickinson, W. H. Bostick and others. [1960] [9]p. incl. illus. diagrs. table, refs. (AFOSR-J81) (Sponsored jointly by Air Force Cambridge Research Labs. under AF 19(604)4086, Air Force Office of Scientific Research under AF 49(638)-156, and Atomic Energy Commission under AT(30-1)-1921) AD 400469 Unclassified

Also published in Phys. Fluids, v. 5: 1048-1056, Sept. 1962.

A clear experimental observation of Rayleigh-Taylor, flute-type instability in a high-temperature plasma expanding across a magnetic field has been made with time-delay, Kerr cell, sequence photography. The wavelength and growth rate of the instability are measured as a function of time for various values of external magnetic field and background gas pressure. With interface decelerations of about 10^9 m/sec^2 the instability develops in 1-4 μ sec with wavelengths of about 10^{-2} m. After 1-4 μ sec the flutes grow with constant velocity. (Contractor's abstract)

2831

Stevens Inst. of Tech. Dept. of Physics, Hoboken, N. J.

INTERACTION BETWEEN MAGNETIC FIELDS AND MOVING PLASMAS, by W. H. Bostick. [1961] [36]p. incl. illus. diagrs. tables. (AFOSR-3392) (Sponsored jointly by Air Force Cambridge Research Center; Air Force Office of Scientific Research under AF 49(638)-1051, and Atomic Energy Commission) Unclassified

Also published in Proc. Symposium on Electromagnetics and Fluid Dynamics of Gaseous Plasma, New York (Apr. 4-6, 1961), Brooklyn, Polytechnic Press, 1962, p. 211-248. (AFOSR-3388)

Experimental results and theoretical descriptive models will be given for various configurations where plasmas move in magnetic fields, with and without a background conducting medium. Constant velocity, accelerated motion, and flute type instabilities are discussed. (Contractor's abstract)

2832

Stevens Inst. of Tech. [Dept. of Physics] Hoboken, N. J.

STUDIES OF PROPULSION OF PLASMA BY MEANS OF A PULSED CRATER GUN (Abstract), by W. H. Bostick. [1961] [1]p. (Bound with AFOSR-582; AD 257892) (AF 49(638)1051) Unclassified

Presented at Fourth annual AFOSR Contractors' meeting on Ion and Plasma Acceleration, Beverly Hills, Calif., Apr. 20-21, 1961.

A pulsed crater gun (or series plasma motor) constructed of a small diameter center wire imbedded in a small hole at the apex of a ceramic conical shell surrounded by an outer conductor has been demonstrated to have an overall conversion efficiency of about 30% and a specific impulse of about 2000, with energy inputs of 5 to 30 joules. Experiments to ascertain the details of the propulsion mechanism are underway: Kerr cell photographs and double probe measurements of the gun in skeletal form operating without the ceramic conical shell show the plasma spreading over a large angle (± 60°), thereby showing very little directivity. Kerr cell photographs also show sausage type (m = 0) instability occurring near the opening of the crater and the plasma emanating from this region with a large lateral velocity. The addition of a conical shell to this skeletal gun projects the plasma predominantly in one direction. The preliminary inference is that the cone acts as a mechanical velocity-direction-conversion device.

2833

Stockholm U. Dept. of Zoology (Sweden).

OBSERVATIONS OF CENTRAL REGULATION OF BODY TEMPERATURE AND OF FOOD AND WATER INTAKE IN THE PIGEON (COLUMBA LIVIA), by B. Åkerman, B. Andersson and others. [1960] [9]p. incl. illus. diagrs. refs. (AFOSR-354) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)195 and Swedish Natural Science Research Council) AD 258870 Unclassified

Also published in Acta Physiol. Scand., v. 50: 328-336, 1960.

Electrical stimulation within restricted parts of the hypothalamus and the preoptic area of the pigeon was found to elicit polypneic panting, hyperphagia and polydipsia. The spatial arrangement in the brain giving rise to the different effects corresponded well to that found in mammals. It may therefore be assumed that central regulation of body temperature, food and water intake is principally the same in birds and mammals. (Contractor's abstract)

2834

Stockholm U. [Inst. of Physics] (Sweden).

ISOSPIN FOR $N + \bar{N} \rightarrow K + \bar{K} + k\pi$ AND SIMILAR REACTIONS, by H. Pilkuhn. [1960] [9]p. incl. tables. (AF 61(052)47) Unclassified

Published in Nuclear Phys., v. 22: 168-176, Jan. 1961.

For antiproton annihilation into a $K\bar{K}$ pair and k pions, multiple pion production in nucleon-nucleon and pion-nucleon collisions, the transition rates into states with given charge configurations of the outgoing particles are expressed in terms of isospin amplitudes. For the

pions' states, representations of the permutation group are employed. Interference terms are discussed, and explicit expressions are given for k up to 5. (Contractor's abstract)

2835

Stockholm U. [Inst. of Physics] (Sweden).

ESTIMATE OF THE POSSIBILITY FOR A $\bar{K}$-Λ COMPOUND, by O. Brulin and B. E. Laurent. [1960] [5]p. (AF 61(052)47) Unclassified

Published in Arkiv Fysik, v. 20: 383-387, 1961.

An investigation of the possibility that ($\bar{K}$, Λ) compounds are formed as a result of interactions is conducted. A static potential in a nonrelativistic 2-particle Schroedinger equation is used. When the intermediate particle is a nucleon, an exchange potential changing the boson K^- to the fermion Λ and vice versa is obtained. An attractive potential in states with odd orbital angular momentum is found. The sign of the potential is changed if the angular momentum is taken to be even or if the interaction is taken to be scalar. The mass of the ground state is found to be equal to the Ξ mass if the coupling constant is chosen so that $G^2/4\pi = 4$ in the scalar and $G^2/4\pi = 10$ in the pseudoscalar case.

2836

Stockholm U. Inst. of Physics (Sweden).

CHARGE BRANCHING RATIOS FOR PERIPHERAL MESON-NUCLEON COLLISIONS, by H. Pilkuhn. [1961] [13]p. incl. diagrs. tables. (AF 61(052)47) Unclassified

Published in Nuclear Phys., v. 29: 199-211, Jan. 1962.

Charge branching ratios for 1-meson and 2-meson exchange graphs are considered, and coefficients for 2-meson exchange graphs are calculated. (Contractor's abstract)

2837

Stockholm U. [Inst. of Physics] (Sweden).

LOW-ENERGY K^--NUCLEON SCATTERING AND ODD ($\Sigma\Lambda$) PARITY, by M. Roos. [1961] [3]p. incl. diagr. table, refs. (AF 61(052)47) Unclassified

Published in Arkiv Fysik, v. 20: 539-541, 1962.

It is suggested that examination of the K^--p elastic scattering cross sections at momenta down to about 62 mev/c, and at large scattering angles, might be used to make a choice between the (a+) and (a-) solutions predicted for the cross sections by the zero-effective-range theory. It is noted, however, that in order to make any theoretical conclusions regarding the cross sections below 172 mev/c the $\Sigma\Lambda$ parity must be known. Under the assumption of odd $\Sigma\Lambda$ parity, the (a+) and (a-) solutions are compared as functions of scattering angle and of momentum from 62 to 172 mev/c. At 62 mev/c the (a+) solutions for even and odd $\Sigma\Lambda$ parity are compared and shown to differ.

2838

Stockholm U. Inst. of Physics (Sweden).

RESEARCH ON HIGH ENERGY ANTIPARTICLE INTERACTIONS, by J. Allan, P. J. Carlson and others. Sept. 1, 1961, 55p. incl. illus. diagrs. tables, refs. (AFOSR-1728) (AF 61(052)452) AD 272320 Unclassified

One of the main lines of the research presented concerns the interaction of antiprotons of 2 gev/c momentum with the nuclei of nuclear emulsions. The final analysis has to be preceded by an extensive analysis of interactions caused by negative pions of the same momentum. These results together with the angular and the energy distribution of the secondary pions and the energy distribution of knock-on protons agree quite well with a cascade calculation based on a knowledge of elementary processes, mainly pion scattering, production and absorption. The new experimental results thus remove the necessity to consider as severe the bad agreement between an earlier experiment and the cascade calculations. Further the observation of K-mesons produced by pions indicates a low cross section for K-meson production. A progress report on an experiment with about 25,000 negative K-mesons at rest and 10,000 in flight at 400 mev is given. Preliminary results of an investigation of the cross section for pion electron scattering with negative pions of 16 gev energy is also reported. (Contractor's abstract, modified)

2839

Stockholm U. Psychological Lab. (Sweden).

A PSYCHOPHYSICAL STUDY OF CARTOGRAPHIC SYMBOLS, by G. Ekman, R. Lindman, and W. William-Olsson. Feb. 18, 1961, 13p. incl. dtagrs. table. refs. (Technical scientific note no. 6) (AFOSR-1247) (AF 61(052)300) AD 262154 Unclassified

In 2 experiments the subjective volume of certain cartographic symbols was studied by the method of magnitude estimation. The stimulus matertal consisted of several sets of cubes and spheres, drawn with perspecttve and shadow. The total range of stimulus volume was 1:3,500. Psychophysical power functions ytelded a good fit to all experimental data. The exponents varted from 0.56 to 0.82, most of them being close to the average value, 0.69. The results substantiate the tentative conclusion from a previous study, according to which volume estimates in the case of small projected solids essenttally reflect perception of area, and this concluston ts further confirmed by a third experiment designed to throw addittonal light on thts particular question. (Contractor's abstract)

2840

Stockholm U. [Psychological Lab.] (Sweden).

ON THE VALIDITY OF SCALES DERIVED BY RATIO AND MAGNITUDE ESTIMATION METHODS, by M. Mashhour. Nov. 14, 1961, 14p. incl. illus. tables, refs. (Technical scientific note no. 7) (AFOSR-2547) (AF 61-(052)300) AD 276385 Unclassified

The procedure for scale construction by ratio estimation is analyzed and discussed. A brief summary of procedures for scale construction with magnitude estimation is given. Different procedures for testing the internal consistency of ratio matrices are reviewed. Two procedures for submitting ratio matrices to rigorous consistency tests are proposed. It is shown that under special experimental conditions, scales derived by magnitude estimation can likewise be subjected to these tests. The tests are illustrated by data from a series of experiments on velocity perception with both methods. (Contractor's abstract)

2841

Strasbourg U. Inst. de Recherches Nucleatres (France).

RESEARCH ON THE EXCITED STATES OF LIGHT ATOMIC NUCLEI, by S. Gorodetzky. Jan. 15, 1961, 13p. incl. refs. (AFOSR-420) (AF 61(514)1400) AD 255004 Unclassified

Work concerned studies and experimental investigations of the states of light atomic nuclei, mainly with regard to spins, parities, and transitions between energy levels. The investigation was made by means of measurement of angular correlation of internal conversion electron pairs or monopolar pairs. This method gives the multipolarity of a transition by the comparison of the experimental correlation with calculated correlations. The knowledge of the multipolarity gives indications on the spin and the parity of the corresponding levels. (Contractor's abstract)

2842

Strasbourg U. Inst. de Recherches Nucleaires (France).

DOUBLE GAMMA EMISSION IN THE 6.06-MEV MONOPOLE TRANSITION OF O^{16}, by S. Gorodetzky, G. Sutter and others. [1961] [3]p. incl. diagrs. table, refs. (AFOSR-2932) [AF 61(052)598] AD 612438 Unclassified

Also published in Phys. Rev. Ltrs., v. 7: 170-172, Sept. 1, 1961.

A search for the double γ-ray mode of decay of the O^{+} 6.03 mev state in O^{16} was made. The state is formed by the F^{19} (p, $\alpha\gamma$)O^{16} reaction at the 1880-kev resonance and α-γ-γ coincidences are observed between a solid state α-detector and two NaI crystals. An experimental value of $\Gamma\gamma\gamma/\Gamma\pi = (2.5 \pm 11) \times 10^{-3}$ is obtained.

2843

Sydney U. School of Physics (Australia).

CHARACTERISTICS OF HIGH-ENERGY NUCLEAR INTERACTIONS AT AND ABOVE 10^{14} ev, by A. Ueda and C. B. A. McCusker. [1961] [17]p. incl. diagrs. tables, refs. (AFOSR-3618) (AF 49(638)942) AD 424219 Unclassified

Also published in Nuclear Phys., v. 26: 35-51, July 1961.

An attempt has been made to explain (a) the changes in slope of the γ ray energy spectrum around γ energies of 1000 gev at 220 gm/cm^2 and 740 g/cm^2 from the top of the atmosphere, (b) the change in slope of the extensive air shower density spectrum at sea level at densities of about 1000 particles/m^2, (c) the double change in slope of the energy spectrum of γ rays from local nuclear interactions at 220 g/cm^2, (d) the absence of such a change at sea level, and (e) the μ-meson spectrum at sea level. The cascade theory developed by Fukuda, Ogita and Ueda has been used together with the following basic hypotheses: (1) in a nucleon-nucleon collision the maximum pion energy in the CMS is about 25 gev, (2) the fractional energy going into the pion component decreases with increasing primary energy (from 30% at 500 gev to 5% at 5×10^7 gev), (3) at very high energies a large fraction of the energy goes into a few heavier particles and then some of this, via the Σ^0, into the electromagnetic cascade. Good agreement between theoretical predictions and experimental results has been obtained. (Contractor's abstract)

2844

Sydney U. School of Physics (Australia).

A COMPARISON OF PION AND NUCLEON INTERACTIONS IN NUCLEAR EMULSIONS BETWEEN 10^{11} AND 10^{13} ev, by F. A. Brisbout, C. Gauld and others. [1961] [5]p. incl. diagrs. table. (AFOSR-3788) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)842] and Nuclear Science Foundation) Unclassified

Also published in Nuclear Phys., v. 28: 217-221, Aug. 1961.

Using data obtained from a 10 l emulsion stack by the Sydney group and a 22 l stack by the Chicago group it is shown that at energies around 1000 gev: (a) the average number of shower particles in secondary jets (mainly produced by pions) is about half that in jets produced by protons, (b) the spread of multiplicities in pion-nucleon encounters at a given energy is small, (c) the spread of multiplicities in proton produced jets is considerable and in good agreement with the predictions of tunnel theory assuming a geometric interaction cross section for protons and (d) the average number of heavy prongs in secondary jets (mostly produced by pions) decreases with increasing energy for about 15 at 6 gev to about 3 at 5000 gev. (Contractor's abstract)

2845

Sydney U. School of Physics (Australia).

EXTENSIVE AIR SHOWERS AND THE CHARACTERISTICS OF HIGH-ENERGY NUCLEAR INTERACTIONS AT AND ABOVE 10^{14} EV, by A. Ueda and C. B. A. McCusker. [1961] [14]p. incl. diagrs. tables, refs. (AFOSR-1828) (AF AFOSR-61-92) AD 427647 Unclassified

Also published in Nuovo Cimento, Series X, v. 23: 877-890, Mar. 1, 1962.

Various characteristics of extensive air showers have been deduced using the cascade model of Ueda and McCusker which contains certain assumptions regarding nuclear interactions at high energies. These have previously been successful in explaining the energy spectra of vartous components. It has also been assumed that all primary particles are protons having an incident energy spectrum represented by a power law. The model can successfully predict many features of air showers including: (1) the zenith angle dependence at sea level and mountain altitudes; (2) the size dependence of nuclear active particles of energy greater than a given (low) value; (3) the change in slope of the size spectrum at sea level; (4) the near independence of the attenuation length on shower size; (5) the energy spectrum of nuclear active particles. Suggestions are made for the improvement of the model in some respects. (Contractor's abstract)

2846

Sydney U. [School of Physics] (Australia).

THE FLOW ABOUT A MOVING BODY IN THE UPPER IONOSPHERE, by G. A. Bird. [1961] [7]p. incl. diagrs. refs. (AFOSR-3991) (AF AFOSR-61-93) Unclassified

Also published in Jour. Aerospace Sci., v. 29: 808-814, July 1962.

A particle approach is used to study the flow pattern around a body moving in the upper layers of the ionosphere. The effects of distant encounters between charged particles (dynamic friction) and of the earth's magnetic field are taken into account. It is shown that when the magnetic lines of force are parallel to the direction of motion of the body, there may be a marked concentration of charged particles in the vicinity of the body and a considerable fraction of the reflected or deflected charged particles may reimpinge on the body surface. A numerical example is given for the size and shape of the charged-particle-density contours in the flow field surrounding a circular disc, and these are compared with the corresponding neutral-particle contours.

2847

Syracuse U. [Dept. of Chemistry] N. Y.

INFRARED OBSERVATION OF THE O-H BAND OF PURE ETHANOL AND ETHANOL SOLUTIONS TO THE CRITICAL TEMPERATURE, by E. Fishman. [1961] [5]p. incl. diagrs. tables, refs. (AFOSR-1418) (AF 49(638)3) Unclassified

Also published in Jour. Phys. Chem., v. 65: 2204-2208, Dec. 1961.

The infrared absorption of pure ethanol and dilute solutions of ethanol dissolved in ethyl ether, ethyl vinyl ether, acetone, acetonitrile, pentane, carbon disulfide and carbon tetrachloride has been determined in the 3μ region from room temperature to the cirtical temperatures of the liquids. In the active solvents there is a continuous, linear shift in frequency of the polymer band and no evidence of an equilibrium with free alcohol molecules. The slopes of the frequency vs temperature lines vary from 0.89 for pure alcohol to 0.14 for diethyl ether solution. In the inert solvents, the polymer band behaves as in pure alcohol up to the temperature of its disappearance, but the dimer band seems to depend on the solvent for its frequency and temperature behavior. These observations are discussed in terms of the dimer-polymer models proposed by Pimentel, et al, and the hydrogen bond theory of Finch and Lippincott.

2848

Syracuse U. [Dept. of Chemistry] N. Y.

A VERY HIGH TEMPERATURE INFRARED CELL FOR PURE LIQUIDS OR SOLUTIONS, by E. Fishman. [1961] [3]p. incl. diagrs. (AFOSR-3424) (AF 49(638)3) AD 441851 Unclassified

Also published in Appl. Opt., v. 1: 493-495, July 1962.

An infrared cell which extends the range of temperatures for liquids up to the critical temperature is described. Window materials are sapphire or calcium fluoride, sealed to the cell walls by teflon O-rings. Brass may be used for the cell body, but alloys of low thermal expansion are preferable. Thermal expansion of the cell prevents accurate determination of intensities. The cell performed well enough to yield the spectrum of liquid water and alcohol solutions up to the critical points. (Contractor's abstract)

2849

Syracuse U. [Dept. of Mathematics] N. Y.

SOME TOPICS ON MARKOV CHAINS, by J. Neveu. Apr. 1961, 20p. (Research rept. no. 32) (AFOSR-471) (AF 49(638)265) AD 256865 Unclassified

This report discusses the Martin representation, additive functionals, and fictitious states. (Contractor's abstract)

2850

[Syracuse U. Dept. of Mathematics, N. Y.]

BOUNDARIES FOR π-CONTINUOUS MARKOV CHAINS AND REPRESENTATIONS OF EXCESSIVE FUNCTIONS, by S.-T. C. Moy. Dec. 1961, 22p. [AF 49(638)265] Unclassified

In this paper the boundaries for Markov chains with a general state space are treated. A condition of π-continuity is imposed on the transition function. A transition function is π-continuous if the transition probabilities admit a density function representation with respect to some probability measure π. If the state space is countable any transition function is π-continuous for an appropriate π. A kernel K(x, y) and a boundary based on the kernel are introduced. The boundary is not necessarily metrizable or separable, hence, the potential theory apparatus is not available. However, Hunt's probability approach can be extensively used in this case. Similar convergence theorem and representation theorem of excessive functions are proved. (Contractor's abstract, modified)

2851

Syracuse U. [Dept. of Mathematics] N. Y.

MEROMORPHIC FUNCTIONS WITH SECTORS FREE OF ZEROS AND POLES, by S. Hellerstein. Jan. 1961, 15p. (AFOSR-222) (AF 49(638)571) AD 255904
Unclassified

Let f(z) be a meromorphic function which is not a polynomial. Assume that all the zeros and poles of f lie on the real axis. Let ϵ (> 0) be given and denote by $n_\epsilon(r, k)$ the number of zeros of $f^{(k)}(z)$ (taking multiplicities into account) which lie in the disk $z \leq r$ and outside the angles $-\epsilon < \arg z < \epsilon$; $\pi - \epsilon < \arg z < \pi + \epsilon$. Then for functions of finite order and r sufficiently large, $n_\epsilon(r, k) < (K/\epsilon)r$, where K depends only on f and k. For functions of infinite order $n_\epsilon(r, k) < (K/\epsilon)r^2 \log r \log^2 T(r, f)$, provided r avoids the values of an exceptional set of finite measure. (T(r, f) is the Nevanlinna characteristic of f). The theorem is a consequence of a more general 1 for meromorphic functions with 1 sector S free of zeros and poles. Here again it is possible to prove that a sector interior to S contains few zeros of the successive derivatives of f.

2852

Syracuse U. [Dept. of Mathematics] N. Y.

BOUNDS FOR THE NUMBER OF DEFICIENT VALUES OF CERTAIN CLASSES OF MEROMORPHIC FUNCTIONS by A. Edrei and W. H. J. Fuchs. [1961] [30]p. incl. refs. (AFOSR-281) (In cooperation with Cornell U., Ithaca, N. Y.) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)571 and National Science Foundation) AD 255969 Unclassified

Also published in Proc. London Math. Soc., v. 12: 315-344, Apr. 1962.

An aspect of Nevanlinna's theory of meromorphic functions is considered. It is shown that it is possible to bound the number of deficient values if the zeros and poles obey geometrical restrictions on their position in certain rather slender annuli only. Stated in intuitive and somewhat imprecise form, it is concluded that the number of deficient values remains finite unless the moduli as well as the arguments of the zeros and poles are well scattered. (Contractor's abstract, modified)

2853

Syracuse U. [Dept. of Mathematics] N. Y.

MEROMORPHIC FUNCTIONS WITH TWO VALUES DISTRIBUTED ON A FINITE NUMBER OF PATHS EXTENDING TO INFINITY, by A. Endrei. May 1961, 43p. (AFOSR-815) (AF 49(638)571) AD 267853
Unclassified

Let f(z) be a meromorphic function such that all its zeros and poles lie on a finite number of regular, separated paths extending to infinity. (The exact definitions of regular and separated are defined.) It is shown that if T (T does not equal zero, T does not equal infinity) is a deficient value (in the sense of Nevanlinna) of f(z), or of any 1 of its derivatives, there must exist severe restrictions on the order λ of f(z). In fact, λ must be finite and cannot exceed a bound depending only on the configuration of the paths carrying the zeros and poles of f(z). This shows that, if 3 distinct values, finite or infinite, are distributed on a finite number of paths and if the order of f(z) is infinite, or finite but large enough, then no value, finite or infinite, may be deficient. In particular, entire functions of infinite order cannot have 2 finite values distributed on a finite number of regular, separated paths.

2854

Syracuse U. [Dept. of Mathematics] N. Y.

ON A CLASS OF MEROMORPHIC FUNCTIONS WITH DEFICIENT ZEROS AND POLES, by S. Hellerstein. [1961] [10]p. (AFOSR-4623) (AF 49(638)571) AD 611741 Unclassified

Also published in Pacific Jour. Math., v. 13: 115-124, Spring 1963.

Let f(z) be a meromorphic function all of whose zeros a_μ lie on a finite number of rays arg z = const and all of whose poles b_ν lie on a finite number of rays arg z = const. If the arguments and zeros satisfy a linear independence condition (over the rational), so that for a suitable integer L all the numbers a_μ^L lie in a small sector around arg z = 0 while the numbers b_ν^L lie in a small sector around arg z = π, then there is a positive number K depending only on the configuration of rays such that under the condition

$\Sigma|a_\mu|^{-K} + \Sigma|b_\nu|^{-K} = \infty$, $\Sigma|a_\mu|^{-\xi} + \Sigma|b_\nu|^{-\xi} < \infty$ for some $\xi > K$, $\limsup (N(r, f) + N(r, 1/f))/T(r, f) < 1/(1 + A)$, where A is an absolute constant. The conclusion remains valid, even if there are zeros a′ and poles b′ not on the configuration of rays, provided that

$\Sigma|a'|^{-\eta} + \Sigma|b'|^{-\eta} < \infty$ for some $\eta < B$, where B is an absolute constant.

2855

Syracuse U. [Dept. of Mathematics] N. Y.

ON MEROMORPHIC FUNCTIONS WITH REGIONS FREE OF POLES AND ZEROS, by A. Edrei and W. H. J. Fuchs. Nov. 1961, 47p. (AFOSR-3328) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)571 and National Science Foundation)
AD 428408 Unclassified

Also published in Acta Math., v. 108: 113-145, Dec. 1962.

Let f(z) be an entire function of finite order. Assume that most of its zeros lie on a finite number of regular paths extending to infinity and determining curvilinear sectors of opening $\geq c > 0$. Then f(z) cannot have more deficient values than twice the numerical value of the order of the function (in the sense of R. Nevanlinna) other than 0 and ∞. The proof of this result depends on a number of lemmas and methods which also yield a simpler proof of theorem which asserts that if F(z) is a meromorphic function, if all its zeros and poles lie on the regular paths described above and if F(z), or any 1 of its derivatives, has a deficient value other than 0 and ∞, then the order of f(z) is necessarily finite and cannot exceed a bound depending only on the configuration of the paths carrying the zeros and poles.

2856

Syracuse U. [Dept. of Mathematics] N. Y.

METRIC ENTROPY, WIDTHS, AND SUPERPOSITIONS OF FUNCTIONS, by G. G. Lorentz. Oct. 1, 1961, 32p. incl. refs. (AFOSR-1590) (AF 49(638)619)
AD 265349 Unclassified

Also published in Amer. Math. Monthly, v. 69: 469-485, June-July 1962.

The purpose of this paper is to give an introduction to some recent developments connected with properties of compact sets of continuous functions. These developments, because of their importance on one hand and their simple and basic character on the other deserve to be more widely known. It is impossible in this paper to give complete proofs. This is an excellent model of an expository paper. It clarifies the underlying ideas and occasionally provides useful details missing from the original papers as well as additions to them. The presentation of Kolmogorov's theorem on the representation of continuous functions of many variables as compositions of continuous functions of fewer variables is extremely illuminating and helpful in reading the concise original paper. (Math. Rev. abstract)

2857

[Syracuse U. Dept. of Mathematics, N. Y.]

ON SOME INTERPOLATION PROBLEMS FOR ANALYTIC FUNCTIONS, by H. S. Shapiro and A. L. Shields. [1961] [20]p. incl. refs. (In cooperation with New York U.)
(Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)619 and Office of Naval Research)
Unclassified

Published in Amer. Jour. Math., v. 83: 513-532, July 1961.

Let $\{z_n\}$ $(n = 1, 2, \ldots)$ be a sequence of points in the open unit disc. Let T_p be the transformation taking $f(z)$ in H_p into the sequence $\{f(z_j)(1 - |z_n|)^{1/p}\}$. By Banach space method, it is shown that TH_p is equal to the sequence space ℓ_p if and only if $\{z_n\}$ satisfies the conditions (C) $\Pi_{n \neq k} |z_k - z_n)/(1 - \bar{z}_n z_k)| \geq \delta > 0$ $(k = 1, 2, \ldots)$. For $p = \infty$, this result specializes to the solution of a problem of R. C. Buck by L. Carleson (Amer. Jour. Math., v. 80: 921-990, 1958). For $p = 2$, it is shown that the above result can be used to obtain interpolation theorems for various Hilbert spaces of analytic functions, in particular, for the Hilbert space of analytic functions square integrable over a strip, results obtained by B. Epstein, D. S. Greenstein, and J. Minker (Ann. Acad. Sci. Fenn. Ser. AI, no. 250/10, 1958) for equally spaced points are shown to hold for points z_n satisfying $|z_m - z_n| \geq d > 0$.

2858

Syracuse U. [Dept. of Physics] N. Y.

IMPURITY SPIN RELAXATION VIA THE CONDUCTION ELECTRONS IN SILICON (Abstract), by A. Honig. [1958] [1]p. (AF 18(603)50) Unclassified

Presented at Kamerlingh Onnes Conf. on Low Temperature Phys., Leiden (Netherlands), June 23-28, 1958.

Published in Physica, Suppl., v. 24: S163, Sept. 1958.

The impurity electron spin relaxation time in phosphorus doped silicon was measured as a function of incident infrared radiation power having a room temperature black body spectral distribution. This relaxation is presumably brought about by the conduction electrons produced by photoionization of the impurity atoms. Among existing interaction mechanisms, Pines, Bardeen and Slichter's mechanism yields the largest relaxation rate. For an incident infrared power of 4×10^{-9} watt, the bound electron spin relaxation time was reduced from 15 min (zero infrared radiation power) to 4 min. Assuming a photon absorption probability of unity, one obtains the $\sim 10^6/cm^3$ conduction electron concentration required by the spin exchange mechanism for a 4 min relaxation time if the conduction electron lifetime against trapping is about 0.5 μsec. This trapping lifetime appears reasonable, though no direct measurements have yet been made. It has also been found that the relaxation rate is proportional to the incident infrared power, and hence to the concentration of conduction electrons.

2859

Syracuse U. [Dept. of Physics] N. Y.

PARAMAGNETIC RESONANCE IN SEMICONDUCTORS, by A. Honig. Final rept. Apr. 29, 1961, 14p. incl. diagrs. refs. (AFOSR-660) (AF 18(603)50)
AD 257488 Unclassified

An extensively referenced summary is presented of research conducted on the following subjects: (1) electron spin — lattice relaxation in silicon, (2) electron spin-spin relaxation in silicon, (3) γ ray anisotropy from dynamically oriented nuclei, and (4) combined infrared radiation — spin resonance studies. The electron spin-spin relaxation work is presented in some detail. Results from the combined infrared radiation — spin resonance program relate to (1) trapping lifetimes and transport phenomena, (2) conduction electron — phosphorus impurity atom singlet exchange cross section in silicon, (3) photo-induced electron spin — lattice relaxation mechanisms, (4) compensation dependent electron spin — lattice relaxation mechanism, and (5) a metastable photo-excited paramagnetic state in silicon. (Contractor's abstract)

2860

Syracuse U. [Dept. of Physics] N. Y.

INFRARED INDUCED PARAMAGNETIC EXCITED STATE IN PHOSPHORUS-DOPED SILICON (Abstract), by A. Honig. [1961] [1]p. (AF 18(603)50)
Unclassified

Presented at meeting of the Amer. Phys. Soc., Monterey, Calif., Mar. 20-23, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 118, Mar. 20, 1961.

For a particular crystal of Si containing $\sim 10^{15}$ phosphorus impurities/cm^3, an excited state has been appreciably populated by photoionizing the neutral phosphorus impurities, and electron spin resonance in the excited state has been observed. The lifetime of an electron in the excited state exceeds several hr at liquid helium temperatures, but the state can be rapidly emptied by infrared radiation of wavelength greater than $\sim 30\mu$. This radiation has insufficient energy to photoionize phosphorus impurities from their ground state, but has sufficient energy to depopulate the excited state. The electron spin resonance associated with this excited state is a single line at $g \cong 1.998$, and the spin-lattice relaxation time is only slightly shorter than the relatively long times associated with the 2 hyperfine lines of the ground-state spin resonance. Identifications of this excited state as part of the fivefold nearly degenerate 1S state in the Kohn-Luttinger theory of impurity states in Si is suggested by the experiments. Other conceivable identifications will be discussed, as well as possible explanations of why most Si samples do not exhibit this photoinduced resonance.

2861

Syracuse U. [Dept. of Physics] N. Y.

COMPENSATION DEPENDENT ELECTRON SPIN RELAXATION IN N-TYPE SILICON (Abstract), by G. Yang and A. Honig. [1961] [1]p. (AF 18(603)50)
Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 20, Feb. 1, 1961.

Spin-lattice relaxation of phosphorus donor electrons in a compensated Si sample containing 6×10^{15}/cm^3 phosphorus impurities and 2×10^{15}/cm^3 boron impurities has been investigated at liquid He temperatures. By subtracting from the measured relaxation probability the relaxation probabilities due to mechanisms found in uncompensated samples, the relaxation probability due to compensation is obtained. The temperature and magnetic field dependences for this compensation dependent mechanism have been determined. In addition, the dependence of this relaxation probability on concentration of charged impurities has been obtained by a recently developed technique. This technique permits control of the concentration of ionized impurities in compensated samples by supplying charged impurities with photo-excited electrons and holes from the valence band. The results of these experiments are consistent with a previously suggested interpretation (see item no. 2060, Vol. III) that relaxation results from spin diffusion from relaxation centers consisting of phosphorus ion-phosphorus neutral pairs, i.e., the analog of the hydrogen molecular ion.

2862

Syracuse U. Dept. of Physics, N. Y.

"GAUGE-INVARIANT" VARIABLES IN GENERAL RELATIVITY, by P. G. Bergmann. [1961] [16]p. (AFOSR-972) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)461], National Science Foundation, and Wright Air Development Division) AD 261030 Unclassified

Also published in Phys. Rev., v. 124: 274-278, Oct. 1, 1961.

Einstein's field equations for the gravitational field possess solutions having a large variety of topological properties; among them there are solutions whose curvature goes asymptotically to zero at spatial infinity. If restricted to solutions that are asymptotically Minkowskian, then it is tempting to try to divide the effects of curvilinear coordinate transformations into those that correspond to a Lorentz transformation and those that represent gauge-type effects. The group-theoretical aspects of such schemes are analyzed. Making a definite assumption concerning the group of curvilinear transformations that will preserve the asymptotic Minkowski character of the metric field, it is concluded that the reduction to a Lorentz-covariant theory

is in fact impossible. The course of the analysis suggests, however, that this negative result depends on the initial group of transformations adopted; it is conceivable that a slightly different invariance group would be compatible with a special-relativistic formulation of the theory. (Contractor's abstract)

2863

Syracuse U. [Dept. of Physics] N. Y.

AN APPROACH TO GRAVITATIONAL RADIATION BY A METHOD OF SPIN COEFFICIENTS, by E. Newman and R. Penrose. [1961] [13]p. incl. refs. (AFOSR-3868) (Sponsored jointly by Aeronautical Research Lab. and [Air Force Office of Scientific Research under AF 49(638)461]) AD 402873 Unclassified

Also published in Jour. Math. Phys., v. 3: 566-578, May-June 1962.

A new approach to general relativity by means of a tetrad or spinor formalism is presented. The essential feature of this approach is the consistent use of certain complex linear combinations of Ricci rotation coefficients which give, in effect, the spinor affine connection. It is applied to 2 problems in radiation theory; a concise proof of a theorem of Goldberg and Sachs and a description of the asymptotic behavior of the Riemann tensor and metric tensor, for outgoing gravitational radiation. (Contractor's abstract)

2864

Syracuse U. [Dept. of Physics] N. Y.

OBSERVABLES IN GENERAL RELATIVITY, by P. G. Bergmann. [1861] [5]p. incl. diagrs. refs. (AFOSR-3869) [AF 49(638)461] Unclassified

Also published in Rev. Modern Phys., v. 33: 510-514, Oct. 1961.

A survey is presented, without mathematical details, of the difficulties which arise in generally covariant field theories from the arbitrariness of the space-time coordinate system, and of attempts to overcome these difficulties by the employment of (1) a Hamiltonian formalism and (2) intrinsic coordinates.

2865

Syracuse U. Dept. of Physics, N. Y.

ASYMPTOTIC PROPERTIES OF A SYSTEM WITH NON-ZERO TOTAL MASS, by P. G. Bergmann, I. Robinson, and E. Schücking. [1961] [5]p. (AFOSR-3870) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)461] and Wright Air Development Division) Unclassified

Also published in Phys. Rev., v. 126: 1227-1231, May 1, 1962.

When certain geometrical figures, which in a flat space would be closed, such as parallelograms of geodesics, are constructed far from the massive source of a gravitational field, they will fail to close in the Riemann-Einstein manifold considered here. If, on removing such a figure to infinity it is scaled up proportionally to its distance from the source, the size of the gap will have an asymptotic value of the order of the Schwarzschild radius of the massive source. Accordingly one cannot construct an asymptotically geodesic coordinate system in the whole region far from the source that will mesh properly everywhere at spatial infinity. Coordinate systems in actual use are not as nearly geodesic as would be compatible with the local curvature of the manifold. (Contractor's abstract)

2866

Syracuse U. [Dept. of Physics] N. Y.

GROUP THEORETICAL CONSIDERATIONS CONCERNING THE CONSTRUCTION OF LORENTZ-COVARIANT "OBSERVABLES" IN GENERAL RELATIVITY (Abstract), by P. G. Bergmann. [1961] [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., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 305, Apr. 24, 1961.

It has been suggested that the dynamical variables of general relativity should preferably be invariant with respect to gauge-type coordinate transformations, but noninvariant with respect to Lorentz-type transformations, both homogeneous and inhomogeneous. Such a program is feasible only if the totality of all transformations to be considered is a nonsimple group, that is, one which contains the gauge-type transformations as a normal subgroup. Such nonsimple groups can in fact be found, though there is some question as to whether they have the structure desired. The construction of dynamical variables with the transformation properties indicated is also discussed.

2867

Syracuse U. [Dept. of Physics] N. Y.

REMARKS ON FORCE-CONSTANT MODELS FOR LATTICE DYNAMICS, by H. Kaplan. [1961] [16]p. incl. diagr. refs. (AFOSR-1707) (AF 49(638)642) AD 270140 Unclassified

Also published in Phys. Rev., v. 125: 1905-1910, Mar. 15, 1962.

It is shown that the need to specify the equilibrium pressure may impose a restriction on the force constants used in calculating lattice vibration spectra. The existence of such a restriction depends upon the lattice under consideration and the generality of the force-constant model that is used. For a model including general interactions with sufficiently distant neighbors (third neighbors will usually be sufficient), specification of the equilibrium

pressure imposes no restrictions. For the cubic crystals explicitly studied, one can conclude that models including third neighbor force constants are not restricted, whereas some second neighbor models and almost all nearest neighbor models are restricted. This is true even if long-range Coulomb forces are included in addition to the short-range force constants. An argument is presented to show that the Cauchy relations of elasticity theory depend upon the vanishing of external stresses in equilibrium, contrary to the conclusions of other published work. The equilibrium atomic spacing near the surface of a crystal is studied and it is shown that this has no influence upon the relation between the equilibrium pressure and the force constants well within the bulk of the crystal. (Contractor's abstract)

2868

Syracuse U. [Dept. of Physics] N. Y.

EFFECT OF AN IMPURITY LAYER ON SURFACE WAVES, by H. Kaplan. [1961] [6]p. incl. diagr. tables, refs. [AF 49(638)642] Unclassified

Also published in Phys. Rev., v. 125: 1271-1276, Feb. 15, 1962.

The effects of a homogeneous impurity mass layer on the surface waves of a semi-infinite monatomic square lattice with nearest and next nearest neighbor central springs are studied. In the long-wavelength limit the impurity layer does not alter the surface waves from those of a pure semi-infinite lattice. However, depending upon the ratio of the impurity mass to the host mass, and for wavelengths shorter than a critical wavelength, the long-wavelength surface wave may disappear and new surface waves with frequencies either higher or lower than the spectrum of the pure infinite lattice may appear. The relationship of this model to the analogous 1- and 3-dimensional problems is discussed. This theory is expected to be applicable to problems such as the effect of an oxide layer on the surface vibrations of a crystal. (Contractor's abstract)

2869

Syracuse U. Dept. of Physics, N. Y.

LATTICE VIBRATIONS OF ZINCBLENDE STRUCTURE CRYSTALS WITH APPLICATION TO ZnS, by H. Kaplan and J. J. Sullivan. [1961] [32]p. incl. diagrs. tables, refs. (AFOSR-2309) (AF 49(638)642) AD 274955 Unclassified

The vibrations of the zincblende lattice were studied using the shell model of Dick and Overhauser and of Cochran. Only nearest neighbor short range force constants of core-core, core-shell and shell-shell types were included in the model in addition to the coulomb forces between the charged shells and cores. The model was applied to ZnS for which only long wavelength experimental data is available. It was established that the effective ionic charge of the Zn ion in ZnS (the sum of the core and shell charges of the ion) is probably near + 0.1 electronic charges. After the long wavelength data were included in the model enough freedom remained to fit a wide variety of short wavelength data. The short wavelength transverse frequencies in the (100) direction in the Brillouin zone were particularly sensitive to the ratio of electronic polarizabilities of the 2 ions, tending to be depressed when the polarizabilities were made more nearly equal. The present calculation is compared with other calculations of the vibration spectrum of ZnS. (Contractor's abstract)

2870

Syracuse U. [Dept. of Physics] N. Y.

LATTICE VIBRATIONS OF ZINCBLENDE STRUCTURE CRYSTALS (Abstract), by H. Kaplan and J. J. Sullivan. [1961] [2]p. [AF 49(638)642] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 279-280, Apr. 24, 1961.

A calculation is made of the lattice vibration spectrum of zincblende structure crystals in symmetry directions in the Brillouin zone, using the shell model previously used by Cochran et al to study germanium and alkali halide crystals. The parameters of the model (shell and core charges, shell springs and short range force constants) are adjusted to fit the elastic, piezoelectric and high and low frequency dielectric constants. Care is taken to ensure that the model corresponds to zero pressure in equilibrium. The zincblende structure differs from the alkali halides in that the polarizabilities affect the elastic constant C_{44}. A comparison calculation using the Born and Huang model, which includes long-range but not short-range polarization effects, reveals the same instability for short wave lengths in the <100> directions as was found earlier for the alkali halides. This work is compared with that of Merten which used a rigid ion model.

2871

Syracuse U. [Dept. of Physics] N. Y.

PHOTOCONDUCTIVITY IN P-TYPE INDIUM ANTIMONIDE WITH DEEP ACCEPTOR IMPURITIES, by W. Engeler, H. Levinstein, and C. Stannard, Jr. [1961] [6]p. incl. diagrs. table. [AF 49(638)642] Unclassified

Presented at the 1961 Internat'l. Conf. on Photoconductivity, Cornell U., Ithaca, N. Y., Aug. 21-24.

Abstract published in Bull. Amer. Phys. Soc., Series II. v. 6: 481-482, Nov. 24, 1961. (Title varies)

Also published in Jour. Phys. and Chem. Solids, v. 22: 249-254, Dec. 1961.

The addition of Au, Ag or Cu impurities to InSb may be expected to produce 2 acceptor levels in InSb when these atoms with 1 valence electron replace In in the crystal lattice. The location of the energy levels has been

determined by observing the extrinsic photoconductivity produced by the excitation of electrons from the valence band to the impurity levels and from the levels to the conduction band. The energy levels for Ag are in close agreement with those calculated by assuming a simple He atom model. The greater divergence for Au is attributed to the lattice distortion introduced when the larger Au atom replaces In in the crystal lattice. Oscillatory behavior of photoconductivity associated with charge carrier excitation to the lower level of all 3 impurities has been attributed to the successive emission of longitudinal optical phonons. (Contractor's abstract)

2872

Syracuse U. Dept. of Physics, N. Y.

DOUBLE HYPERFRAGMENTS AND RELATIVE PARITY OF Λ AND Σ HYPERONS, by S. Iwao. [1961] [9]p. incl. diagrs. table. (AFOSR-177) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)801 and National Science Foundation) AD 611362
Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 33, Feb. 1, 1961.

Also published in Nuclear Phys., v. 26: 1-9, July 1961.

In a previous paper (see Phys. Rev. Ltrs., v. 4: 140, 1960), a theory of hyperfragments was developed. The parameters of the 2-body N-Λ interaction were determined from the observed binding energies of the Λ hyperon. They explained well the present experimental status of hyperfragments. Hence, this method is applied to the so-called "double hyperfragments". The double hyperfragments are bound states of 2 Λ particles and ordinary nuclei. Such systems might be expected to be produced by the absorption of high-energy K^- mesons by complex nuclei or by Ξ^- absorption. Only one additional parameter in the $^1S_0$ state is not previously determined by the single hyperfragment analysis. With the use of global symmetry, it is expected that double hyperfragments should exist for $A \gtrsim 4$. The binding energies of the double hyperfragments are of interest because the sign of the $^1S_0$ potential for the Λ-Λ interaction is closely related to the relative parity of the Λ and Σ particle. Thus the two-pion exchange potential gives an attractive force here for the same parity while zero for opposite parity. For opposite parity bound states will form for $A \gtrsim 5$.

2873

Syracuse U. Dept. of Physics, N. Y.

KINEMATICAL AND DYNAMICAL RESONANCES, by A. O. Barut and K. H. Ruel. [1961] [10]p. incl. diagrs. (AFOSR-178) [AF 49(638)801] AD 611375
Unclassified

Also published in Phys. Rev., v. 122: 1340-1342, May 15, 1961.

A method is given to characterize and distinguish the kinematical and dynamical resonances in the scattering of elementary particles by studying the resonance energy as a function of the coupling constant. The ambiguity of the solutions of the dispersion relations is resolved and the relation of the kinematical and dynamical resonances to bound states is discussed. (Contractor's abstract)

2874

Syracuse U. Dept. of Physics, N. Y.

NATURE OF THE RESONANCE IN THE STATIC PION-NUCLEON SCATTERING IN ONE-MESON APPROXIMATION, by A. O. Barut and K. H. Ruel. [1961] [6]p. incl. diagr. (AFOSR-880) (AF 49(638)801) Unclassified

Also published in Nuclear Phys., v. 30: 462-467, Feb. 1962.

The solution of the Chew-Low integral equation for the static p-wave meson-nucleon scattering is studied as a function of the coupling constant to deduce the nature of the 33-resonance. It is shown that a dynamical resonance can occur for a suitable choice of the cut off function. The possibility of a kinematical resonance is also discussed and the effective range formula is derived directly from the dispersion relation. (Contractor's abstract)

2875

Syracuse U. Dept. of Physics, N. Y.

ON THE INTERACTION OF THE PION AND CASCADE PARTICLE, by S. Iwao. [1961] [3]p. (AFOSR-3825) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)801] and National Science Foundation) Unclassified

Also published in Prog. Theoret. Phys. (Japan), v. 26: 1008-1010, Dec. 1961.

The problem of whether the π-baryon coupling is either universal, direct or derivative is investigated. Using the static model resonance, energies of the π - Ξ system are predicted for both spin 1/2 and 3/2 hyperons and these may be observable in the reactions

$$K^- + p \rightarrow \Xi^{-*} + K^* \rightarrow \Xi^- + \pi^0 + K^+ \rightarrow \Xi^0 + \pi^- + K^+.$$

2876

Syracuse U. Dept. of Physics, N. Y.

PRELIMINARY DETERMINATION OF Σ - Λ PARITY USING POLOLOGY, by S. Iwao. [1961] [10]p. incl. tables, refs. (AFOSR-3827) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)-801] and National Science Foundation) Unclassified

Also published in Nuovo Cimento, Series X, v. 23: 516-525, Feb. 1, 1962.

A convenient expression for the normalization of the T-matrix pole term is given. The method of pology is applied to various processes. The coupling constant of the N Λ K interaction is determined from the $\bar{p} + p \rightarrow \Lambda + \bar{\Lambda}$ angular distribution. Further application of the method to $\Sigma^0 - K^0$ production from $\pi^- - p$ interactions and $\Sigma^- + \pi^+$ production from $K^- + p$ interactions indicate that the Σ - Λ relative parity is even, although this conclusion cannot be considered firm. This constitutes support for the hypothesis of global symmetry. Some additional applications of pology are suggested and discussed. (Contractor's abstract)

2877

Syracuse U. [Dept. of Physics] N. Y.

THE PION SPECTRUM IN RADIATIVE HYPERON DECAY, by S. Iwao and J. Leitner. [1961] [10]p. incl. diagr. (AFOSR-3925) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)801], National Science Foundation, and Office of Naval Research) Unclassified

Also published in Nuovo Cimento, Series X, v. 22: 904-913, Dec. 1, 1961.

The calculations of Barshay et al (Phys. Rev., v. 114: 931, 1959) on relative hyperon decay are extended to include the pion momentum spectra. The results show that radiative hyperon decay will appear as an important source of background in the study of hyperon leptonic decay. (Contractor's abstract)

2878

Syracuse U. [Dept. of Physics] N. Y.

LOW TEMPERATURE ELECTRON TRAPPING LIFETIMES AND EXTRINSIC PHOTOCONDUCTIVITY IN N-TYPE SILICON DOPED WITH SHALLOW IMPURITIES, by R. Levitt and A. Honig. Aug. 1, 1961, 16p. incl. diagrs. tables, refs. (Technical note no. 1) (AFOSR-1433) (AF 49(638)966) AD 264468 Unclassified

Presented at the 1961 Internat'l. Conf. on Photoconductivity, Cornell U., Ithaca, N. Y., Aug. 21-24.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 482, Nov. 24, 1961.

Also published in Jour. Phys. and Chem. Solids, v. 22: 269-284, Dec. 1961.

The trapping lifetimes of conduction electrons photoexcited from shallow impurities have been measured in the liquid helium temperature range for samples of n-type silicon whose donor and compensating acceptor concentrations vary from 10^{13} to 10^{16} impurities/cm^3. A steady state method was employed, in which the conduction electron lifetime t_L is equal to $n_e \tau^i / N_D^O$. n_e is the conduction electron concentration which is determined from low temperature photo-Hall measurements, and $N_D^O \tau^i$ is the electron generation rate. The neutral donor concentration N_D^O is measured by the Hall effect and τ^i, the lifetime against photoionization of a neutral donor, is obtained directly by an electron spin resonance technique. The trapping lifetimes t_L are generally independent of temperature between 4.2°K and 1.2°K, and are inversely proportional to the compensating acceptor concentration. This latter was determined using a recently developed combined infrared radiation and spin resonance method. The trapping cross-section result for phosphorus donors is about 5×10^{-12} cm^2 at 3°K. This is about an order of magnitude larger than the value obtained from the giant trap theory of Lax. Also, the concentration independence of the cross-section in the region of temperature independent t_L is not easily accounted for. The mobility of electrons photoexcited with 2 micron radiation considerably exceeds the mobility of electrons photoexcited with 8-25 micron radiation. This suggests the possibility of excitation to another band or minimum by the 2 micron radiation, as is also suggested by the free carrier absorption peak near 2 microns found in n-type silicon by Spitzer and Fan.

2879

Syracuse U. [Dept. of Physics] N. Y.

INVESTIGATION OF A POSSIBLE DIFFERENCE IN THE ELECTRIC CHARGES OF THE ELECTRON AND THE PROTON, by J. W. Trischka. Final rept. Oct. 1961 [20]p. incl. diagrs. (AFOSR-1698) (AF AFOSR-60-23A) Unclassified

The hypothesis that the expansion of the universe could be explained if the ratio of electron and proton charges differed from unity by a few parts in 10^{18} has long been disproven. Interest still exists in the measurement of the charge difference, however, and the author seeks possible ways of detecting that difference by the use of 2 methods: (1) the Vertical Electrical Field Apparatus in which an iron sphere is suspended by a vertical magnetic field, and a vertical electric field is used to produce motion in the charged sphere, and (2) the Horizontal Electric Field Apparatus which has a magnetic field which is very weak in 1 horizontal direction and the electric field in the same horizontal direction. It should be noted that these methods must detect charges whose magnitude is a fraction (e.g. 0.1) of the electronic charge. Thus far, however, neither method has been able to detect charges of this magnitude. However, much knowledge has been gained from the use of these apparatus and this report reviews them. They are: (1) a noise reducing circuit which improved the signal to noise ratio in measurements made with the VEFA; (2) an oscillation damper which prevents horizontal oscillations of the suspended sphere; and (3) a method for making iron spheres of the order of 0.003 in. in diameter. (Contractor's abstract, modified)

2880

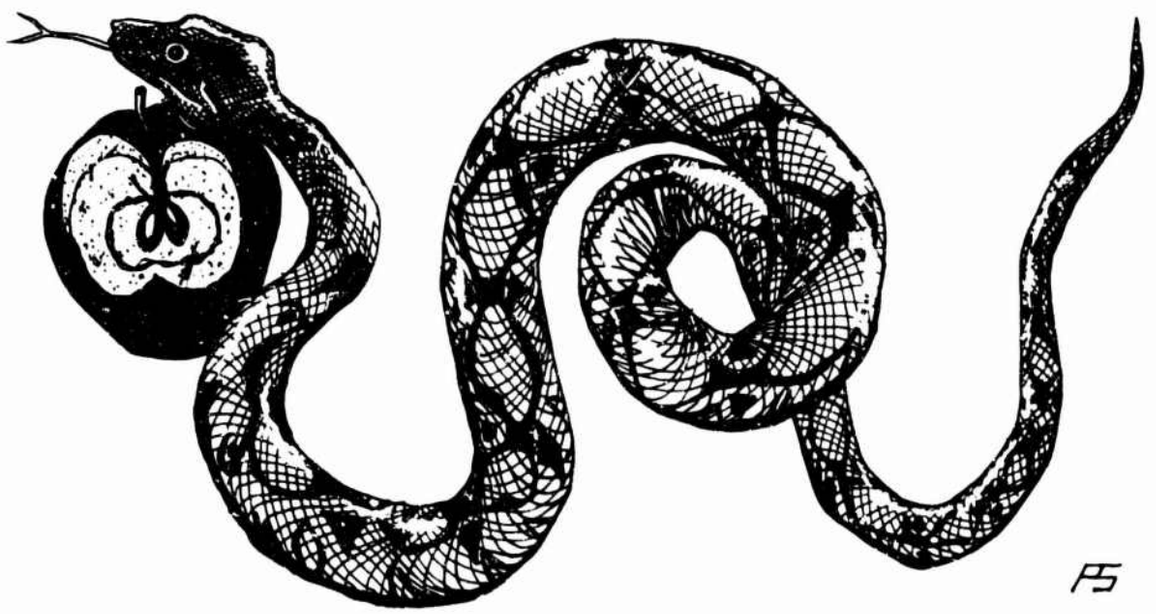
Syracuse U. [Research Inst. Dept. of Physics, N. Y.]

PRELIMINARY RESULTS ON THE HELICITY OF THE PROTON (Abstract), by J. Leitner, E. M. Harth and others. [1961] [1]p. [AF 49(638)588] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 63, Feb. 1, 1961.

Parity nonconservation in Λ decay induces a longitudinal polarization of the proton in the Λ rest frame. In the laboratory frame this appears as a transverse polarization proportional to α, the Λ decay asymmetry parameter. If the decay proton undergoes a subsequent elastic nuclear scattering, the transverse polarization can be detected by measuring the right-left asymmetry in an azimuthal scatter angular distribution. Previous experiments which measured this asymmetry in p-iron and p-carbon scattering have yielded contradictory results. Both experiments, however, are subject to a possible contamination by inelastic scattering. From an exposure of the helium bubble chamber to a low-energy K beam at the Bevatron, a sample is obtained of about 20-Λ decay protons which undergo subsequent scattering from helium. Since there are no excited states of helium, and since the scattered proton energy is low enough to be measured accurately by means of range, it is possible to rule out all inelastic contamination. The observed sample has an average transverse polarization of -0.80 α. Within the acceptance criteria, the observed average analyzing polarization is ~35%. The sample is being analyzed to obtain the sign of α (the negative of the proton helicity).



2881

Technical Research Group, Inc., Syosset, N. Y.

RESEARCH ON PROPERTIES OF LASER DEVICES, by M. C. Neustein. [1960] 1v. (Rept. no. 134TR2) (AFOSR-TN-60-370) (AF 49(638)673) AD 452586 Unclassified

The theoretical and experimental progress of a program to produce working models of LASER devices is presented. The theoretical performance of the oscillator is described and criteria are given which insure that the power output can be focussed to a Frauhofer spot. The first objective of the program is to demonstrate a population inversion by the coherent amplification of an optical signal. Various schemes are described. These include both gaseous and condensed systems. (Contractor's abstract, modified)

2882

Technical Research Group, Inc., Syosset, N. Y.

RESEARCH ON PROPERTIES OF LASER DEVICES, by R. T. Daly, G. Gould and others. Jan. 9, 1961, 80p. incl. illus. diagrs. (Rept. no. TRG-134-TR-4) (AFOSR-79) (AF 49(638)673) AD 401714 Unclassified

The progress of a program to produce working models of LASER devices is presented. Narrow-beam pulsed oscillations were observed at 6943A (R_1 line) from ruby crystals. The highest power observed corresponded to a brightness of nearly 10^8 watts/cm^2/ster/angstrom or about 10^9 times the brightness of the sun at this wavelength. Two satellite levels of concentrated ruby were determined to have sufficient population for Laser operation by absolute intensity measurements under pulsed excitation. On the basis of fluorescence measurements, certain rare earth ions appear suitable for CW operation if they can be obtained in suitable crystalline materials. The preparation of some of the more likely materials has been undertaken. The possibility of oscillation at 3 and 7 microns was investigated with optically pumped cesium vapor. The measurement of fluorescence at 3 microns with low-intensity lamps indicates that operation will be possible when the available high-intensity lamps are used. The radiative emission measurements at infrared and visible frequencies emitted by the Hg-Kr system using discharge excitation indicated a population inversion of about 10^6 atoms/cc for the 1.8 micron transition. An additional factor of 20 is required in this population excess to obtain the oscillation threshold. (Contractor's abstract)

2883

Technical Research Group, Inc., Syosset, N. Y.

CUBE-CORNER FABRY-PEROT INTERFEROMETER, by P. Rabinowitz, S. F. Jacobs and others. [1961] [2]p. incl. illus. diagrs. (AFOSR-2068) (AF 49(638)-673) Unclassified

Also published in Jour. Opt. Soc. Amer., v. 52: 452-453, Apr. 1962.

Polarized Haidinger fringes have been observed in a Fabry-Perot interferometer with one flat replaced by a cube-corner prism. Orientation of the polarization planes of the fringes and their relative phase shifts have been measured. Some applications have been suggested. (Contractor's abstract)

2884

Technical Research Group, Inc., Syosset, N. Y.

CROSSED ROOF PRISM INTERFEROMETER, by G. Gould, S. Jacobs and others. [1961] [2]p. incl. diagrs. refs. (AFOSR-2069) (AF 49(638)673) Unclassified

Also published in Appl. Opt., v. 1: 533-534, July 1962.

A modification of the Fabry-Perot resonator with relaxed alignment tolerances is described. Experimentally, fringes have been observed with a single roof reflector vs flat, as well as with 2 crossed roof reflectors. In the first case 2 front-surface mirrors were mounted at a right angle, forming a roof reflector. These opposed a 95%-reflecting multilayer flat. Two sets of fringes were observed; 1 set polarized normal and 1 parallel to the plane of incidence. Fringes were also observed when the roof reflector was replaced with a roof prism, making use of total internal reflection. In the second case the flat was replaced with a second roof reflector, oriented at right angles to the first roof reflector. A single set of fringes was observed in this case. Reflection loss has been virtually eliminated by employing total internal reflection in a prism; Fresnel losses were reduced by constructing the entrance faces at or near Brewster's angle.

2885

Technical Research Group, Inc., Syosset, N. Y.

COHERENT LIGHT AMPLIFICATION IN OPTICALLY PUMPED Cs VAPOR, by S. Jacobs, G. Gould, and P. Rabinowitz. [1961] [3]p. incl. diagrs. table. (AFOSR-2070) [AF 49(638)673] Unclassified

Also published in Phys. Rev. Ltrs., v. 7: 415-417, Dec. 1, 1961.

It is shown by calculation that, in Cs vapor pumped with He 3888A light, the $8P_{1/2}$ level can be populated substantially more than the lower levels $8S_{1/2}$ and $6D_{3/2}$, predicting "laser" action at 7.2 μ and 3.2 μ. Amplification by the stimulated emission at 3.2 μ was realized in a 90 cm optically pumped Cs cell, similar in form to the 9 cm source cell. Brief experimental details are given, with tests which are believed to rule out alternative explanation of the data.

2886

Technical Research Group, Inc., Syosset, N. Y.

SELF-ALIGNING FABRY-PEROT INTERFEROMETERS FOR USE AS LASER RESONATORS (Abstract), by G. Gould, S. F. Jacobs and others. [1961] [1]p. [AF 49(638)673] Unclassified

Presented at annual meeting of the Opt. Soc. Amer., Inc., Los Angeles, Calif., 1961.

Published in Jour. Opt. Soc. Amer., v. 51: 1467, Dec. 1961.

The retrodirective properties of cube corners and roof prisms were used to relax alignment tolerances of a Fabry-Perot interferometer. Devices of both types have been constructed and their characteristics as resonators and interferometers have been investigated. (Contractor's abstract)

2887

Technical Research Group, Inc., Syosset, N. Y.

POLARIZATION PROPERTIES OF CORNER REFLECTORS AND CAVITIES, by E. R. Peck. [1961] [5]p. incl. diagrs. [AF 49(638)673] Unclassified

Published in Jour. Opt. Soc. Amer., v. 52: 253-257, Mar. 1962.

The polarization properties of single-corner reflectors and of certain types of cavities using corner reflectors are investigated and described. States of polarization are found which remain invariant under transmission. Particular attention is given to the lossless case of total internal reflection. (Contractor's abstract)

2888

Technion - Israel Inst. of Tech., Haifa.

RESEARCH ON CROSS STRESSES IN THE FLOW OF RAREFIED AIR, by M. Reiner. Mar. 1, 1961, 1v. incl. illus. diagrs. tables, refs. (AFOSR-44) (AF 61-(052)223) AD 258433 Unclassified

The research conducted under this contract is briefly reviewed. It may be assumed that every liquid, including homogeneous simple liquids, possesses an elasticity of shape which gives rise to cross-effects for which the Navier-Stokes equations cannot account. The law of elasticity has not yet been determined and may be different for homogeneous simple liquids and high polymers. Cross-stresses are present in the laminar flow of di-atomic gases. These stresses diminish with diminishing ambient pressure. Therefore the Navier-Stokes equations cannot account for them. The cross-stresses act in both directions of plane laminar flow, namely the direction of flow, and the direction of the gradient flow. The first is a tension, the second a pressure. Both are second order effects, and are quantitatively proportional to the square of the velocity gradient. There does not exist a kinetic theory of gases which can account for them. The prevailing theories give a second order pressure in the direction of flow, which in addition should increase with diminishing ambient pressure. A theory attempted at by Reiner gives a second order tension in the direction of flow. The kinetic theories refer to monatomic gases. Further experimental investigations with mono- and polyatomic gases are required in order to check the existing kinetic theories for monatomic gases and provide further empirical data for a kinetic theory for di-and polyatomic gases. Contractor's abstract)

2889

Technion - Israel Inst. of Tech., Haifa.

CROSS-STRESSES IN THE FLOW OF RAREFIED AIR, by A. Foux and M. Reiner. Mar. 1, 1961 [39]p. incl. illus. diagrs. tables. (Bound with its AFOSR-44; AD 258433) (AF 61(052)223) Unclassified

The cross-stresses effect discovered by Reiner in the laminar flow of air at atmospheric pressure was investigated at 2/3 and 1/3 ambient air pressure. It was found that the effect decreases with decreasing ambient pressure, At higher rates of flow an instability sets in and a Taylor-Saffman effect is developed which increases with decreasing ambient pressure. (Contractor's abstract)

2890

Technion - Israel Inst. of Tech., Haifa.

CROSS-STRESSES IN THE LAMINAR FLOW OF GASES IN ACCORDANCE WITH MAXWELL'S DYNAMICAL THEORY, by M. Reiner. Mar. 1, 1961, 15p. incl. diagrs. (Bound with its AFOSR-44; AD 258433) (AF 61(052)223) Unclassified

It is shown that the cross-stresses in the laminar flow of gases seems to follow from the dynamical theory as developed by Maxwell without assuming non-Newtonian or cohesional forces. It is found that the second order stress superimposed upon the first order stress of classical hydrodynamics which appears in plane laminar shearing flow, is a tension in the direction of flow. In other words, the pressure in this direction is reduced. In torsional flow this implies a centripetal pumping effect. The pressure is always positive. This implies a self supporting thrust bearing action.

2891

Technion - Israel Inst. of Tech., Haifa.

SECOND-ORDER EFFECTS IN THE TORSIONAL FLOW OF A GAS IN ACCORDANCE WITH THE KINETIC THEORY, by M. Bentwich and M. Reiner. Mar. 1, 1961, 8p. (Bound with its AFOSR-44; AD 258433) (AF 61(052)223) Unclassified

If air is sheared in torsional flow between 2 discs, 1

stationary, the other rotating with constant velocity ω, and the distance d between both discs is very small (some microns) so that the velocity gradient ω/d is large, then Reiner has shown that the air is drawn inside between the discs in a centripetal manner, and that at the same time a thrust bearing pressure is developed between both plates. The purpose of this paper is to investigate whether an appropriate theory can be based on a kinetic theory of gases which takes account of second order effects. It is concluded that the phenomenon revealed in the experiments cannot be explained by kinetic theory.

2892

Technion - Israel Inst. of Tech., Haifa.

REAL AND COMPLEX DIFFERENTIAL SYSTEMS, by B. Schwarz. Final technical rept. Jan. 1961 [27]p. incl. diagr. (AFOSR-640) (AF 61(052)323) AD 258233 Unclassified

Some results on the frequencies of nonhomogeneous rods are presented. Two results are proved for the principal frequency of clamped nonhomogeneous rods; 1 corresponds to a theorem of P. R. Beesack and the other to a theorem of M. G. Krein for nonhomogeneous strings. An inequality is proved for the minima of the n-th frequency, $n = 2^k$, of clamped rods with equimeasurable density. The least positive eigenvalue for 2 classes of integral equations is considered. The L^2 kernels are symmetric and non-negative ($K(x, y) = K(y, x) \geq 0$, $0 \leq xy, y \leq a$). The maximum of the least positive eigenvalue λ_1 of the corresponding Fredholm equation for any equimeasurable class of these kernels is found. For the (larger) class of all these kernels which have a given L^2 norm and for which $K(x, y)$ is bounded by given non-negative constants h and H ($h \leq k(x, y) \leq H$, $0 \leq x, y \leq a$) both extrema of λ_1 are found. (Contractor's abstract)

2893

Technion - Israel Inst. of Tech., Haifa.

ON THE LEAST POSITIVE EIGENVALUE OF INTEGRAL EQUATIONS WITH EQUIMEASURABLE KERNELS, by B. Schwarz. [1961] [7]p. (AF 61(052)-323) Unclassified

Published in Trans. Amer. Math. Soc., v. 104: 488-494, Sept. 1962.

Let $K(x, y)$ be a non-negative, symmetric L^2 kernel defined for $0 \leq x, y \leq a$ with $0 < a < \infty$. Assume that $K(x, y) > 0$ on a set of positive measure. Let E(K) be the class of all symmetric kernels $M(x, y)$ equimeasurable to $K(x, y)$. For each $M \in E(K)$, let $\lambda_1(M)$ be the least positive eigenvalue of the integral equation $\varphi = \lambda M\varphi$. The author proves that $\max_{M \in E(K)} \lambda_1(M) = \{a^{-1} \int_0^a \int_0^a K(x, y)\,dxdy\}^{-1}$. The proof involves the construction of a kernel $K^*(x, y)$ in E(K) which is constant on each line parallel to the diagonal $y = x$. It is shown that the desired minimum is not unique; in fact, it is attained for a large subclass of E(K). The minimum is equal to the reciprocal of the L^2 norm of $K(x, y)$ if and only if E(K) contains a kernel of rank one, which is not generally the case. The author concludes with some remarks about the analogous problem for matrices. (Math. Rev. abstract)

2894

Technion - Israel Inst. of Tech., Haifa.

ANALYTIC ITERATION, by E. Jabotinsky. June 1961, 24p. incl. refs. (Technical note no. 1) (AFOSR-1672) (AF 61(052)482) AD 272418 Unclassified

Also published in Trans. Amer. Math. Soc., v. 108: 457-477, Sept. 1963.

The explicit expression for coefficients of the power series expansion of $[F(s,z)]^t$, where $F(s,z)$ is the s-iterate of an analytic function $F(z) = z + f_2z^2 + \ldots$ where s, in general, may be complex and t is any complex number, is given (Theorem I). This is preceded by the expose of previous results of the author in an appropriate form. The explicit expressions in Theorem I are applied to the computation of Grunsky's coefficients. Applications to problems of schlicht functions and iterations are indicated. (Contractor's abstract)

2895

Technion - Israel Inst. of Tech. [Dept. of Aeronautical Engineering] Haifa.

BUCKLING OF THIN CIRCULAR CONICAL SHELLS SUBJECTED TO AXISYMMETRICAL TEMPERATURE DISTRIBUTIONS AND EXTERNAL PRESSURE, by J. Singer. July 1961 [24]p. incl. diagrs. (Technical note no. 3) (AFOSR-859) (AF 61(052)339) AD 273070 Unclassified

A method for the analysis of the instability of conical shells under external pressure is applied to the problem of buckling due to axisymmetrical temperature distributions. The method is based on a solution of the Donnell type stability equations, derived by Seide, and rederived in a modified form to facilitate solution by the Galerkin method. The solution implies slightly relaxed boundary conditions for the u and v displacements, but for the w displacements the usual conditions of simple supports are enforced rigorously. The procedure for the calculation of a critical temperature parameter is described in detail and the method is then extended to the case of a shell subjected simultaneously to external pressure and axisymmetrical temperature distributions. The thermal stresses needed for the stability analysis are computed with the aid of a solution of Meissner equations, in the presence of axisymmetrical temperature distributions, developed by Huth. Typical cases are analyzed. (Contractor's abstract)

2896

Technion - Israel Inst. of Tech. Dept. of Aeronautical Engineering, Haifa.

THE EFFECT OF AXIAL CONSTRAINT ON THE INSTABILITY OF THIN CIRCULAR CYLINDRICAL SHELLS UNDER UNIFORM AXIAL COMPRESSION, by J. Singer. Sept. 1961 [9]p. incl. diagrs. (Technical note no. 4) (AFOSR-2028) (AF 61(052)339) AD 271631 Unclassified

Also published in Internat'l. Jour. Mech. Scl., v. 4: 253-258, 1962.

The effect of axial elastic restraint on the instability of a circular cylindrical shell under uniform axial compression is analyzed by a Rayleigh-Ritz approach within the bounds of linear theory. The effect is calculated for a wide range of parameters, and design curves are presented for the percentage increase in critical load. (Contractor's abstract)

2897

Technion - Israel Inst. of Tech. Dept. of Aeronautical Engineering, Haifa.

A DONNELL TYPE THEORY FOR BENDING AND BUCKLING OF ORTHOTROPIC CONICAL SHELLS, by J. Singer. Dec. 1961, 16p. incl. diagrs. (Technical note no. 5) (AFOSR-2372) (AF 61(052)339) AD 279952 Unclassified

Donnell type equations are derived for bending and buckling of thin circular orthotropic conical shells. These equations reduce to the equations for orthotropic cylindrical shells, derived by Bodner, when the cone angle approaches zero, and to Seide's equation for the case of an isotropic shell. Uncoupled stability equations for the axial and circumferential displacements u and v are given, as well as an eighth-order equation for the radial displacement w. An alternative Batdorf type modified equation for w alone is presented. (Contractor's abstract)

2898

Technion - Israel Inst. of Tech. [Dept. of Mathematics] Haifa.

CLASSES OF BIORTHONORMAL SYSTEMS. II, by J. Steinberg. Final technical rept. Oct. 1961, 36p. incl. refs. (AFOSR-2210) (AF 61(052)324) AD 272420 Unclassified

Also published in Ann. Math. Pura et Appl., v. 59: 285-318, 1962.

The (A)-summability and mean-convergence of Fourier series in terms of certain biorthonormal systems have been investigated. The problem of completing a set of polynomials to a biorthonormal system has been solved in the case of certain sets of type zero (Sheffer's classification). (Contractor's abstract)

2899

Technion - Israel Inst. of Tech. Dept. of Physics, Haifa.

SOME INVESTIGATIONS OF THE GRAVITATIONAL FIELD EQUATIONS, by A. Peres and N. Rosen. [1959] [5]p. [AF 61(052)428] Unclassified

Published in Les Theories Relativistes de la Gravitation; Colloq. Internationaux du Centre National de la Recherche Scientifique, Royaumont (France) (June 21-26, 1959), Paris, Centre National de la Recherche Scientifique, 1962, p. 415-419.

By taking time-averages in a weak field approximation, it is concluded that the presence of non-linear terms in Einstein's vacuum field equations excludes the possibility of small stable oscillations of the field about an asymptotically Minkowskian equilibrium. (Math. Rev. abstract)

2900

Technion - Israel Inst. of Tech. Dept. of Physics, Haifa.

COLLECTIVE MOTIONS IN A PLASMA DUE TO MAGNETIC INTERACTION, by G. Kalman. [1961] [3]p. [AF 61(052)428] Unclassified

Published in Nuovo Cimento, Series X, v. 20: 198-200, Apr. 1, 1961.

A report of a calculation of the transverse modes of oscillation of a plasma with no applied magnetic field is presented. The Bohm-Pines method is used and Coulomb interactions are neglected.

2901

Technion - Israel Inst. of Tech. Dept. of Physics, Haifa.

VELOCITY-DEPENDENT CORRELATIONS IN THE STATISTICAL DISTRIBUTION OF THE ELECTRIC MICROFIELD IN A PLASMA, by A. Ron and G. Kalman. [1961] [6]p. incl. diagrs. refs. [AF 61(052)-428] Unclassified

Published in Phys. Rev., v. 123: 1100-1105, Aug. 15, 1961.

The polarization of a plasma in the neighborhood of a moving ion depends on the ion velocity. This affects the distribution of the stochastic field acting upon the ion. The correction to the Holtsmark distribution due to the complete test particle - field particle correlation including this dynamic effect is calculated up to the order e^2. The results are: (1) a shift towards smaller fields, (2) anisotropy, and (3) velocity dependence, which is not necessarily equal to the zero velocity effect even on the average. (Contractor's abstract)

2902

Technion - Israel Inst. of Tech. Dept. of Physics, Haifa.

LIOUVILLE-EQUATION IN RELATIVISTIC DYNAMICS, by G. Kalman. [1961] [2]p. [AF 61(052)428] Unclassified

Published in Nuovo Cimento, Series X, v. 23: 908-909, Mar. 1, 1962.

The author quotes some works of others and his own which prove the impossibility of a Hamiltonian formalism of relativistic dynamics, and then proves that the Liouville equation can be saved from this crisis. (Math. Rev. abstract)

2903

Technion - Israel Inst. of Tech. Dept. of Physics, Haifa.

MAGNETIZATION PROCESS AND DOMAIN STRUCTURE FROM MAGNETORESISTANCE MEASUREMENTS IN THIN NICKEL WIRES, by A. A. Hirsch, N. Friedman, and G. Gorodetsky. [1961] [3]p. incl. diagrs. (AFOSR-J576) (AF 61(052)481) AD 414024 Unclassified

Presented at Internat'l. Conf. on Magnetism and Crystallography, Kyoto (Japan), Sept. 25-30, 1961.

Also published in Jour. Phys. Soc. Japan, v. 17: Suppl. B-I: 651-653, Mar. 1962.

From measurements of the magnetoresistance effect in thin nickel wires, conclusions are drawn about the mechanism of the magnetization process and the possible domain structure. The experimental data for the hysteresis loops of magnetoresistance are given at liquid air and room temperatures when a single magnetic field or 2 crossed magnetic ones are applied. The theoretical analysis using a simple model of single domain structure indicated that this is true if the magnetic anisotropy is made up of a uniaxial and a cubic magnetocrystalline component. The formation of magnetization curves composed of 2 or 3 closed loops at low temperatures is interpreted. (Contractor's abstract)

2904

Technion - Israel Inst. of Tech. Dept. of Physics, Haifa.

TEMPERATURE DEPENDENCE OF COERCIVITY AND DOMAIN STRUCTURE IN THIN FERROMAGNETIC LAYERS, by A. A. Hirsch. [1961] [12]p. incl. diagrs. refs. (AFOSR-J577) (AF 61(052)491) AD 414126 Unclassified

Also published in [Electric and Magnetic Properties of Thin Metallic Layers] Elektrische en Magnetische Eigenschappen van Dunne Metaallaagjes; a Symposium, Liège (Belgium) (Sept. 4-7, 1961), Brussels, Paleis der Acad., 1961, p. 128-138.

The temperature dependence of coercivity for static reversals which has been observed in some ferromagnetic layers is different from that expected from theories describing the layers as built from single domain particles, in which the magnetization process occurs by rotation in unison of electron spins. In a previous paper (Physica, v. 25: 581, 1959) the author suggested a possible explanation for the same phenomenon, supposing that thermal fluctuations can contribute to a process of large magnetization jumps. This work has now been extended also to transient effects of magnetization which are observed in layers submitted to dynamical asymmetrical changes of the external magnetic field. It has been shown that the origin of both phenomena may be related to the same mechanism of transition of the magnetization vector from metastable equilibrium states to stable ones. Calculations of theoretical reversals have indicated that the occurrence of the metastable equilibrium states are possible in a magnetic structure composed of domains with mixed crystalline and uniaxial anisotropies. A possible explanation for observed apparent paramagnetic layers has been outlined briefly. (Contractor's abstract)

2905

Technische Hochschule, Hannover (Germany).

DYNAMICS OF STRUCTURES BY TRANSFER MATRICES, by E. Pestel. Final rept. June 1961 [260]p. incl. diagrs. tables. (AFOSR-1449) (AF 61-(052)302) AD 265036 Unclassified

The method of transfer matrices is applied to the static and kinetic treatment of multicell-box-girders. Such structures generally consist of a rectangular system of straight beams, which are interconnected by thin upper and lower cover-plates. The substitute system is an orthogonal grid of spars and bulkheads to which at their crossing points torque boxes are hinged. The elements of the state vector, i.e. the deflection w, the slope φ, the bending moment M and the shear Q, are assembled for all spars at 1 boundary of the system in a single state vector. The transfer of these elements takes place over the entire width of the system through repeated multiplications of square matrices, which are set up for each section between successive bulkheads. The product of all transfer matrices interconnects the 2 state vectors at the 2 boundaries of the system. For the investigation of the natural vibration of the structure, the boundary conditions yield a system of homogeneous linear equations, the determinant of which is set equal to zero in order to obtain the frequency equation. (Contractor's abstract)

2906

Technische Hochschule, Hannover (Germany).

THIN-WALLED COMPRESSION MEMBERS, by A. Pflüger. Mar. 1961, 33p. incl. diagrs. (Technical rept. no. 3) (AFOSR-1160) (AF 61(052)365) AD 262195 Unclassified

Research was concerned with the postbuckling behavior of thin-walled columns. The instability in the elastic and plastic range was considered in previous reports (item nos. 2085 and 2086, Vol. III). Also, the effect of elevated temperature on buckling was investigated. The ultimate or crippling strength of thin-walled columns, the Euler buckling strength of locally buckled columns, and the failure load of angle sections were determined experimentally. Graphs were prepared to provide for an easy application of the results. A method was proposed for approximately determining the buckling loads of columns at raised temperatures by properly reducing the values at room temperature. These considerations were based on test results taken from the available literature. (Contractor's abstract)

2907

Technische Hochschule, Munich (Germany).

[CHANGES IN THE POOL SIZES OF VARIOUS INTERMEDIATES DURING PHOTOSYNTHESIS IN CHLORELLA] Veränderungen von Zwischenstoffkonzentrationen bei der Grünälge Chlorella in Abhängigkeit von der Photosynthese, by I. Liesenkotter. Nov. 1961 [110]p. incl. illus. diagrs. tables, refs. (AFOSR-4350) (AF 61(052)244) Unclassified

The first part of the present report describes experiments in which the influence of external factors (such as glucose-feeding, light-dark transition and different gas phases) on the pool sizes of intermediates in respiration and photosynthesis of Chlorella is investigated. In the second part the influence of different metabolic inhibitors (MJAA, Arsenate, 2, 4-DNP, and KCN) is reported. Some experiments with C^{14} were carried out in order to obtain a more complete picture.

2908

Technische Hochschule. [Mathematical Inst.] Munich (Germany).

METHODS OF HYPERSONIC FLOW THEORY, by C. V. Conta. Feb. 28, 1961, 39p. incl. illus. (Technical note no. 3) (AFOSR-809) (AF 61(052)377) AD 258079 Unclassified

Shock relations of an ideal gas are discussed for two limiting cases (K. OSWATITSCH, Zeitsch. Angew. Math. und Phys., v. 2: 249-264, 1951 and H. S. TSIEN, Jour. Math. and Phys., v. 25: 247-251, 1946). The first triangle of the characteristic net is investigated for the case of plane flow past a contour with attached bow shock. Results are applied to shock expansion method and power law bodies. In the case of blunt bodies, relations on the boundary of the elliptic region are considered. Newtonian theory is discussed. (Contractor's abstract)

2909

Technische Hochschule. [Mathematical Inst.] Munich (Germany).

PRACTICAL NUMERICAL METHODS OF THREE-DIMENSIONAL SUPERSONIC FLOW, by R. Sauer. Final rept. June 1, 1961, 25p. incl. illus. (AFOSR-1262) (AF 61(052)377) AD 264817 Unclassified

Research pertaining to the following has been carried out: investigations on the numerical methods for non-linear supersonic flow equations; problems of 2-dimensional unsteady non-linear flows; and Dorodnicyn's methods for the treatment of the blunt body problem. (Contractor's abstract, modified)

2910

Technische Hochschule. [Mathematical Inst.] Munich (Germany).

ON THE CONVERGENCE OF CHARACTERISTIC FINITE-DIFFERENCE METHODS OF HIGH ACCURACY FOR QUASI-LINEAR HYPERBOLIC EQUATIONS, by H. J. Stetter. [1961] [24]p. incl. diagrs. refs. (AFOSR-3108) (AF EOAR-61-21) Unclassified

Also published in Numerische Math., v. 3: 321-344, 1961.

A large family of finite-difference methods for the numerical solution of the problem treated by Thomas are constructed and necessary and sufficient conditions for their convergence are established. Subsequently, these schemes which seem suitable for practical use are investigated in detail and their coefficients and properties are assumed in the concluding section.

2911

Technische Hochschule. [Mathematical Inst.] Munich (Germany).

[A DIFFERENCE METHOD FOR APPROXIMATE SOLUTIONS OF INITIAL-VALUE PROBLEMS FOR HALF-LINEAR PARTIAL DIFFERENTIAL EQUATIONS. I. AXIOMS] Ein Differenzenverfahren zur näherungsweisen Lösung des Anfangswertproblems für Systeme halblinearer partieller Differentialgleichungen. I. Ordnung, by R. Albrecht and W. Urich. [1960] [16]p. (AFOSR-3423) (AF EOAR-61-21) Unclassified

Also published in Numerische Math., v. 3: 131-140, 1961.

Consider the initial-value problem (*) $a_{ik}{}^{0}\frac{\partial u^k}{\partial t} + a_{ik}{}^{\nu}(t,x)\frac{\partial u^k}{\partial x^\nu} = b_i(t,x,u)$, $u^k(0,x) = \bar{u}^k(x)$, where $i, k = 1, 2, \ldots, m$; $\nu = 1, 2, \ldots, n$; $a_{ik}{}^{0} = \text{const} \neq 0$; $\det(a_{ik}{}^{0}) \neq 0$; $x = (x^1, \ldots, x^n)$; $u = (u^1, \ldots, u^m)$; and where we have used the summation convention. It is assumed that (*) has at most one solution and that the $a_{ik}{}^{\nu}$, b_i and $\bar{u}^k$ are of class C^1 in all arguments. The authors write the system (*) in the form (**)

$a_{ik}{}^{0}\left(\frac{\partial u^k}{dt}\right)_{(ik)} = b_i(t, x, u)$ (no summation over indices in parenthesis), where $\left(\frac{\partial u^k}{dt}\right)_{(ik)} = \frac{\partial u^k}{\partial t} + \frac{\partial u^k}{\partial x^\nu}\left(\frac{a^\nu{}_{(ik)}}{a^0{}_{(ik)}}\right)$. Let $x^\nu = x^\nu{}_{(ik)}(t, \tau, \xi)$ be the solution of $dx^\nu/dt = a^\nu{}_{(ik)}/a^0{}_{(ik)}$ through the point (τ, ξ). The authors approximate (**) by replacing $(du^k/dt)_{(ik)}$ by $(\tau-\tau_0)^{-1}\{U^k\}(\tau;\xi) - U^k(\tau_0; x_{(ik)}(\tau_0, \tau, \xi))$. Let $U_N{}^k(x, t)$ denote the approximation obtained by the scheme described above corresponding to the subdivision of the t-interval $[0, \delta]$ into N equal parts. The authors prove that if the assumptions stated above are satisfied and if the $\partial U_N{}^k/\partial x^\nu$ form an equicontinuous family, then the $U_N{}^k$ converge uniformly to the solution of (*) as $N \to \infty$. (Math. Rev. abstract)

2912

Technische Hochschule, Vienna (Austria).

[THERMAL STRESS IN DELTA WINGS] Wärmespannungen in Dreiecksflügeln, by L. Böswirth. [1961] [15]p. incl. diagrs. refs. (AFOSR-1664) (AF 61(052)-214) AD 456403 Unclassified

Also published in Osterr. Ingr.-Arch., v. 16: 30-47, 1961.

The thermal stress in one out of four shallow conical shells for delta wings is calculated. The temperature field is so symmetric that, regarding this, the vertically symmetrical plane of the wings is assumed, however knowledge of this is optional. A numerical example is calculated. (Contractor's abstract)

2913

Technische Hochschule, Vienna (Austria).

[BREAKING DOWN A FLAT SPHERICAL SHELL OF VISCO-ELASTIC MATERIAL] Durchschlagen einer flachen Kugelschale aus viskoelastischem Material, by V. E. Tungl. [1961] [13]p. incl. diagrs. tables. (AFOSR-J526) (AF 61(052)214) Unclassified

Also published in Osterr. Ingr.-Arch., v. 16: 286-298, 1962.

For a flat, thin spheroidal disk of incompressible viscoelastic raw material under temperature change and right axle load the breakdown time is found. The numerical evaluation for the quasistatic problem of the spherical sector is given, holding the temperature constant. (Contractor's abstract)

2914

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 WITH THE OBJECTIVE OF ESTABLISHING THE MOST EFFICIENT AND EFFECTIVE COMBINATION OF CHAMBER DIAMETER, CHAMBER LENGTH AND E-FUNCTION SHAPE OF THE SWIRL PLANE, by W. Rogner. Final technical rept. Apr. 1-May 31, 1961. June 30, 1961, 39p. incl. illus. (AFOSR-1354) (AF 61(052)-385) AD 264082 Unclassified

The 2 most important operational requirements were considered to be: (1) uniform temperature distribution in the flue at the combustion chamber exit; and (2) good combustion and combustion chamber efficiency. Air quantities injected were: the primary air used for combustion of atomized fuel; the secondary air for cooling hot combustion gases and the pipe wall; and the tertiary air used to maintain uniform temperature at the exit. Problems concerned with maintaining a total air quantity of 320 kg/h and efficient balance of the 3 air quantities are discussed. Experiments with combustion chambers of differing sizes resulted in the conclusions that greater constructional length would increase the chamber efficiency, and larger inlet and exit cross-sections would have an adverse effect due to the reduction of flow velocity. (Contractor's abstract)

2915

Texaco Experiment, Inc., Richmond, Va.

RECOMBINATION OF IONS IN FLAMES. EFFECT OF TEMPERATURE, by I. R. King. Aug. 1, 1961, 5p. incl. diagrs. (Technical publ. no. 165A; EXP-278) (AFOSR-463) (AF 49(638)650) AD 454648 Unclassified

Also published in Jour. Chem. Phys., v. 37: 74-80, July 1, 1962.

Some results are reported in which the recombination coefficient of natural flame ions has been determined as a function of flame temperature. Measurements were conducted with an alternate-probe technique in a propane-air flame. Flame temperatures were varied by (a) varying the fuel-air ratio, (b) diluting the flame with nitrogen, (c) using a water-cooled burner grid to extract heat from the flame, and (d) replacing the nitrogen in the air with argon. Although the temperature range covered was fairly small (400°K) and a certain amount of scatter in the results was unavoidable, the results showed a definite trend: the recombination rate increases slightly with increasing temperature. The order of magnitude of the recombination coefficient (10^{-7} cm^3/sec) indicates either third-body or dissociative recombination must be the predominant process in these flames. An ion-ion process agreeing with the Langevin prediction is indicated.

2916

Texaco Experiment, Inc., Richmond, Va.

RECOMBINATION OF IONS IN FLAMES, by I. R. King. Dec. 15, 1961, 30p. incl. diagrs. tables, refs. (Technical publ. no. 174A: EXP-278) (AFOSR-596) (AF 49(638)650) AD 271360 Unclassified

A technique for measuring recombination rates in flames is described and some results showing the effect of temperature, pressure, and the presence of electronegative gases on recombination are presented. Experimental results are compared with predictions based on present-day theories of recombination. Results are interpreted in terms of an ion-ion process with recombination occurring most probably between an OH(-) and an $H_3O(+)$ ion. The importance of electron attachment in such a process is emphasized.

2917

Texaco Experiment, Inc., Richmond, Va.

RECOMBINATION RATES OF ALKALI METAL IONS, by I. R. King. Dec. 1, 1961, 5p. incl. table. (Technical publ. no. 168A; EXP-278) (AFOSR-1519) (AF 49(638)650) Unclassified

Also published in Jour. Chem. Phys., v. 36: 553-554, Jan. 1962.

Recombination rates of a number of alkali metal ions have been determined at a temperature of 1970°K and a pressure of 1 atm. Results show that recombination coefficients vary in the same order as the ionization potentials of the ionized species. Generally speaking, the chloride compounds gave somewhat lower values than the carbonates. The chloride compounds also gave more positive ions than the carbonates. This is in good agreement with results obtained when chlorine gas was added to a hydrocarbon-air flame. That is, the chlorine caused an increase in positive-ion concentration and a decrease in electron concentration at a fixed point in the flame. Of considerable interest is the fact that the recombination coefficients not only vary from salt to salt but they also correlate roughly with the ionization potential of the salts. In all cases the recombination coefficients in flames containing alkali metal salts were some 2 orders of magnitude smaller than those for natural ions, which indicate that recombination is most likely occurring between an ion and an electron rather than between 2 ions.

2918

Texas A. and M. Coll. [Dept. of Physics] College Station.

TRANSLATIONAL AND ROTATIONAL CONTRIBUTIONS TO NUCLEAR SPIN-LATTICE RELAXATION IN BENZENE (Abstract), by M. Eisner and R. W. Mitchell. [1961] [1]p. [AF 18(600)1300] Unclassified

Presented at meeting of the Amer. Phys. Soc., Mexico City (Mexico), June 22-24, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 363, June 22, 1961.

T_1 measurements have been made on protons in C_6H_6-C_6D_6 solutions. The rotational contribution to the relaxation of benzene protons is obtained from the infinite dilution value inferred by extrapolation. $1/T_1$ is found to be a linear function of volume fraction and the translational contribution is found from the difference of $1/T_1$ for the pure C_6H_6 and the infinite dilution $1/T_1$. The rotational and translational relaxation times found in this manner are 60 and 30 sec, respectively. The rotational correlation time is calculated and found to be 2.0×10^{-12} sec in reasonable agreement with $2.3 \text{ sec} \times 10^{-12}$ sec, the value inferred from the rotational relaxation time. Using the value of the diffusion coefficient measured by spin-echo techniques, a translational relaxation time of 30 sec is obtained assuming the distance of closest approach during collision to be 5.0×10^{-8} cm.

2919

Texas A. and M. Coll. [Dept. of Physics] College Station.

THE DOUBLE MINIMUM POTENTIAL OF H_2CO (Abstract), by N. W. Naugle, Jr., R. Henderson, and J. B. Coon. [1959] [1]p. [AF 49(638)593] Unclassified

Presented at Symposium on Molecular Structure and Spectroscopy, Ohio State U., Columbus, June 15-19, 1959.

Published in Spectrochim. Acta, v. 15: 753, Oct. 1959.

The energy levels and wave functions have been obtained for a convenient double minimum potential function with 2 parameters. The problem has been solved in dimensionless form so as to be applicable to any double minimum problem. As a test case the O^+, 1^+ and 1^- levels known for NH_3 lead to a barrier height within 5%, and a displacement of the N atom from the H plane within 10%, of the known values. For the low barriers of H_2CO the present method is expected to give better results than for the high barrier of NH_3. The barrier height B and the angle θ_m of out-of-plane bending, are determined for the $^1A_2$ electronic state of H_2CO and D_2CO using values of the O^+, O^- and 1^+ levels given by Robinson. The results are $B(H_2CO) = 379 \text{ cm}^{-1}$, $B(D_2CO) = 376 \text{ cm}^{-1}$, $\theta_m(H_2CO) = 30.94°$ and $\theta_m(D_2CO) = 31.16°$. If the 1^- level is given a weight equal to that of the other levels a barrier more than 100 cm^{-1} higher is obtained. However, it is reasonable that the lower levels should lead to the best barrier height. The levels O^+, O^- and 1^+, known for the $^3A_2$ state of H_2CO, lead to a barrier height $B = 793 \text{ cm}^{-1}$ and a bending angle $\theta_m = 40.0°$.

2920

Texas A. and M. Coll. [Dept. of Physics] College Station.

THE FRANCK-CONDON PRINCIPLE AND THE STRUCTURES OF EXCITED ELECTRONIC STATES OF MOLECULES, by J. B. Coon, R. E. DeWames, and C. M. Loyd. [1961] [15]p. incl. diagrs. tables, refs. (AFOSR-1313) (AF 49(638)593) AD 412609 Unclassified

Also published in Jour. Molec. Spectros., v. 8: 285-299, Apr. 1962.

An approximate method is described for quantitatively applying the Franck-Condon principle to the problem of determining the structure of an excited electronic state of a simple polyatomic molecule. The method is applicable to an electronic transition for which both electronic states have structures of the same symmetry. Necessary information includes the geometrical structure and the totally symmetrical frequencies of the ground state, as well as the vibrational analysis of a vibronic band system and the resulting information about the totally symmetrical frequencies of the excited state. The relative intensities of a few selected vibronic bands must be measured. One dimensional Condon overlap integrals for these bands are expressed in terms of parameters which depend on the change of the geometrical structure with the electronic transition. A comparison of the squares of the overlap integrals with the band intensities permits the evaluation of the geometrical parameters. In an initial calculation the normal coordinates of the excited state are assumed to be parallel to those known for the ground state. The approximate excited state structure calculated on this basis is used to determine more exact normal coordinates of the excited state. A final calculation based on these coordinates yields an improved excited state structure. Actually there are always several excited state structures consistent with band intensities. It is therefore necessary to have some additional information from the band envelopes. As examples, the structures of 1 excited state of ClO_2 and of 2 excited states of SO_2 are determined. (Contractor's abstract)

2921

Texas A. and M. Coll. [Dept. of Physics] College Station.

THE FRANCK-CONDON PRINCIPLE AND THE 3600A SYSTEM OF CO_2 (Abstract), by J. B. Coon, R. E. DeWames and others. [1961] [1]p. [AF 49(638)593] Unclassified

Published in Symposium on Molecular Structure and Spectroscopy, Ohio State U., Columbus, June 12-16, 1961, p. 18.

Also published in Spectrochim. Acta, v. 17: 1093, Oct. 1961.

A simple method of applying the Franck-Condon principle to polyatomic molecules leads to the geometrical structure of the excited electronic state of the 3600A system of ClO_2. The calculation is based on the photographically measured relative intensities of the vibronic bands (ν'_1, ν'_2, O) where $\nu'_1 = 0, 1, 2$ and $\nu'_2 = 0, 1$. Of the 4 excited state structures consistent with observed intensities the structure ($r' = 1{\cdot}623A$, $2\alpha' = 107°46'$) agrees well with the structure known from the rotational spectra of the vibronic bands, ($r' = 1{\cdot}620A$, $2\alpha' = 107°24'$). The structure of the ground state used in this calculation is ($r'' = 1{\cdot}472A$, $2\alpha'' = 117°24'$). Certain excited state vibrational levels have been previously interpreted as 1^+ and 2^+ of a double minimum potential in the anti-symmetrical coordinate Q'_3. A double minimum potential function consistent with the observed levels has been found. A Franck-Condon calculation using the wave functions of these levels explains the relative intensities of some of the most prominent bands.

2922

Texas A. and M. Coll. Dept. of Physics, College Station.

NUCLEAR MAGNETIC RELAXATION OF A THREE-SPIN ASYMMETRIC MOLECULE IN A LIQUID, by G. W. Kattawar and M. Eisner. [1961] [3]p. incl. diagr. (AFOSR-J220) (AF AFOSR-62-151) AD 400439 Unclassified

Also published in Phys. Rev., v. 126: 1054-1056, May 1, 1962.

The semiclassical density-matrix theory of relaxation is employed to calculate the relaxation of the z component of nuclear magnetization of molecules in a liquid for the case in which 3 identical nuclei of spin 1/2 are arranged at the vertices of an isosceles triangle whose angles are 30°, 30°, and 120°. It is found that, if the initial state of the spin systems is characterized by a spin temperature, the relaxation consists of the sum of a 7 terms which decay exponentially with different time constants. It is also found that even though the z component of the magnetization is a function of 7 distinct time constants, a plot of $\ln(M_z - M_{eq})$ can be approximated by a single straight line for regions of experimental interest. The time constant for this straight line differs less than 1% from the average relaxation time calculated from the formulas of Gutowsky and Woessner. (Contractor's abstract)

2923

Texas Technological Coll. Dept. of Chemistry, Lubbock.

THE THERMAL DEAQUATION OF SOME AQUOPENTAMMINE-COBALT(III) COMPLEXES, by W. W. Wendlandt and J. L. Bear. [1961] [4]p. incl. diagrs. table, refs. (AFOSR-293) (AF 49(638)787) AD 252982 Unclassified

Also published in Jour. Phys. Chem., v. 65: 1516-1519, Sept. 1961.

The thermal deaquation of $(Co(NH_3)\ 5H_2O)X_3$ type

complexes, where X is Cl^-, I^-, and NO_3^-, was studied. The kinetics of the deaquation reaction was found to obey a first order rate law, with activation energy values ranging from 19 ± 2 to 31 ± 3 kcal. The heats of deaquation, as determined by quantitative differential thermal analysis, were 6.1 and 7.8 kcal mole for the chloride and bromide complexes, respectively. Dissociation pressure measurements of the deaquation reaction showed it to be irreversible in the solid state. (Contractor's abstract)

2924

Texas Technological Coll. Dept. of Chemistry, Lubbock.

THE KINETICS AND HEATS OF OLATION OF SOME HYDROXOAQUOTETRAMMINECOBALT(III) COMPLEXES, by W. W. Wendlandt and J. K. Fisher. [1961] [4]p. incl. diagrs. table, refs. (AF 49(638)-787) Unclassified

Published in Jour. Inorg. and Nuclear Chem., v. 24: 1685-1688, Dec. 1962.

It is known that when hydroxoaquotetramminecobalt(III) complexes are heated to about 100°C, the following olation reaction takes place: $2[(NH_3)_4Co(OH)OH_2]X_2 \rightarrow [(NH_3)_4Co(OH)_2Co(NH_3)_4]X_4 + 2H_2O$. The products are water vapor and the binuclear cobalt(III) complex containing 2 -OH bridging groups. Similar reactions have been observed for the hydroxoaquobis(ethylenediamine)cobalt(III) and chromium(III) complexes. More recently, the olation process has been used to explain the partial heterogeneous dehydration of various salt hydrates. Since most processes have been observed in solution, it was of interest to examine the solid-state olation reaction in the cobalt(III) complexes and to determine the kinetics and heat of olation by the technique of differential thermal analysis. (Contractor's abstract)

2925

Texas U. Dept. of Chemical Engineering, Austin.

A STUDY OF NEODYMIUM SUBSTITUTED YTTRIUM IRON GARNET, by T. H. Ramsey, Jr., H. Steinfink, and E. J. Weiss. [1961] [6]p. incl. diagrs. tables, refs. (AFOSR-J36) (Sponsored jointly by [Air Force Office of Scientific Research under AF AFOSR-62-237] and Edward Orton, Jr. Ceramic Foundation) Unclassified

Also published in Jour. Phys. and Chem. Solids, v. 23: 1105-1110, Aug. 1962.

Yttrium iron garnet ($3Y_2O_3$, $5Fe_2O_3$), a ceramic magnetic material, belongs to the ferrite family. This research has made a study of this garnet in which a portion of the yttrium has been replaced with neodymium, causing a ferro rather than a ferri magnetic alignment of moments. Precision determination of lattice parameters showed that 1.95Nd could substitute for Y. Electrical and magnetic evaluations were made for several substituted compositions. Resistivities were 10^7-10^{11} Ω-cm, depending on processing. For the NdYIG series, the maximum curie temperature was 295°C, and the maximum saturation magnetization was 2100G. The initial permeability, μ_o, varied from 24-38 depending on composition.

2926

Texas U. [Dept. of Chemistry] Austin.

EXPLORATORY EXPERIMENTS OF SURFACE DEPOSITS ON METALS FROM PYROLYSIS OF HYDROCARBONS. II. SURFACE COMPLEXES WITH ALKYNES. III. ALKYNE COMPLEXES WITH METAL IONS, by R. J. Wallace, W. L. Hopper and others. Dec. 1961, 12p. (Technical note no. 7) (AFOSR-1946) (AF 18(603)142) AD 270516 Unclassified

Studies were made of the gas phase reactions of alkyne vapors and of the chemisorption of liquid alkynes or dissolved alkynes at ordinary room temperatures. Since this chemisorption on a metallic surface may depend upon formation of surface complexes through the effect of forces similar to those involved in formation of complexes with metallic ions, the interaction of certain alkynes and alkenes with various metallic salts has also been investigated.

2927

Texas U. Dept. of Physics, Austin.

CONVERSION-ELECTRON ANGULAR CORRELATIONS FOR STRIPPING REACTIONS, by E. V. Ivash. [1961] [3]p. (Sponsored jointly by Air Force Office of Scientific Research under AF 33(038)20681 and Atomic Energy Commission) Unclassified

Published in Phys. Rev., v. 125: 1337-1339, Feb. 15, 1962.

The (d, p;e) and (d, n;e) angular correlation between the outgoing proton or neutron of a stripping reaction and a possible internal conversion electron is theoretically investigated. Expressions for the correlation function similar to those for (d, p;γ) and (d, n;γ) angular correlations are obtained, differing only in the presence of the particle parameters $b_\nu(LL';e)$. It is suggested that conversion-electron correlations for stripping reactions may prove useful as a nuclear spectroscopic tool for the heavier nuclei. (Contractor's abstract).

2928

Texas U. Dept. of Physics, Austin.

PRESSURE AND SOLVENT EFFECTS ON THE ABSORPTION SPECTRUM OF AZULENE (Abstract), by W. W. Robertson, O. E. Weigang, Jr., and A. D. King, Jr. [1959] [1]p. (AF 49(638)35) Unclassified

Presented at Symposium on Molecular Structure and Spectroscopy, Ohio State U., Columbus, June 15-19, 1959.

Published in Spectrochim. Acta, No. 9: 757, Oct. 1959.

Calculations by Pariser (Jour. Chem. Phys., v. 25: 1112, 1956) have shown azulene to have excited state dipole moments opposed to that of the ground state. If so, one might expect polar solvents to shift the azulene absorption spectrum to shorter wavelengths and the compression of such solutions to result in additional blue shifts. To test these ideas the spectrum of azulene has been recorded in both polar and nonpolar solvents at temperatures down to -80°C and at pressures up to several thousand atmospheres. For comparison the spectrum of naphthalene was recorded under similar conditions. Results are only partly as anticipated. The 3 azulene transitions, ^1L_b, ^1L_a and ^1B_b, shift to the blue upon solution in polar solvents. However, upon compression the ^1L_a and ^1B_b bands undergo progressive red shifts with increasing solvent density. The ^1L_b shows a blue shift from vapor to solution in nonpolar solvents and an additional blue shift with increasing optical polarizability of the solvent or with increasing solvent density. Upon decreasing the temperature of the polar solvent, the rate of red shift with solvent density is less for the ^1L_a and ^1B_b than in the compressed solvent, as is the rate of blue shift of the ^1L_b. The characteristic rates of shift of the various transitions with solvent density tend to verify Pariser's assignment of the band falling at 4.05 ev as a separate transition from the ^1B_b.

2929

Texas U. Dept. of [Physics] Austin.

AN ELECTRON MICROSCOPE STUDY OF CARBON FORMATION IN THE PYROLYSIS OF HYDROCARBONS, by G. L. Johnson. [1961] [11]p. incl. illus. tables. (AFOSR-3972) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)-560 and Petroleum Research Fund) Unclassified

Also published in Proc. Fifth Conf. on Carbon, New York, Pergamon Press, 1962, p. 395-405.

Studies of the pyrolysis of various hydrocarbon vapors were made in a flow system under conditions such that electron micrographs of the particles formed might be correlated with gas chromatographic data on the nature of the reaction products. Tests were made with various types of hydrocarbons, but acetylene was used most extensively. The nature and size of particles formed were investigated as functions of the concentration of hydrocarbon (in mixtures with helium as an inert component) temperature over the range of 500-1000°C, and contact time up to 40 sec in the flow reactor; and the corresponding reaction stages--particularly appearance of H_2 and CH_4-- were followed. The effects of additives such as H_2, O_2, Cl_2, and H_2O were tested. Differences in carbon formation in gas phase and on ordinary surfaces were checked, especially in the transition range from polymerization to formation of solid particles. Results indicate that hydrogen formation is important in the early stages of carbon formation, with methane formation occurring as a secondary reaction; also that physical condensation of polymer to liquid droplets is a secondary process occurring on cooling of reaction products rather than a precursor of carbon formation. A chemical condensation process for nucleation of solid particles is indicated. (Contractor's abstract)

2930

Texas U. [Dept. of Psychology] Austin.

THE REPRESSION-SENSITIZATION SCALE: RATIONALE, RELIABILITY, AND VALIDITY, by D. Byrne. [1961] [16]p. incl. tables, refs. (AFOSR-145) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)460 and Texas U. Research Inst.) Unclassified

Also published in Jour. Personality, v. 29: 334-349, Sept. 1961.

Work in the area of perceptual defense has led to the concept of a behavior dimension comprising psychological defenses ranging from regression to sensitization. Several scales of the MMPI have been found to be related to this dimension, and the present test consists of a combination of 6 of these scales. Normative data for the R-S scale are presented from a college population. Concurrent and/or construct validity for the R-S scale is supported by a series of correlational studies with Ullmann's facilitation. Inhibition scale, the California F scale, and other measures. Thus the R-S scale appears to be a reliable test, and the evidence suggests that it is a measure of defensive behavior.

2931

Texas U. [Dept. of Psychology] Austin.

ARBITRARINESS OF FRUSTRATION AND ITS CONSEQUENCES FOR AGGRESSION IN A SOCIAL SITUATION, by E. Burnstein and P. Worchel. [1961] [13]p. incl. tables. (AFOSR-203) (AF 49(638)460) AD 295918 Unclassified

Also published in Jour. Personality, v. 30: 528-540, Dec. 1962.

The reduction in aggressive responses under nonarbitrary as compared to arbitrary frustration was studied as a result of response inhibition or lowered instigation of aggression. One hundred male Ss selected from the different sections of the elementary course in psychology served in small groups of 3 to 5 Ss. All groups were given "The Case of Johnny Rocco" to discuss under 3 different conditions of frustration: (a) arbitrary, (b) nonarbitrary, and (c) no frustration. There was no significant difference in the private expression of negative feelings towards the confederate on the questionnaire between the experimental groups but both groups were significantly

more negative than the no-frustration group. With a decrease in the strength of the inhibiting social norms there was an increase in direct aggression (rejection of confederate) in both the arbitrary and nonarbitrary conditions. There was significantly greater displacement of aggression towards the E and the self under nonarbitrary than under the arbitrary frustration. Decreasing the strength of the postulated inhibitory forces for expressing aggression under nonarbitrary frustration resulted in lesser displacement of aggression towards the E.

2932

Texas U. [Dept. of Psychology] Austin.

RACIAL PREJUDICE, INTERPERSONAL ATTRACTION, AND ASSUMED DISSIMILARITY OF ATTITUDES, by D. Byrne and T. J. Wong. [1961] 16p. incl. tables, refs. (AFOSR-J689) (AF 49(638)460) AD 413778 Unclassified

Also published in Jour. Abnorm. and Social Psychol., v. 65: 246-253, 1962.

This investigation was undertaken in order to (a) test hypotheses dealing with assumed attitude dissimilarity as a function of racial prejudice and (b) to explore the interactive effects of race, racial prejudice, and attitude similarity-dissimilarity in determining interpersonal attraction. In the first experiment, highly prejudiced subjects were found to assume greater attitude dissimilarity between themselves and a Negro stranger than between themselves and a white stranger; for subjects low in prejudice the assumed dissimilarity scores for whites and Negroes did not differ. In the second experiment, similarity of attitudes resulted in positive ratings and dissimilarity of attitudes resulted in negative ratings, regardless of the prejudice of the subjects or the race of the stranger.

2933

Thiokol Chemical Corp. Reaction Motors Div., Denville, N. J.

THE ELECTRICAL PROPERTIES OF IONIZED FLAMES. PART I. STUDY OF FLAME IONIZATION, by T. H. Dimmock and W. R. Kineyko. Aug. 1961, 34p. incl. diagrs. tables. (AFOSR-825) (AF 49(638)-305) AD 262367 Unclassified

The concentration and distribution of the ions in high-temperature flames enriched with easily ionized additives was determined. Ionization densities up to 10^{14}/cc were measured by Langmuir probes. Other methods of measuring flame ionization, such as double probes and microwave attenuation were employed and corroborated single probe measurements. For these tests, hydrogen flames were burned with both oxygen and nitric oxide. Measurements of ionization in the H_2/O_2 flames reached 10^{14}/cc and agreed with theoretical values. Measurements in the H_2/NO flame never surpassed 10^{13}/cc and were found to depend critically upon propellant flow rate and burner geometry. A large cold gas boundary layer which exists in the nitric oxide flames forms a thermal barrier to the passage of electrons from the burner into the flame and influences probe measurements.

2934

Thiokol Chemical Corp. Reaction Motors Div., Denville, N. J.

THE ELECTRICAL PROPERTIES OF IONIZED FLAMES. PART II. ELECTROSTATIC AND MAGNETOHYDRODYNAMIC DEFLECTION, by T. H. Dimmock, C. G. Miller and others. Aug. 1961, 34p. incl. diagrs. tables. (AFOSR-990) (AF 49(638)305) AD 262368 Unclassified

The electrical properties of highly ionized, high temperature flames have been investigated to determine the interaction of the flame with electric and/or magnetic fields. With electric fields alone, no deflection is obtained because the field intensity within the flame is too small whether the field electrodes are outside or inside of the flame. Most of the potential drop between the electrodes occurs at the boundary layer on the electrodes. (With the unseeded flame, however, electrostatic deflection up to 45 degrees was readily obtained). A combination of transverse electric and longitudinal magnetic fields produced a Lorentz force on the flame of 10 newtons/cu m this force deflected a highly ionized flame up to 45 degrees. The deflection is proportional to the Lorentz force and inversely proportional to the inertial force. The magnitude of the flame conductivity (i. e., ionization) determines the power supply requirements for the electric field; the power required for the electric field decreases with increasing flame conductivity. (Contractor's abstract)

2935

Thiokol Chemical Corp. Reaction Motors Div., Denville, N. J.

FLAME DEFLECTION AND ELECTRICAL EFFECTS ON FLAMES (Abstract), by H. G. Wolfhard and T. H. Dimmock. [1961] [1]p. (Bound with AFOSR-582; AD 257892) (AF 49(638)305) Unclassified

Presented at Fourth annual AFOSR Contractors' meeting on Ion and Plasma Acceleration, Beverly Hills, Calif., Apr. 20-21, 1961.

An experimental program is being conducted to measure the distribution and intensity of ionization in seeded high temperature flames. The investigation can be divided into the following 3 phases: (1) the production and diagnostics of flames with controlled, high ionization; (2) the study of the electric field gradients within flames burning under the influence of external electric fields; and (3) the deflection of highly ionized flames by interaction with electric and magnetic fields. It is shown that measured limits of ionization depend critically on the thickness of cold gas boundary layers and the quenching diameter of the propellants used. Flames burning with nitric oxide (NO) never reached

ionization values predicted by the Saha equation as did flames burning with oxygen. Measurements of the distribution and intensity of ionization in flames are presented. When an external magnetic field is impressed upon a highly ionized atmospheric flame, the magnetic body forces are small compared to the inertial forces, (irrespective of mass flow rate) and no flame deflection is possible. With an impressed electric field transverse to such a magnetic field however, deflections up to 45° were obtained. The deflection is dependent on the field arrangements and field intensities and is inversely proportional to the kinetic energy of the flame species.

2936

Thiokol Chemical Corp. Reaction Motors Div., Denville, N. J.

THE ELECTRICAL PROPERTIES OF IONIZED FLAMES, by T. H. Dimmock. [1961] [13]p. incl. illus. diagrs. (AF 49(638)305) Unclassified

Published in Proc. of the Fourth Biennial Gas Dynamics Symposium on Magnetohydrodynamics, Northwestern U., Evanston, Ill. (Aug. 23-25, 1961), Evanston, Northwestern U. Press, 1962, p. 159-171. (AFOSR-2787)

The ionization in seeded, high temperature, atmospheric flames has been measured by probe and microwave methods. For KA-band microwaves, the range of ionization was measured to be 10^{10}-10^{12}/cc. In this range all diagnostic methods were in agreement. Langmuir probe measurements in hydrogen-nitric oxide flames showed a level of ionization well below the theoretical value. In addition single probe measurements were found to depend critically on the cold gas layer between the flame and burner, which in turn is dependent upon flame impingement and propellant quenching diameter. External electric and magnetic fields were employed with seeded and pure flames to measure their interaction with the field. With the electric field alone the interaction is small as the highest field intensity in the flame is about 1 v/cm. By using electrodes within the flame and transverse magnetic field, a seeded flame can be deflected by Lorentz forces. The deflection is directly proportional to Lorentz force and inversely proportional to flame inertia. (Contractor's abstract)

2937

Thiokol Chemical Corp. Reaction Motors Div., Denville, N. J.

ELECTRICAL EFFECTS IN ROCKET COMBUSTION PRODUCTS (Abstract), by T. H. Dimmock. [1961] [1]p. [AF 49(638)305] Unclassified

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

An experimental program has been conducted to measure the ionization distribution in seeded high temperature flames. The burnt gases in these flames closely resembled the combustion products in a rocket exhaust. In the atmospheric flame studies, it was found that ionization densities, measured by probes, depended critically on the thickness of the boundary layer between the flame and burner. The thickness of this layer in turn depended upon propellant quenching diameter, burning rate, turbulence, and impingement. Densities measured by Langmuir probes, microwaves and double probes were in good agreement. External and internal electrostatic fields were applied to pure and seeded atmospheric flames, and Lorentz force fields were applied to seeded flames. The deflection which resulted was limited by the shielding influence of the boundary layer, the inertia of the flame, the buoyancy of the atmosphere, and the available supply of electrical power.

2938

Thornthwaite, C. W., Associates. Lab. of Climatology, Centerton, N. J.

THE CLIMATIC AND HYDROLOGIC FACTORS AFFECTING THE REDISTRIBUTION OF SR^{90}, by J. R. Mather, J. K. Nakamura and C. W. Thornthwaite. Final rept. Sept. 1961 [11]p. incl. diagrs. tables, refs. (Technical rept. no. 1) (AFOSR-1623) (AF 49-(638)887) AD 266676 Unclassified

Measurements have been made of the strontium content in the soil and these results are used to explain the observed distribution of strontium with depth in the soil. A mathematical model was formulated to reproduce laboratory results showing that strontium moves downward in the soil as a wave of decreasing amplitude. The available measured data is presented and also measurements of the daily balance between precipitation and evaporation. Precipitation in excess of evaporation when the soil is at or above field capacity will constitute surplus water available for leaching strontium and other materials downward through the soil. The relation between leaching efficiency, soils and climate, the relation between precipitation and water surplus, use of high speed computer techniques to determine water surplus and strontium movement, and the application of the mathematical model to the movement of calcium in an agricultural soil are explained. Maps of contamination risk and strontium removal time are presented.

2939

Thornthwaite, C. W., Associates. Lab. of Climatology, Centerton, N. J.

THE CLIMATIC WATER BALANCE, by J. W. Mather. INSTRUCTIONS FOR THE USE OF THE IBM 602A CALCULATOR FOR DAILY SOIL MOISTURE ACCOUNTING, by R. E. Pengra. MANUAL FOR THE USE OF THE IBM 650 CALCULATOR FOR COMPUTING POTENTIAL EVAPOTRANSPIRATION AND THE WATER BALANCE, by H. W. Engelbrecht. 1961 [91]p. incl. diagrs. tables, refs. (Technical

note no. 1) (In cooperation with South Dakota State College, Brookings, N. J. and United States Weather Bureau, Baltimore, Md.) (AFOSR-1637) (AF 49(638)-887) AD 266680 Unclassified

The basic concept of potential evapotranspiration and the water balance is presented. By means of the water balance bookkeeping procedure, using the data of air temperature, precipitation and location, it is possible to determine either on a monthly or a daily basis the periods and amounts of the water surplus, water deficit, soil moisture storage, and the runoff of water. The remainder of the report is composed of 2 manuals giving the use of the climatic water balance bookkeeping procedure and high speed computers (the IBM 602A and IBM 650).

2940

Toronto U. Inst. of Aerophysics (Canada).

AN INVESTIGATION OF THE FLUCTUATING FORCES ACTING ON A STATIONARY CIRCULAR CYLINDER IN A SUBSONIC STREAM, AND OF THE ASSOCIATED SOUND FIELD, by R. T. Keefe. Sept. 1961 [104]p. incl. illus. diagrs. refs. (UTIA rept. no. 76) (AFOSR-2147) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)249 and Defence Research Board of Canada) Unclassified

Also published in part in Jour. Acoust. Soc. Amer., v. 34: 1711-1714, Nov. 1962.

An experimental investigation has been made of the fluctuating forces acting on a short segment of a 1 1/8 in diam stationary circular cylinder placed in the UTIA subsonic wind tunnel. The fluctuating lift was measured over a range of Reynold's numbers from 5000 to 100,000 and the fluctuating drag over a range of 20,000 to 100,000. A large increase in the lift coefficient occurred when 2 circular disks were fastened to the cylinder in close proximity to the force transducer. The measurements of the acoustic radiation from cylinders placed in a subsonic air jet showed great sensitivity to the cylinder end conditions. Experiments were performed to arrive at an understanding of the end effects, with limited success. A comparison of a theoretical estimate of the acoustic radiation using the results of the force measurements presented herein and correlation data obtained previously at UTIA shows good agreement with the acoustic measurements on 1 of the configurations tested, and with those of other researchers using a whirling arm apparatus. (Contractor's abstract)

2941

Toronto U. Inst. of Aerophysics (Canada).

"INCOMPRESSIBLE" ACOUSTIC NEAR FIELD AS A SPATIAL DISTRIBUTION OF SOURCES GENERATING THE FAR FIELD (Abstract), by H. S. Ribner. [1961] [1]p. [AF 49(638)249] Unclassified

Presented at Sixty-first meeting of the Acoust. Soc. Amer., Philadelphia, Pa., May 10-13, 1961.

Published in Jour. Acoust. Soc. Amer., v. 33: 650, June 1961.

Suppose one calculates an "incompressible" flow (pressure field $p^{(0)}$) by substituting Laplace's equation for the wave equation in a given acoustic problem. Then the far field $p^{(1)}$ is a solution of the wave equation for a spatial distribution of matter sources of strength $-C_o^{-2}\partial p^{(0)}/\partial t$. (Boundary condition: zero normal velocity). This is readily demonstrated. Physical significance: Since the fluid is actually compressible, isentropy gives $-C_o^{-2}\partial p^{(0)}/\partial t = \partial p^{(0)}/\partial t$.

This density fluctuation is precisely equivalent to a volume fluctuation of the fluid elements. Pulsating sphere: A pulsating sphere generating an "incompressible" field $p^{(0)}$ may be replaced by a rigid sphere surrounded by a cloud of sources of strength $-C_o^{-2}$ $\partial p^{(0)}/\partial t$; this will generate the far field $p^{(1)}$. Aeolian tones: The principle helps explain nonvanishing generation of sound by a stationary rod in an air jet. The sound energy flow at a stationary surface must be zero: the sound is actually emitted from the region of fluctuating compression surrounding the rod. Jet noise: The "incompressible" approximation to the field within the jet is $p^{(0)}$. Source-like pulsations of the fluid elements in response to $p^{(0)}$ are considered to generate the far-field sound $p^{(1)}$. The source strength, modified for convection, is $-C_o^{-2}\,Dp^{(0)}/Dt$.

2942

Toronto U. Inst. of Aerophysics (Canada).

THE DESIGNING OF DYNAMIC PRESSURE STAGES FOR HIGH-PRESSURE/HIGH-VACUUM SYSTEMS, by B. W. Schumacher. Aug. 1961 [51]p. incl. illus. diagrs. tables, refs. (UTIA rept. no. 78) (AFOSR-88) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)281, Defence Research Board of Canada, and Ontario Research Foundation) Unclassified

For firing electron or ion beams into gas spaces with pressures near one atm, passages were designed having free apertures of up to 1 mm in diam. The vacuum in the beam forming region is maintained dynamically by constant pumping. The report shows in detail what pressures can be achieved with any given aperture and pump combination, and how multistage systems can be built having a short over-all length of the passage. (Contractor's abstract)

2943

Toronto U. Inst. of Aerophysics (Canada).

APPLICATION OF AN ELECTRON GUN FOR THE MEASUREMENT OF DENSITY AND TEMPERATURE IN RAREFIED GAS FLOWS, by E. O. Gadamer, E. P. Muntz, and G. N. Patterson. Apr. 1961 [21]p. incl. diagrs. tables. (UTIA rept. no. 73) (AFOSR-629) (AF 49(638)281) AD 264823 Unclassified

Separate aspects are presented of a project aimed at the design and development of the electron gun as a diagnostic probe for the point-by-point investigation of low density flows without disturbing the motion. Part I was undertaken to provide a calculated flux distribution which could be measured by means of the density probe described in Part II. The further development of the electron gun for the determination of temperature at a point in a rarefied gas flow (Part III) was a subsequent project which greatly extended the usefulness of the electron gun in the low density laboratory. (Contractor's abstract)

2944

Toronto U. Inst. of Aerophysics (Canada).

PRESSURE PROBES IN FREE MOLECULE FLOW, by K. R. Enkenhus, E. L. Harris, and G. N. Patterson. July 1961, 13p. incl. diagrs. refs. (UTIA review no. 19) (AFOSR-1677) (AF 49(638)281) AD 265547 Unclassified

When the mean free path becomes a significant fraction of a characteristic dimension of a pressure probe, the usual continuum formulae relating the measured pressure to the free-stream pressure and Mach number are no longer valid. The case where the mean free path is so large compared with the probe diam that intermo ecular collisions may be neglected is treated. This is the condition for free molecule flow. Theoretical expressions are given for the pressure measured in a flowing gas with an orifice probe and a long-tube pressure probe. Experimental investigations were conducted using a low-density wind tunnel and a rotating-arm apparatus. Agreement between theory and experiment was quite satisfactory. Although this work was done primarily in connection with the flow of low density gases over models in the laboratory, the results are equally applicable to situations encountered in upper atmospheric research. (Contractor's abstract)

2945

Toronto U. Inst. of Aerophysics (Canada).

ANALYSIS OF THE PERFORMANCE OF THE UTIA RANDOM LOAD FATIGUE FACILITY, by J. B. Carr. Oct. 1961 [42]p. incl. illus. diagrs. tables. (UTIA technical note no. 54) (AFOSR-1865) (AF 49(638)548) Unclassified

This note presents an analysis of the performance of the UTIA random load fatigue facility. Mobility analogue techniques are utilized to predict the frequency response of the load output to the test specimen for either a constant amplitude current or a constant amplitude voltage input to a basically electro-mechanical system. The use of these theoretical frequency response functions to predict the load capability and the nature of the random stress output is demonstrated. Experimental results from 2 different mechanical configurations of the machine are compared with the predicted results and good agreement is obtained. (Contractor's abstract)

2946

Toronto U. Inst. of Aerophysics (Canada).

STATIC TEMPERATURE MEASUREMENTS IN A FLOWING GAS, by E. P. Muntz. [1961] [11]p. incl. illus. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)-548] and Defence Research Board of Canada) Unclassified

Presented at meeting of the Amer. Phys. Soc., Berkeley, Calif., Nov. 20-22, 1961.

Published in Phys. Fluids, v. 5: 80-90, Jan. 1962.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 7: 377, Apr. 23, 1962. (Title varies)

A method has been developed to measure vibrational and rotational static temperatures at any point in non-radiating low-density flows of nitrogen. An electron beam is used to excite emission in the first negative system of nitrogen. The relative intensities in the rotational and vibrational structure of the emission spectra are predicted theoretically. The theoretical predictions are used to obtain rotational and vibrational temperatures of the nitrogen through which the beam passes. (Contractor's abstract)

2947

Toronto U. Inst. of Aerophysics (Canada).

ON A RELATIVELY COOL TRANSITION FROM A SATELLITE ORBIT TO AN EQUILIBRIUM GLIDE, by B. Etkin. June 1961 [52]p. incl. diagrs. (UTIA rept. no. 75) (AFOSR-1383) (AF 49(638)761) AD 265550 Unclassified

One family of solutions is presented for a monotonic transition from a circular orbit to an equilibrium glide. It is performed at high lift coefficient and low L/D, and terminates at a match point where the prescribed conditions of the glide are met. The vehicle then continues on the glide at a higher value of L/D. The high drag required during transition entails the use of a large auxiliary light-weight drag body, which is jettisoned upon arrival at the match point. The presence of this drag body results in a reduction of the total heat load on the vehicle itself. The exact amount of this reduction depends on the details of the design, but it can be typically of the order of 3/4 in an entry with a peak acceleration of the order of 7 g. As a result, the max average vehicle temperature can be made relatively low, with consequent advantages in the structural design, and in the thermal protection of the payload. (Contractor's abstract)

2948

Toronto U. Inst. of Aerophysics (Canada).

STABILITY OF FLIGHT PATHS OF LIFTING VEHICLES DURING ENTRY INTO PLANETARY

ATMOSPHERES, by J. H. Fine. July 1961 [47]p. incl. diagrs. tables, refs. (UTIA technical note no. 48) (AFOSR-1488) (AF 49(638)761) AD 269127
Unclassified

Small pitching oscillations in a manned lifting vehicle about its trim angle of attack were analyzed for their ability to deflect the vehicle from its trim trajectory. Several planetary atmospheres along with both circular and hyperbolic velocities were considered. The results of this investigation were conclusive. Except for those cases when the static margin of the vehicle was so small as to be impractical, i.e., less than 0.001, the pitching oscillations were unable to cause an appreciable deviation from the reference path. (Contractor's abstract)

2949

Toronto U. Inst. of Aerophysics (Canada).

THE ENTRY OF MANNED [MANEUVERABLE] SPACECRAFT INTO PLANETARY ATMOSPHERES, by B. Etkin. Oct. 1961, 33p. incl. illus. diagrs. table. (UTIA review no. 20) (AFOSR-1963) [AF 49(638)761] AD 273699
Unclassified

Presented at Symposium on Interplanetary Explorations, Toronto, Canada, Oct. 26-27, 1961.

Three main problem areas for the landing of space vehicles are considered. The first concerns the deceleration to which the vehicle and its occupants are subjected. The second concerns the heating of the vehicle, i.e. the temperatures which are developed in the skin and structure; and the third problem area is that of the navigation or guidance of the vehicle to a desired point on the surface. (Contractor's abstract)

2950

Toronto U. Inst. of Aerophysics (Canada).

LANGMUIR PROBES IN A FLOWING LOW DENSITY PLASMA, by J. B. French. Aug. 1961 [66]p. incl. illus. diagrs. tables, refs. (UTIA rept. no. 79) (AFOSR-2159) (AF 49(638)823) AD 273698
Unclassified

Presented at meeting of the Amer. Phys. Soc., Berkeley, Calif., Nov. 20-22, 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 7: 372, Apr. 23, 1962.

Two aspects of the use of Langmuir probes were investigated. First, a Langmuir probe free-molecular with respect to all species, and in a plasma in which the ion temperature is higher than the electron temperature, is considered. Theoretical predictions are that both the ion current and the electron current outside the retarding field region are controlled by ion energy, instead of electron energy. Hence, directed ion energy in the form of plasma mass motion is expected to influence collection. The retarding field method of measuring electron temperature is uninfluenced. Comparisons between ion collecting cylindrical probes parallel and transverse to the supersonic plasma stream agree quantitatively with these predictions. Second, the situation is considered in which the electrons have much higher thermal energy than the ions, and in which the probe is free-molecular with respect to neutral particles but in continuum flow with respect to the ions and electrons. The smaller electron and ion mean free paths are calculated to have little effect on the current collected by the probe, unless mass motion is present. Experiments indicate that a region of increased ion density exists in front of a probe biased to reflect ions back into the oncoming stream. (Contractor's abstract)

2951

Trieste U. [Inst. of Physics] (Italy).

ON THE ENERGY LOSS AND SPECIFIC IONIZATION OF A RELATIVISTIC PARTICLE IN A POLARIZABLE MEDIUM, by P. Budini, L. Taffara and C. Viola. Final rept. Jan. 31, 1961, 68p. incl. diagrs. tables, refs. (AFOSR-567) (AF 61(052)211) AD 258965
Unclassified

The dispersive and absorptive properties of a given medium are studied in order to deduce formulae to be used in the theory of energy loss suffered by a ionizing particle traversing the medium and of ionization produced by it in the medium. Specific energy loss is calculated for electrons and positrons in H and He at different pressure and at liquid state trying to put in evidence the different behavior of the 2 particles. Primary specific ionization is studied and a theory is given for the calculation of ionization of the further generations. Summing the results, total specific ionization can be calculated. The results are applied to some particular cases and compared with experimental results. The problem of mixtures of elements is discussed. In this case a new effect is theoretically foreseen, which should be due to the reabsorption by 1 of the components of the mixture of Cerenkov radiation emitted by the other. This effect could give a pronounced enhancement of relativistic increase of primary specific ionization as it is shown in 2 particular cases. (Contractor's abstract)

2952

Trieste U. [Mathematical Inst.] (Italy).

ON A TRACE PROBLEM, by J. L. Lions. [1961] [11]p. incl. refs. (AFOSR-1443) (AF 61(052)414)
Unclassified

Also published in Rend. Sem. Matem. Univ. Padova, v. 31: 232-242, 1961.

In the plane (x_1, x_2), let Ω be the open set $(x_2 > 0)$ and let u_1 and u_2 be 2 functions given in Ω satisfying certain conditions. The spaces spanned by $u_1(0)$ and $u_2(0)$ when u_1 and u_2 span the space $W(P, \alpha, D(\Lambda), E)$ subject to the condition $\Lambda u_1 + u_2' = 0$ are

characterized. It is proved that if u_1 and u_2 be given in $W(P, \alpha, D(A), E)$ [same conditions as above] then $u_2(0) = f_2$ satisfies the condition $\int_0^\infty \| t^{\alpha-1} \int_0^t G(\sigma) f_2 d\sigma \|_{D(A)} dt < \infty$. It is proved that if f_1 and f_2 be given in E satisfying conditions $\int_{-\infty}^{+\infty} |\lambda|^{1-2\alpha} |f_1(\lambda)|^2_{h(\lambda)} d\mu(\lambda) < \infty$ and $\int_{-\infty}^{+\infty} |\lambda|^{-1-2\alpha}(1 + |\lambda|)^2 |f_2(\lambda)|^2_{h(\lambda)} d\mu(\lambda) < \infty$ then there exist u_1 and u_2 such that $t^\alpha u_j \in L^2(0, \infty; D(A))$, $t^\alpha \frac{du_j}{dt} \in L^2(0, \infty; E)$, $j = 1, 2$; $Au_1 + \frac{\partial u_2}{\partial t} = 0$; and $u_1(\lambda, 0) = f_1(\lambda)$, $u_2(\lambda, 0) = f_2(\lambda)$.

2953

Trieste U. Mathematical Inst. (Italy).

ON PROBABILITY MEASURES RELATED TO THE NAVIER-STOKES EQUATIONS IN THE 3-DIMENSIONAL CASE, by G. Prodi. July 28, 1961, 48p. incl. refs. (Technical note no. 2) (AFOSR-1500) (AF 61-(052)414) AD 266672 Unclassified

For the Navier Stokes system in 3-dimensional case, no theorem is known about existence and uniqueness in the large. The notion of half-invariant measure, based on the only prerequisite of a local existence and uniqueness theorem is introduced. Under certain hypothesis for a half-invariant measure, the existence and uniqueness theorem holds for almost all initial values, and the measure is invariant. The research is concluded by giving 2 criteria for the existence of half-invariant measures. (Contractor's abstract)

2954

Trieste U. Mathematical Inst. (Italy).

RESEARCH STUDY OF NAVIER-STOKES EQUATIONS, by G. Prodi. Technical rept. July 1, 1960-June 30, 1961. July 28, 1961, 9p. (AFOSR-1501) (AF 61(052)-414) AD 266671 Unclassified

An account is given of the research work accomplished on the subject, Analytical problems concerning the equations of Navier-Stokes. The report consists of the description and estimation of the results and the indication of some problems which still remain open. (Contractor's abstract)

2955

Trieste U. [Mathematical Inst.] (Italy).

[CONCERNING A PROBLEM ON THE RELATIVE OUTLINE ON THE SYSTEM OF STOKES EQUATIONS] Su uno problema al contorno relativo al sistema di equazioni di Stokes, by L. Cattabriga. [1961] [33]p. (AFOSR-1665) (AF 61(052)414) Unclassified

Also published in Rend. Sem. Matem. Univ. Padova, v. 31: 308-340, 1961.

The author considers a suitably regular open $\Omega \subset R$ and defines $|u|_{j, L_q} = (\sum_{|\beta| = j} \int_\Omega |D^\beta u|^q dx)^{1/q}$; $D\beta = \partial\beta/\partial x_1\beta_1 \partial x_2\beta_2 \partial x_3\beta_3$, $|D^\beta u| = (\sum_1^3 |D\beta u_1|^2)^{1/2}$ for u a vector function; $\|u\|_{1, L_q} = (\sum_{j \le 1} (|u|_{j, L_q})^q)^{1/q}$; $H_{1, L_q}(\Omega)$ is the Banach space obtained by completion of the C^∞ (vector) functions in $\bar{\Omega}$ with respect to $\| \|_{1, L_q}$; $\overset{o}{H}_{1, L_q}(\Omega)$ is the Banach space obtained by completion under $\| \|_{1, L_q}$ of the C^∞ functions in Ω with compact support; $H_{-1, L_q}(\Omega)$ is the dual of $\overset{o}{H}_{1, L_{q'}}(\Omega)$ $(1/q + 1/q' = 1)$; if Ω is bounded, $H_{1, L_q}(\Omega)/K$ is the quotient of $H_{1, L_q}(\Omega)$ by the space K of constant functions in Ω; for $j > 0$ and functions (or vectors) φ defined on $\dot{\Omega}$ set $|\varphi|_{j-1/q, L_q} = \inf |\nu|_{j, L_q}$ and $\|\varphi\|_{j-1/q, L_q} = \inf \|\nu\|_{j, L_q}$, where the inf is over all functions (or vectors) $\nu \in H_{j, L_q}(\Omega)$ whose trace $\gamma\nu$ on $\dot{\Omega}$ equals φ, and let $H_{j-1/q, L_q}(\dot{\Omega})$ be the Banach space of functions (or vectors) φ such that $\|\varphi\|_{j-1/q, L_q} < \infty$. The system $\Delta u - \operatorname{grad} p = f$, $\operatorname{div} u = g$ in Ω with $u = \varphi$ on $\dot{\Omega}$, is studied, where the vector u and the function p are unknowns. Here $u \in H_{1, L_q}(\Omega)$, $p \in L_q(\Omega)$, and thus $\operatorname{div} u = g$ and $u = \varphi$ are meant in the usual sense, while the first equation has the weak sense $\int (\sum_1^3 D_j u_i D_j \nu_i - p \operatorname{div} \nu) dx = \langle f, \nu \rangle$ for all $\nu \in \overset{o}{H}_{1, L_{q'}}(\Omega)$. Then it is proved that if Ω is of class C^s, $s = \max(1, 2)$, $f \in H_{1-2, L_q}(\Omega)$, $g \in H_{1-1, L_q}(\Omega)$, $\varphi \in H_{1-1/q, L_q}(\dot{\Omega})$, $1 \ne 1$, $1 < q < \infty$, $\int_\Omega g\, dx = \int_{\dot{\Omega}} \varphi \cdot n\, d\sigma$, then there exists a unique $u \in H_{1, L_q}(\Omega)$ and $p \in H_{1-1, L_q}(\Omega)/K$ solving the above equations and, moreover, $\|u\|_1 + \|p\|_{1-1} \le C(\|f\|_{1-2} + \|g\|_{1-1} + \|\varphi\|_{1-1/q})$, where C depends only on 1, q, and Ω. (Math. Rev. abstract)

2956

Tufts U. Inst. for Psychological Research, Medford, Mass.

HUMAN ENGINEERING BIBLIOGRAPHY. 1957-1958. Oct. 1959, 1v. incl. tables, refs. (ONR rept. no. ACR-43) (Sponsored jointly by Air Force Office of Scientific Research and Office of Naval Research under Nonr-49413) AD 235970 Unclassified

The purpose of the present bibliography is to provide a useful compilation of references to the human engineering literature which reflects the most current acquisitions of the Human Engineering Information and Analysis Service, Tufts University. Features of the bibliography include: "Topical Outline of the Literature in Human Engineering" (Part I), "Facsimile of Subject Matter Files (Part II), Alphabetical Index to the Human Engineering Literature" (Part III), the form and content of "Citations and Abstracts" (Part IV), and "Author Index" (Part V).

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Tufts U. Inst. for Psychological Research, Medford, Mass.

HUMAN ENGINEERING BIBLIOGRAPHY. 1958-1959. Oct. 1960, 1v. incl. tables, refs. (ONR rept. no. ACR-55) (Sponsored jointly by Air Force Office of Scientific Research and Office of Naval Research under Nonr-49413) AD 258705 Unclassified

For abstract see Human Engineering Bibliography. 1957-1958; Item no. 2956.

2958

Tufts U. Inst. for Psychological Research, Medford, Mass.

HUMAN ENGINEERING BIBLIOGRAPHY. 1959-1960. Oct. 1961, 245p. incl. refs. (ONR rept. no. ACR-69) (Sponsored jointly by Air Force Office of Scientific Research and Office of Naval Research under Nonr-49413) AD 274945 Unclassified

Personnel responsible for the human factors considerations in the design and development of equipment have a major need for rapid and easy access to the literature pertinent to their work. The fact that the literature associated with human engineering derived from many different journals and periodicals as well as a host of publications from governmental, industrial, and academic laboratories presents a compelling requirement for the development of useful bibliographic aids. This bibliography is 1 of a planned series of annual bibliographies of literature pertinent to human engineering which has been designed to meet this requirement. Two major considerations – ease of use and appropriate selections of material - strongly influenced this bibliography. As a result, 5 main parts exist: (1) a topical outline which defines over 300 topic headings established for this bibliography, (2) an index which associates the approximately 1900 bibliographic entries with the topic headings, (3) an alphabetical index of the common search terms which would aid those using this bibliography but who are unfamiliar with the topic headings, (4) an annotated bibliography of some 1900 citations, and (5) an index of the authors of these citations.

2959

Turin U. (Italy).

PROPERTIES OF THE S-MATRIX AS A FUNCTION OF THE COMPLEX ANGULAR MOMENTUM FOR THE MANY-CHANNEL CASE AND FOR THE DIRAC EQUATION, by L. Favella and M. T. Reineri. [1961] [25]p. [AF 61(052)230] Unclassified

Published in Nuovo Cimento, Series X, v. 23: 616-640, Feb. 1, 1962.

A study of the analytical behavior of the potential scattering amplitude at fixed real energy in the complex plane of the angular momentum has been made in correspondence to a Dirac equation of motion and a Schrödinger's many-channel problem. In both cases the boundary of the region where the singularities are located has been determined. It is proven that in the many-channel case the poles are confined to a strip parallel to the imaginary axis. (Contractor's abstract)

2960

Turin U. (Italy).

POTENTIAL SCATTERING FOR COMPLEX ENERGY AND ANGULAR MOMENTUM, by A. Bottino, A. M. Longoni, and T. Regge. [1961] [51]p. incl. diagrs. table, refs. [AF 61(052)230] Unclassified

Published in Nuovo Cimento, Series X, v. 23: 954-1004, Mar. 16, 1962.

The analytic properties of the partial wave scattering amplitude for potential scattering in the pair of variables k (wave number) and $\lambda = l + 1/2$ have been derived when both variables are complex. Several results on the location of the poles of the S-matrix follow from a procedure of analytic completion. The scattering process is then considered as described by the variables λ and k, instead of s and t, as in Mandelstam's work. The set of properties of $S(\lambda, k) = \exp[2i\delta(\lambda, k)]$ here derived is exactly equivalent to the double dispersion formulas for energy and momentum transfer. (Contractor's abstract)

2961

United States Rubber Co. [Wayne, N. J.]

PHOTOPEAK COUNTING EFFICIENCIES FOR 3 x 3 INCH SOLID AND WELL-TYPE NaI SCINTILLATION CRYSTALS, by R. Gunnink and A. W. Stoner. [1961] [3]p. incl. diagrs. tables. (AFOSR-532) (AF 49(638)-815) Unclassified

Also published in Anal. Chem., v. 33: 1311-1313, Sept. 1961.

Using 4π and $4\pi\beta$-γ coincidence standardization techniques, a 3 x 3 in. well-type and a 3 x 3 in. solid NaI(Tl) crystal were calibrated for photopeak counting efficiency. With these efficiencies, NaI(Tl) crystals of these sizes may be used to determine quantitatively the gamma disintegration rate of radioactive isotopes. (Contractor's abstract)

2962

United States Rubber Co., Wayne, N. J.

DECAY STUDIES OF THE EVEN-EVEN ISOTOPES, Er^{172} AND Dy^{166}, by R. Gunnink and A. W. Stoner. [1961] [17]p. incl. diagrs. table, refs. (AFOSR-1900) [AF 49(638)815] AD 278597 Unclassified

Also published in Phys. Rev., v. 126: 642-646, Apr. 15, 1962.

Er^{172} and Dy^{166}, with half-lives of 48.7 ± 0.5 hr and 81.8 ± 0.5 hr, respectively, were produced by double neutron capture from Er^{170} and Dy^{164}. Gamma rays of the following energies were found in the decay of Er^{172}: 2 coincident 50-kev radiations, 72, 128, 170, 200, 410, 440, and 610 kev. The proposed energy levels for Tm^{172} consistent with the data are as follows: 410, 440, 482, 538, and 610 kev. Log ft values of beta transitions indicate that the 538- and 610-kev levels have spin assignments of 0 or 1 with positive parity. The following gamma transitions were found in the decay of Dy^{166}: 84, 291, 343, 373, and 427 kev. In addition to showing conversion electrons of the 84-kev transition, permanent-magnet spectrometer studies revealed the presence of 2 additional transitions of 30 and 54 kev which were not observed in scintillation studies. The multi-polarity of the low-energy transitions are as follows: 30 kev-M1, 54 kev-E2, and 84 kev-M1. The proposed energy levels for Ho^{166} are at 54, 84, 375, and 427 kev. (Contractor's abstract)

2963

Uppsala U. Gustaf Werner Inst. for Nuclear Chemistry (Sweden).

INFLUENCE OF LOCAL TEMPERATURE CHANGES IN THE PREOPTIC AREA AND ROSTRAL HYPOTHALAMUS ON THE REGULATION OF FOOD AND WATER INTAKE, by B. Andersson and B. Larsson. Feb. 1, 1961 [22]p. incl. illus. diagrs. refs. (Technical note no. 2) (AFOSR-2670) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)183 and Swedish Medical Research Council) Unclassified

Also published in Acta Physiol. Scand., v. 52: 75-89, 1961.

Local cooling of the preoptic area and rostral hypothalamus was found to induce eating in the fed goat. When the same animal was dehydrated to the state of aphagia, cooling of this area inhibited the animal's urge to drink and at the same time induced eating. Although in a normal goat feeding practically stops when the rectal temperature exceeds 40°C (Appleman and Delouche, 1958), local cooling of the preoptic area and the rostral hypothalamus was found to induce the goat to eat hay with a seemingly good appetite at body temperature above 41°C. Warming the same area inhibited eating in the previously hungry animal and at the same time induced the goat to drink large quantities of water. In another goat the preoptic heat loss center had been permanently inactivated by proton irradiation. This animal became adipsic due to the lesion but was seen to continue to eat hay with a seemingly good appetite at body temperatures above 41°C. The anorexic effect of warming the preoptic area thus does not seem to be due to a direct thermal effect on the hypothalamic appetite center. The results provide direct evidence in favor of Brobeck's thermostatic theory of the regulation of food intake and justify the further extension of this theory to involve also the regulation of water intake. (Contractor's abstract)

2964

Uppsala U. Inst. of Chemistry (Sweden).

THE CRYSTAL STRUCTURE OF Pd_3P, by S. Rundqvist and L.-O. Guilman. Jan. 3, 1961 [3]p. incl. table. (Technical note no. 21) (AFOSR-151) (AF 61-(052)40) AD 258416 Unclassified

An x-ray investigation of the Pd-P system was initiated. Preliminary results indicated the apparent existence of at least 4 intermediate phases in the range of 0 to 25 at-%P. The existence of a phase near the composition Pd_3P was confirmed. The homogeneity range determined from alloys quenched from 740°C extended from about $Pd_3P_{0.75}$ to Pd_3P_1. The crystal structure was determined by examination of single-crystals selected from an alloy with the approximate composition $Pd_3P_{0.95}$. The following structural data for $Pd_3P_{0.95}$ were obtained: a = 5.947, b = 7.451, c = 5.170, and U = 229.1A. (Contractor's abstract)

2965

Uppsala U. Inst. of Chemistry (Sweden).

DIPHOSPHIDES OF THE GROUP VIII TRANSITION METALS, by S. Rundqvist. [1961] [3]p. incl. tables,

refs. (Technical note no. 22) (AFOSR-195) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)40 and Swedish State Council for Technical Research) AD 258415 Unclassified

Also published in Acta Chem. Scand., v. 15: 451-453, 1961.

RhP_2, IrP_2, NiP_2, and PdP_2 were synthesized by heating mixtures of metal powder and red phosphorus in evacuated and sealed silica tubes between 800 and 1100°C. Analysis of the x-ray powder patterns indicated that the diffraction lines can be indexed on the basis of monoclinic unit cells. Powder data indicated that RhP_2 and IrP_2 are isostructural. NiP_2 and PdP_2 are also isostructural, and appear to have face-centered unit cells.

2966

Uppsala U. Inst. of Chemistry (Sweden).

THE CRYSTAL STRUCTURE OF Ru_2Si, by B. Aronsson and J. Asellus. [1961] [4]p. incl. tables. (Technical note no. 23) (AFOSR-380) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)40 and Swedish State Council for Technical Research) AD 258414 Unclassified

Also published in Acta Chem. Scand., v. 15: 1571-1574, 1961.

The crystal structure of Ru_2Si has been refined from single crystal data. The unit cell dimensions are a = 5.27_9A, b = 4.00_5A and c = 7.41_8A. The space group is Pnma and the atoms are situated in 4(c) positions with the following atomic parameters: Ru_I: x = 0.8319, z = 0.0650; Ru_{II}: x = 0.9820, z = 0.7119; Si: x = 0.2964, z = 0.1013. Interatomic distances in the isomorphic phases Co_2P, Co_2Si, and Ru_2P and Ru_2Si are discussed. (Contractor's abstract)

2967

Uppsala U. Inst. of Chemistry (Sweden).

THE CRYSTAL STRUCTURE OF Cr_3B_4, by M. Elfström. [1961] [1]p. incl. tables. (Technical note no. 25) (AFOSR-691) (AF 61(052)40) AD 262205 Unclassified

Also published in Acta Chem. Scand., v. 15: 1178, 1961.

Lattice parameters, atomic parameters, and interatomic distances of Cr_3B_4 alloy were investigated. The results of lattice parameter determinations agree with those of Anderson and Kiessling (Acta Chem. Scand., v. 4: 160, 1950). The space group Immm derived by Kiessling in the study of Ta_3B_4 was confirmed. The difference between the 2 shortest nonequivalent boron-boron distances was not significant. Thus, Cr_3B_4 has no abnormally short boron-boron distances as was suggested by Kiessling.

2968

Uppsala U. Inst. of Chemistry (Sweden).

X-RAY INVESTIGATIONS OF THE TERNARY SYSTEM Fe-P-B. SOME FEATURES OF THE SYSTEMS Cr-P-B, Mn-P-B, Co-P-B AND Ni-P-B, by S. Rundqvist. June 17, 1961, 43p. incl. diagrs. tables, refs. (Technical note no. 24) (AFOSR-692) (AF 61-(052)40) AD 262199 Unclassified

Also published in Acta Chem. Scand., v. 16: 1-19, 1962.

The solid region of the Fe-P-B system has been investigated in the range Fe-FeP_2-BP-FeB-Fe by means of x-ray and chemical analyses. The main features of an isothermal section at 1000°C have been determined. Boron substitutes for phosphorus to a large extent in Fe_3P and to a smaller extent in Fe_2P and FeP. Two ternary phases exist, viz. Fe_5PB_2, homogeneous in a relatively narrow composition range, and $Fe_3P_{1-x}B_x$ (denoted ϵ_1), homogeneous in the approximate range $0.48 < x < 1$ at 1000°C. Solid solubility of boron is appreciable in Cr_3P and Mn_3P, but is very restricted in Ni_3P. The ternary phase Mn_5PB_2 is isostructural with Fe_5PB_2. In the Co-P-B system, 3 ternary phases have been found, viz. $Co_3P_{1-x}B_x$, homogeneous in a narrow range near x = 0.7 and isostructural with the ϵ_1 phase in the Fe-P-B system, $Co_3P_{1-y}B_y$, homogeneous in a narrow range near y = 0.5 and isostructural with Fe_3P, and finally Co_5PB_2, isostructural with Fe_5PB_2 and Mn_5PB_2. The crystal structures of Fe_3P, ϵ_1 (with the composition $Fe_3P_{0.37}B_{0.63}$), and Fe_5PB_2 have been determined and refined using single-crystal methods. The space-group of the ϵ_1 structure is $P\,4_2/n$ with 24 iron atoms in 3 sets of eightfold positions. The boron and phosphorus atoms are randomly distributed in 1 eightfold position. The structure is very closely related to that of Fe_3P. Fe_5PB_2 has the Cr_5B_3 ($D\,8_1$)-type structure. The distribution of the boron and phosphorus atoms is essentially ordered. (Contractor's abstract)

2969

Uppsala U. Inst. of Chemistry (Sweden).

A TERNARY SIGMA PHASE IN THE SYSTEM Cr-Ni-P, by T. Lundström. Aug. 2, 1961 [14]p. incl. diagrs. refs. (Technical note no. 26) (AFOSR-1053) (AF 61(052)40) AD 272327 Unclassified

Also published in Acta Chem. Scand., v. 16: 149-154, 1962.

The metal-rich part of the ternary phase diagram Cr-Ni-P at 1050°C is described. The l.p. variations for the sigma phase were studied. A study was also made of the possible occurrence of sigma phases in other Cr-Ni-X systems (where X = Al, Si, Ge, Sn, As) and also in the systems Mo-Pd-Si and W-Pt-Si. Only phosphorus was found to have an effect comparable to Si in stabilizing sigma phases. (Contractor's abstract)

2970

Uppsala U. Inst. of Chemistry (Sweden).

THE CRYSTAL STRUCTURES OF TWO THORIUM GERMANIDE PHASES WITH COMPOSITIONS APPROXIMATING TO $Th_{0.9}Ge_2$ AND $ThGe_2$, by A. Brown. Sept. 18, 1961 [23]p. incl. diagrs. tables, refs. (Technical note no. 27) (AFOSR-1384) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)40 and Swedish State Council of Technical Research) AD 272435 Unclassified

Also published in Acta Cryst., v. 15: 652-656, July 1962.

The structure of two germanium-rich thorium germanides have been found to have C-face-centered orthorhombic symmetry. One of the phases represents a new structure type; the second has the C49 ($ZrSi_2$)-type structure, is isostructural with UGe_2 and is probably stoichiometric $ThGe_2$. The first structure can be derived from the second by a simple crystallographic translation of some of the component atoms. The structures are discussed in the light of their close relationship with the anti-C38 (Fe_2As)-type phases $ThAs_2$, $ThSb_2$ and $ThBi_2$ and their similarity to the polymorphs of $ThSi_2$. The first phase is thought to have a defect structure and a composition close to $Th_{0.9}Ge_2$. (Contractor's abstract)

2971

Uppsala U. Inst. of Chemistry (Sweden).

PHOSPHIDES OF THE B (MnP) STRUCTURE TYPE, by S. Rundqvist. Oct. 4, 1961 [14]p. incl. diagr. tables, refs. (Technical note no. 28) (AFOSR-1387) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)40 and Swedish State Council of Technical Research) AD 272328 Unclassified

Also published in Acta Chem. Scand., v. 16: 287-292, Apr. 1962.

The mono-phosphides of Cr, Mn, Fe, Co, W, and Ru crystallize in the B 31 (MnP) structure type. The unit cell dimensions of these phosphides have been measured, and the structures of MnP, FeP and CoP have been determined accurately by single-crystal methods. Some data for unit cell variations accompanying isomorphous substitution are presented and discussed. (Contractor's abstract)

2972

Uppsala U. Inst. of Chemistry (Sweden).

STRUCTURAL FEATURES OF SOME PHASES RELATED TO CEMENTITE, by B. Aronsson and R. Rundqvist. [1961] [10]p. incl. diagrs. tables, refs. (AFOSR-1447) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)40 and Swedish State Council of Technical Research) Unclassified

Also published in Acta Cryst., v. 15: 878-887, Sept. 1962.

Investigations during the last few years have shown that a number of phases, especially borides, of the seventh and eighth group metals are isomorphous with cementite or crystallize in structures closely related to that of cementite. In this paper the recently obtained structural data are summarized and discussed. The influence of the radius ratio on trends in interatomic distances and latttice parameters is particularly considered. On basis of the presented data some general remarks on 'complicated' interstitial phases are also made. (Contractor's abstract)

2973

Uppsala U. Inst. of Chemistry (Sweden).

X-RAY INVESTIGATIONS OF Mn_3P, Mn_2P AND Ni_2P, by S. Rundqvist. Dec. 27, 1961 [16]p. incl. tables, refs. (Technical note no. 30) (AFOSR-1921) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)40 and Swedish State Council of Technical Research) AD 274278 Unclassified

Also published in Acta Chem. Scand., v. 16: 992-998, 1962.

The crystal structures of Mn_3P(Fe_3P type) Mn_2P and Ni_2P (revised C 22 type) were refined by single-crystal methods. Both Mn_2P and Ni_2P have appreciable homogeneity ranges. X-ray power investigations in the Mn-P system indicate that the existence of the phase described as Mn_3P_2 is doubtful. Some phase-analytical data for the MnP system are discussed. (Contractor's abstract)

2974

Uppsala U. Inst. of Chemistry (Sweden).

REFINEMENT OF THE Ni_3P STRUCTURE, by S. Rundqvist, E. Hassler, and L. Lundvik. [1961] [2]p. incl. tables. (AFOSR-1922) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)-40 and Swedish Technical Research Council) Unclassified

Also published in Acta Chem. Scand., v. 16: 242-243, 1962.

Structure data for Ni_3P was obtained by single-crystal

methods. The space group is $I\bar{4}$ ($-S_4^2$); Z = 8. The unit cell dimensions were determined from powder photographs recorded in Guinier-type focusing camera with CuKa and CrKa$_1$ radiation using silicon as the internal calibration standard. The standard derivations for the atomic positions and the interatomic distances are presented in table form.

2975

Uppsala U. Inst. of Chemistry (Sweden).

ON THE CRYSTAL STRUCTURE OF HYDRATED SODIUM PEROXOBORATE, by A. Hansson. [1961] [2]p. incl. diagrs. tables. (AFOSR-J28) (AF 61(052)-40) AD 297174 Unclassified

Also published in Acta Chem. Scand., v. 15: 934-935, 1961.

There is some controversy about the nature of the compound that crystallized from a water solution of sodium borate and hydrogen peroxide. It has been described both as $NaBO_2 . H_2O_2 . 3H_2O$ and as $NaBO_3 . 4H_2O$.

Crystals of the compound were obtained from a solution of 3.5 g borax, 0.35 g NaOH and 9 ml 30% H_2O_2 in 125 ml water. Analyses of the sodium, boron, and active oxygen contents of the crystals were in agreement with the composition given by the above formulae. Weissenberg photographs were taken of 2 single crystals rotated around different axes. Comparison of single crystal photographs and powder photographs established that only 1 substance had crystallized from the solution. The intensities of 500 independent reflections were estimated. The triclinic unit cell contains 1 formula unit $Na_2B_2(O_2)_2-(OH)_4 . 6H_2O$ and has the dimensions a = 7.34A, b = 6.81A, c = 8.15A, with $\alpha = 101°$, $\beta = 110°$ and $\gamma = 120°$. The space group is $P\bar{1}$. The unrefined parameters of Na, O and B atoms, the bond distances within the peroxoborate ion and the bond distances between sodium and oxygen atoms are presented in table form.

2976

Uppsala U. Inst. of Chemistry (Sweden).

THE OCTAHEDRAL COORDINATION IN ADDUCT MOLECULES. BOND LENGTHS AND BOND ANGLES, by C.-I. Brändén, A. Hansson and others. Apr. 20, 1961 [8]p. incl. diagrs. tables. (Technical note no. 13) (AFOSR-476) (AF 61(052)43) AD 265316 Unclassified

The crystal structures $SbCl_5 . POCl_3$ (I), $SbCl_5 . MePO$ (II), $SbCl_5 . Ph_2SO$ (III), $SnCl_4 . 2SeOCl_2$, and $(TiCl_4 . POCl_3)_2$ were determined. Bonds to Cl atoms opposite to donor-acceptor bonds are generally stronger than the other bonds from the acceptor atom to Cl atoms. Bond angles in compounds I, II, and III respectively are O-Sb-Cl, 85, 88, 85°; Cl-Sb-Cl, 90, 90, 90°; Cl-Sb-Cl*, 95, 92, 95° (Cl* is the Cl atom situated opposite to a donor atom). All these deviations from ideal octahedral coordination are due to two steric factors: van der Waals radii of ligand atoms and their distances from the central atom.

2977

Uppsala U. Inst. of Chemistry (Sweden).

THE CRYSTAL STRUCTURE OF $SbCl_5 . SO(C_6H_5)_2$, by A. Hansson and M. Vanngard. Apr. 20, 1961 [15]p. incl. diagrs. tables, refs. (Technical note no. 14) (AFOSR-477) (AF 61(052)43) AD 264819 Unclassified

The crystal structure of $SbCl_5 . SO(C_6H_5)_2$ was determined from 3-dimensional x-ray data. The crystals were prepared from a mixture of a solution of 0.40g $(C_6H_5)_2SO$ dissolved in 30 ml CCl_4 and a solution of 0.25 ml $SbCl_5$ in 30 ml CCl_4. The structure was made up of $SbCl_5 . SO(C_6H_5)_2$ molecules, and coordination around the Sb atom was octahedral. The O and Sb atoms in $(C_6H_5)_2SO$ and $SbCl_5$ functioned as donor and acceptor atoms, respectively. Coordinate, bond angle, and molecular distance data are given. The bond between the O and Sb atoms was weak. The stability of the addition compound was attributed to secondary effects.

2978

Uppsala U. Inst. of Physical Chemistry (Sweden).

THE FIFTH INTERNATIONAL SYMPOSIUM ON FREE RADICALS, Uppsala U., July 6-7, 1961. Stockholm Almqvist and Wiksell [1961] [825]p. incl. diagrs. tables, refs. (AFOSR-1495) (Sponsored jointly by Air Force Office of Scientific Research, Dept. of the Army, and Swedish Ministry of Education) AD 262103 Unclassified

Various aspects of free radicals are discussed. The symposium is divided into the following major categories: free radical reactions at low temperatures, spectroscopic studies on free radicals, electron spin resonance studies on free radicals, properties and reactions of radicals produced by high energy radiation and photochemical studies on free radicals.

2979

Uppsala U. Inst. of Physical Chemistry (Sweden).

HIGH INTENSITY PHOTOLYSIS STUDIES OF ACETONE AND SOME ALIPHATIC ALDEHYDES, by G. Wettermark. [1961] 78p. incl. illus. diagrs. tables, refs. (AFOSR-4288) (AF 61(052)70) Unclassified

Also published in Arkiv Kemi, v. 18: 1-78, 1961.

The vapor phase photolysis of acetone, acetaldehyde,

propionaldehyde, n-butyraldehyde and isobutyraldehyde has been investigated at very high light intensities. It was found that reactions which are first order with respect to radical concentration could be satisfactorily eliminated. This resulted in a striking simplification of the reaction schemes and has led to new information concerning the primary photochemical mechanisms and the reactions of the formed radicals. (Contractor's abstract, modified)

2980

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. (AF 61-(052)70) AD 419223 Unclassified

Reactions between excited molecules and molecular fragments have been studied. The vapor phase photolysis of acetone, acetaldehyde, propionaldehyde, n-butyraldehyde and isobutyraldehyde has been investigated at very high temperatures. A large number of data has been collected from the flash heating studies of benzene, mesitylene, ethylbenzene and phenantrene. Mass spectrographic studies have also been undertaken.

2981

Uppsala U. [Inst. of Physical Chemistry] (Sweden).

REACTIONS BETWEEN EXCITED MOLECULES AND MOLECULAR FRAGMENTS, by S. Claesson. [1961] [1]p. [AF 61(052)70] Unclassified

Presented at Second AFOSR Contractors' meeting on Chemical Kinetics of Propulsion, Illinois Inst. of Tech. Armour Research Foundation, Chicago, Sept. 11-12, 1961. (AFOSR-1417; AD 265513)

High intensity photolysis has been carried out on a number of ketones and aldehydes in vapor phase. Analyses for all the major products formed have been performed by means of gas-chromatography and mass-spectrometry. By using parallel light of high intensity it has also been possible to study the quantum yield as a function of light intensity over a wide range of intensities. The quantum yield shows a pronounced decrease as the light intensity increases. This is certainly due to the fact that long-lived electronically excited molecules are formed which are deactivated to the ground state in collisions between 2 such molecules. From the quantitative analyses of the products the relative importance of the different possible reactions have been calculated. Also a number of relations between the ratio of rate constants for various free radical reactions have been calculated from these data. Furthermore some high intensity pyrolysis work has been performed placing the sample in a quartz capillary directly in the middle of the discharge. From aromatic hydrocarbons the products formed are mainly carbon, hydrogen and hydrocarbons with 1 and 2 carbon atoms.

2982

Uppsala U. Inst. of Physics (Sweden).

PENETRATION MATRIX ELEMENTS AND NUCLEAR STRUCTURE EFFECTS IN Tl^{203}, by T. R. Gerholm, B.-G. Pettersson and others. [1961] [19]p. incl. diagrs. tables, refs. [AF 61(052)13] Unclassified

Published in Nuclear Phys., v. 24: 177-195, Apr. 1961. 1961.

Gamma-gamma, electron-gamma and gamma-electron directional correlation experiments on the $d_{5/2}$ (400 kev) $d_{3/2}$ (279 kev)$S_{1/2}$ cascade in Tl^{203} are reported. The following results were obtained: $A_2(\gamma\gamma) = -0.130 \pm 0.006$, $A_2(2\gamma) = -0.011 \pm 0.004$, $A_2(\gamma e) = -0.030 \pm 0.003$. In addition the K-conversion coefficient of the 400 kev transition was determined from the coincidence experiments. The value obtained is $\beta_1 k$ (400 kev) $= 0.145 \pm 0.007$. The experiments were performed in order to search for nuclear structure effects in the M1 internal conversion process. These effects are expected to be negligible in the l-allowed (400 kev) transition. This is confirmed by the experiments which are in perfect agreement with the theory assuming no nuclear structure effects. Large nuclear structure effects are to be expected for the strongly retarded l-forbidden (279 kev) transitions. This is also confirmed by the angular correlation experiments. It is shown that all experimental data are consistent with a λ-value of $+76 \pm 1$, where λ is defined as the ratio of the penetration matrix element and the normal γ ray matrix element. The value for the weighting factor $C(Z, k)$ was taken to be 0.0260. The errors for λ given here do not include the uncertainty in the weighting factor which is supposed to be known to within $\pm$ 10%. The agreement between the theory and the experimental results is further improved if the particle parameters are corrected for the finite size of the nucleus in the E2 conversion process. (Contractor's abstract)

2983

Uppsala U. Inst. of Physics (Sweden).

PENETRATION MATRIX ELEMENTS AND NUCLEAR STRUCTURE EFFECTS IN Tl^{201}, by B.-G. Pettersson, T. R. Gerholm and others. [1961] [27]p. incl. diagrs. tables, refs. (Sponsored jointly by [Air Force Office of Scientific Research under AF 61(052)-13] Swedish Atomic Energy Commission, and Swedish National Research Council) Unclassified

Published in Nuclear Phys., v. 24: 196-222, Apr. 1961.

It is concluded that the present formulation of the theory of internal conversion, including nuclear structure dependent factors, is fully consistent with the experimental data. Experimentally determined penetration matrix elements provide new pieces of information

about the nuclear structure. It is shown that in order to get a unique determination of the λ-parameter it is necessary to determine both the internal conversion coefficient and the electron-gamma angular correlation. (Contractor's abstract, modified)

2984

Uppsala U. Inst. of Physics (Sweden).

MAGNETIC AND QUADRUPOLE INTERACTIONS IN Hg^{197m} ANGULAR CORRELATIONS, by B.-G. Pettersson, J. E. Thun, and T. R. Gerholm. [1961] [20]p. incl. diagrs. tables, refs. [AF 61(052)13] Unclassified

Published in Nuclear Phys., v. 24: 223-242, Apr. 1961.

A series of electron-gamma angular correlation studies of the 165 kev-134 kev cascade in Hg^{197m} and the 130 kev-279 kev cascade in the decay-product Au^{197m} are reported. For the Au^{197m} cascade no observable attenuations of the angular correlation pattern were found due to the short lifetime of the intermediate level. In Hg^{197m} the correlation was found to be attenuated by a static quadrupole interaction for carrier-free sources deposited onto different metal and insulator backings. No measurable attenuation due to an interaction with the electron core was seen for metallic source backings. However, an additional attenuation attributed to the after-effects of the conversion-process was found for sources embedded in insulating environments. The interplay between the 2 different types of interaction gives a complicated attenuation mechanism, which, however can be disentangled by means of time-differential angular correlations. A direct proof of the existence of an attenuation-effect due to the excitation of the electron core is furnished by a magnetic decoupling experiment, confirming the results obtained in the correlation experiments. (Contractor's abstract)

2985

Uppsala U. Inst. of Physics (Sweden).

EXPERIMENTAL DETERMINATION OF THE CONVERSION COEFFICIENT OF THE 412 KEV E2 TRANSITION IN Hg^{198}, by B.-G. Pettersson, J. E. Thun, and T. R. Gerholm. [1961] [8]p. incl. table, refs. [AF 61(052)13] Unclassified

Published in Nuclear Phys., v. 24: 243-250, Apr. 1961.

The K-conversion coefficient of the 412 kev transition in Hg^{198} has been measured using a coincidence method. The result obtained $\alpha_K = 0.0305 \pm 0.0010$ is in agreement with the theoretical value for a pure E2 transition as calculated by Rose and by Silv and Band. The authors disagree with recent results obtained by the internal-external conversion method.

2986

Uppsala U. Inst. of Physics (Sweden).

PENETRATION MATRIX ELEMENTS AND NUCLEAR STRUCTURE EFFECTS IN Ta^{181}, by Z. Grabowski, B.-G. Pettersson and others. [1961] [18]p. incl. diagrs. tables, refs. [AF 61(052)13] Unclassified

Published in Nuclear Phys., v. 24: 251-268, Apr. 1961.

Gamma-gamma and electron-gamma angular correlations in Ta^{181} are measured. The following results are obtained: $G_2A_2(133\gamma + 137\gamma - 482\gamma) = 0.065 \pm 0.003$, $G_2A_2(137\gamma - 482\gamma) = -0.04 \pm 0.015$, $G_2A_2(133K - 482\gamma) = -0.118 \pm 0.005$, $G_2A_2(137K - 482\gamma) = +0.030 \pm 0.013$, $G_2A_2(133\gamma + 137\gamma - 482K) = -0.005 \pm 0.003$, and $A_2(346\gamma - 136K) = +0.02 \pm 0.01$. The quadrupole attenuation factor G_2 is determined by delayed angular correlations and found to be the same in the gamma-gamma and electron-gamma correlations. The value obtained is $G_2 = 0.22 \pm 0.015$. An independent determination of G_2 gives $G_2 = 0.23 \pm 0.015$. Two conversion coefficients were determined from electron-gamma coincidence data: $\alpha_K(133) = 0.54 \pm 0.08$ and $\alpha_K(482) = 0.026 \pm 0.002$. The results are used to analyze the 482 kev conversion process in terms of nuclear structure dependent conversion matrix elements. The 482 kev transition is of mixed E2/m1 character. The mixing ratio becomes $\delta(482) = 6.4 \pm 0.8$. The M1 conversion process is strongly affected by the penetration terms. The M1 conversion coefficient is about 10 times larger than the normal finite size corrected value. From the conversion coefficient and the angular correlations the parameter λ, defined as the ratio of the penetration matrix element and the normal gamma-ray matrix element, becomes $-70 \geq \lambda \geq -125$. The large λ-value is a consequence of the large retardation of the 482 kev M1 transition. For the strongly retarded 133 kev E2 transition, however, the conversion process is found to be normal. It is concluded that the spin of the 619 kev level is + 5/2 in disagreement with earlier tentative assignments. (Contractor's abstract)

2987

Uppsala U. Inst. of Physics (Sweden).

POSSIBLE NUCLEAR STRUCTURE EFFECTS IN Lu^{175}, by J. E. Thun, Z. Grabowski and others. [1961] [12]p. incl. diagrs. refs. [AF 61(052)13] Unclassified

Published in Nuclear Phys., v. 29: 1-12, Jan. 1962.

Electron-gamma, gamma-electron and gamma-gamma angular correlations in Lu^{175} have been measured. The following results were obtained: $A_2(282\gamma - 114\gamma) =$

0.240 ± 0.004, $A_2(282\gamma\text{-}114K) = 0.02 \pm 0.01$, $A_2(282K\text{-}114\gamma) = 0.015 \pm 0.030$. No perturbation, due to quadrupole interaction, was found. The following conversion coefficients were determined from coincidence and single counting rates: $\alpha_K(114) = 1.6 \pm 0.3$; $\alpha_K(282) = 0.030 \pm 0.007$. The result of the 282K-114γ angular correlation measurement is greatly diminished from normal. This may be understood in terms of the presence of penetration matrix elements in the conversion process of the retarded 282 kev E1 + M2 transition. The measured K-conversion coefficients show no deviation from the tabulated values. (Contractor's abstract)

2988

Uppsala U. Inst. of Physics (Sweden).

ANGULAR CORRELATION MEASUREMENTS IN Hf^{177}, by J. E. Thun, Z. Grabowski and others. [1961] [8]p. incl. diagrs. refs. [AF 61(052)13] Unclassified

Also published in Nuclear Phys., v. 29: 13-20, Jan. 1962.

Gamma-gamma, electron-gamma and gamma-electron angular correlations of the 208 kev-113 kev cascade in Hf^{177} have been measured. The following results were obtained: $A_2(208\gamma\text{-}113\gamma) = -0.143 \pm 0.003$, $A_2(208\gamma\text{-}113K) = 0.000 \pm 0.008$, $A_2(208K\text{-}113\gamma) = 0.200 \pm 0.035$. The angular correlation between the K-conversion electrons of the retarded 208 kev E1 transition and 113 kev gamma rays was found to be normal. (Contractor's abstract)

2989

Uppsala U. Inst. of Physics (Sweden).

ANGULAR CORRELATION AND RESONANT SCATTERING IN Sn^{117}, by W. D. Hamilton, Z. Grabowski and others. [1961] [12]p. incl. diagrs. refs. [AF 61-(052)13] Unclassified

Published in Nuclear Phys., v. 29: 21-32, Jan. 1962.

Electron-gamma and gamma-gamma correlation measurements have been made of the decay cascade in Sn^{117m}. The following correlation coefficients were determined: $A_2(159\gamma\text{-}161\gamma) = -0.146 \pm 0.010$, $A_2(159K\text{-}161\gamma) = -0.160 \pm 0.008$. These confirm the M4 (159 kev) and M1 (161 kev) multipolarities, and indicate that both transitions are essentially pure. The resonant scattering condition for the 161 kev γ-ray was provided by the thermal method. Matched Sn and Cd scatterers were used and the resonant cross-section was determined relative to that for Rayleigh scattering. The total mean-life of the 161 kev level has the value $\tau = (1.6 \pm 0.5) \times 10^{-10}$ sec, and corresponds to a hindrance factor of 24 ± 8 for the l-forbidden M1 transition. (Contractor's abstract)

2990

Uppsala U. Inst. of Physics (Sweden).

DECAY OF Sm^{153} TO Eu^{153}, by T. Suter, P. Reyes-Suter and others. [1961] [33]p. incl. diagrs. tables, refs. [AF 61(052)13] Unclassified

Published in Nuclear Phys., v. 29: 33-65, Jan. 1962.

The decay of Sm^{153} to Eu^{153} has been investigated by means of an iron yoke double focusing spectrometer, gamma-gamma and electron-gamma coincidence spectrometers. A precision measurement of the 69.672 kev line has been performed with an iron-free double focusing spectrometer. Internal conversion lines and photo-electric lines of the following transitions have been measured and their energies determined with a precision of a few parts in 10^4: 69.672; 75.34; 83.37; 89.47; 97.45; 103.174; ~ 104.8; 172.85 kev. Conversion electron and gamma intensities, multipolarities, mixing ratios and conversion coefficients are given. Using the photo-electron method, 16 other weak transitions were measured with a resolution of 0.5% to 0.25%: 151.5; 411.5; 424.3; 437.7; 449.7; 463.6; 521.3; 531.4; 533.2; 539.1; 555.2; 578.6; 596.9; 603.1; 609.1; 636.0 kev. Difficulties in the computations of intensities of low energy γ-rays from external conversion measurements are briefly discussed. A decay scheme is proposed on the basis of the energy data and a quantitative analysis of the gamma-gamma and electron-gamma coincidences. Excited levels at the following energies have been established: 83.37; 97.45; 103.17; 172.85; (191 4); 634.6; 636.4; (694.3); (706.4) kev. (Contractor's abstract)

2991

Uppsala U. [Inst. of Physics] (Sweden).

DIRECT MEASUREMENTS OF CONVERSION LINES IN THE EV SCALE (Abstract), by S. Hagström, C. Nordling, and K. Siegbahn. [1961] [1]p. [AF EOAR-62-123] Unclassified

Presented at the Eleventh General Physics Conf., Lund U. (Sweden), June 2-4, 1961.

Published in Arkiv Fysik, v. 22: 408, 1962.

The calibration lines used in beta- and electron-spectroscopy are in some way or other related to x-ray spectroscopy measurements and thus founded on the x-unit. A suitable calibration line with its energy known directly in electron volts has been obtained by accelerating thermionic electrons through a very well-defined electric potential. The B_e-resolution of this thermionic electron line is 2×10^{-4} with an accelerating voltage of about 3 kv. The absolute value of this voltage is known with high accuracy. Some preliminary calibration measurements on conversion lines in the ThB spectrum have been made. The thermionic current can be adjusted to give a counting rate appropriate for GM detection which means that all geometric parameters can be kept the same in both types of measurement.

2992

Uppsala U. [Inst. of Physics] (Sweden).

PRECISION MEASUREMENTS OF AUGER LINES AND L LEVEL ENERGIES IN THE ELEMENTS Sr^{38} Ag^{47} (Abstract), by C. Hörnfeldt and A. Fahlman. [1961] [1]p. [AF EOAR-62-123] Unclassified

Presented at the Eleventh General Physics Conf., Lund U. (Sweden), June 2-4, 1961.

Published in Arkiv Fysik, v. 22: 412, 1962.

The energies of the KLL Auger lines of Sr^{38} and Mo^{42} have been determined. For both elements, 7 components could be established in the KLL group. The energy of the strongest line, due to the $KL_{II}L_{III}$ transition, has further been determined in the elements Y^{39} - Nb^{41} and Ru^{44} - Ag^{47}. The experimental data concerning the absolute energies deviate systematically by 59-75 ev from those predicted by Asaad and Burhop, which may be attributed to neglect of relativity in the theory. The relative energies are in good agreement. Further, the L_I, L_{II} and L_{III} level energies in the same elements have been measured with the photo electron method. Only a minority of the corresponding x-ray absorption edges for pure metals have been observed and a comparison shows some discrepancies. (Contractor's abstract)

2993

Uppsala U. [Inst. of Physics] (Sweden).

APPLICATION OF THE PHOTOELECTRON METHOD TO A STUDY OF THE FUNDAMENTAL CONSTANT COMBINATION h/e (Abstract), by C. Nordling, S. Hagström, and K. Siegbahn. [1961] [1]p. [AF EOAR-62-123] Unclassified

Presented at the Eleventh General Physics Conf., Lund U. (Sweden), June 2-4, 1961.

Published in Arkiv Fysik, v. 22: 428, 1962.

Experimental determinations of the fundamental constant combination h/e have previously been made from studies of the x-ray short-wavelength limit. These measurements yield values of h/e which are at variance with the value obtained from a least squares adjustment of the atomic constants. Preliminary results obtained with a new method for the determination of h/e are presented. The principle of the method is as follows. Two conversion lines are recorded in a beta-spectrometer. An earthed electrode is placed in front of the source and an electrical potential can be given to the source. This will shift the position of both electron lines, and for a certain value of the applied potential the low-energy line coincides with the former position of the high-energy line. In this way the energy difference between the electron lines can be measured in the ev scale. If, for instance, the 2 electron lines involved are due to photoelectric effect of x-rays in 2 different shells of an element, the energy difference between the lines can be obtained from x-ray spectroscopy data in terms of frequency. Equating the energy difference, measured in electron volts, to the corresponding energy in units of hv gives h/e.

2994

Uppsala U. Inst. of Physiology (Sweden).

OSCILLATORY ELECTROPHORESIS IN ION EXCHANGE MEMBRANES, by T. Teorell. [1961] [8]p. incl. diagrs. refs. (AFOSR-3451) (AF 61(052)363) Unclassified

Also published in Arkiv Kemi, v. 18: 401-408, 1961.

Experiments with electrophoresis of a homogeneous electrolyte solution across a bed (membrane) of ion exchange gels show, under appropriate conditions, oscillatory variations, with time, of voltage resistance and electro-osmotic bulk flow. A tentative discussion is given in terms of the author's earlier theories for the membrane oscillator which suggest how the electrolyte/membrane system can develop negative conductances and hence instability and oscillations. This type of oscillation may be relevant to the excitability phenomena exhibited by living tissues such as the nerves. (Contractor's abstract)

2995

Uppsala U. Inst. of Physiology (Sweden).

AN ANALYSIS OF THE CURRENT-VOLTAGE RELATIONSHIP IN EXCITABLE NITELLA CELLS, by T. Tecrell. [1961] [6]p. incl. diagrs. refs. (AFOSR-3452) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)363, Swedish Cancer Association, and Swedish Medical Research Council) Unclassified

Also published in Acta Physiol. Scand., v. 53: 1-6, 1961.

Experiments were performed on cells of the fresh water algae Nitella using triangular waves of varying frequencies, i.e. depolarizing-hyperpolarizing currents with varying, linear slopes. With very low frequencies one obtains steady state rectification curves, but with intermediate frequencies instability phenomena are revealed. The experimental findings of dynamic current-voltage characteristics are compared with the theoretical results, which can be predicted from the author's electrohydraulic hypothesis for excitability phenomena. It is suggested that electro-osmotic processes, arising from presence of membrane fixed charges, may play a part in the excitability of Nitella. (Contractor's abstract)

2996

Uppsala U. Inst. of Physiology (Sweden).

EXCITABILITY PHENOMENA IN ARTIFICIAL

MEMBRANES, by T. Teorell. [1961] [26]p. incl. illus. diagrs. table, refs. (AFOSR-J177) (AF 61(052)-363) AD 400430 Unclassified

Presented at Internat'l. Biophysics Cong., Symposium on Molecular Aspects of Viral Replication, Stockholm (Sweden), July 31-Aug. 4, 1961.

Also published in Biophys. Jour., v. 2: 27-52, Mar. 1962. (Supplement)

A wet physicochemical system is described which is designed to represent the cell conditions and exhibits excitability that is like many of the physiological events. This report deals with electrolyte solution separated by a boundary, the membrane, which includes a feature, which is of importance, namely the presence of immobile or fixed ionic groups in the porous matrix. The system can be supplied with energy, and can be stimulated by an electric current. This analog is also sensitive to pressure stimuli and may offer some viewpoints of another important physiological problem, namely the mechano-electrical transduction.

2997

Utah U. Dept. of Chemical Engineering, Salt Lake City.

THIRD AFOSR CONTRACTOR'S MEETING ON COMBUSTION OF SOLID PROPELLANTS, Utah U., Salt Lake City, Jan. 30-31, 1961, 1v. incl. diagr. table, refs. (AFOSR-986) [AF 49(638)170] Unclassified

This report contains 12 abstracts of papers presented at the meeting. The topics include (1) fundamental studies of solid propellant ignition, (2) propellant ignition and igniter characteristics, (3) ignition of composite propellants, (4) progress in the theory of composite propellant burning, (5) combustion of laminated solid propellants, (6) mechanism of burning of composite solid propellants, (7) investigations of the mechanisms of decomposition, combustion and detonation of solids, (8) solid propellant combustion mechanism, (9) analytical investigation of the effects of acoustic energy on the combustion of solid propellants, (10) disturbances in burning solid propellants, (11) influence of propellant burning rate, grain design and motor scale on erosive burning of ammonium perchlorate formulations, and (12) experimental study of combustion instability in solid rocket propellants.

2998

Utah U. Dept. of Chemical Engineering, Salt Lake City.

IGNITION AND COMBUSTION OF SOLID PROPELLANTS, by R. C. Mitchell, J. A. Keller and others. Final technical rept. Mar. 1957-Sept. 30, 1961 [77]p. incl. illus. diagrs. tables, refs. (AFOSR-2225) (AF 49(638)170) AD 274624 Unclassified

The response was studied of propellant ignition to externally supplied heat flux. Both radiant flux from electrically heated tube furnaces and convective flux from shock-heated gas were employed, the former giving fluxes in the range 5 to 50, the latter, 100 to 300 Btu/sec., sq. ft. The results, ignition delay time as a function of heat flux are correlated. The theory predicts the effect of initial propellant temperature on the ignition time-heat flux relationship, but is noncommittal with respect to the effect of pressure. The effect of pressure on the ignition delay time of perchlorate propellants is a function of heat flux level, being very slight, for the propellants studied, at flux levels above 20 Btu/sec., sq. ft. Exploratory studies concerned flame spread, effects of aerodynamic transients on burning propellant, and the diffusion flame between large bodies of fuel and oxidant. One firm conclusion is that flame spread across fresh surface, unassisted by external heat flux to that surface, is too slow to be an important factor in the over-all ignition process. As one aspect of the aerodynamic transient studies, a theory of the rarefaction tube was developed. (Contractor's abstract)

2999

Utah U. Dept. of Chemical Engineering, Salt Lake City.

IGNITION OF COMPOSITE PROPELLANTS (Abstract), by N. W. Ryan. [1961] [1]p. [AF 49(638)170] Unclassified

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

Ignition of composite propellants by high-flux convective heating with shock-heated gases has been extended to higher flux levels (300 plus Btu/(hr, sq ft, deg F)) and shorter ignition times than previously reported from this project. The increase in range has been achieved by increasing gas velocities to a level such that stable ignition cannot be attained with propellants that are intrinsically difficult to ignite. A detailed study of heat flux under the conditions employed has been necessary. Computer programs have been written for the tedious parts of the calculations. Burning strands 1/2 in. in diameter have been subjected to rarefaction waves of controlled strength, the burning surface being observed by a photocell. There is no evidence that there is a critical rarefaction strength. Generalizations, based on tests with 3 propellants, are (1) the most easily ignited propellants recover most rapidly from the quenching effects of the rarefactions, and (2) the property of the rarefaction determining the response of a given propellant is the fractional pressure drop. Close-up, high-speed photography of the burning surface of metallized propellant shows that when present in a concentration of only 2%, the aluminum particles burst while still on the surface. When present at 16%, the particles are carried away from the surface before they burst. To the present, such observations have been made only for burning at atmospheric pressure. A program of chemical arc study, in which large bodies of fuel and oxidizer are brought together and the diffusion flame between them observed has been begun. Exploratory tests indicate that the diffusion flame can be established in a steady state.

3000

Utah U. [Dept. of Electrical Engineering] Salt Lake City.

THE ANOMALOUS BEHAVIOR OF LEAD-TO-LEAD IMPACT, by H. B. Vanfleet, W. S. Partridge, and E. T. Cannon. [1958] [25]p. incl. illus. diagrs. table. (AF 49(638)462) Unclassified

Published in Proc. Third Symposium of Hypervelocity Impact, Chicago, Ill. (Oct. 7-9, 1958), v. 1: 115-139, Feb. 1959.

Results indicate that over a limited energy range of lead-to-lead impact a linear relationship between crater volume and impact energy seems to apply, but that over a larger range of energy the relationship seems to be $V = V_0(1-e^{-CE})$. The area of the crater in the surface of the target is linearly related to the area and the volume per unit area is linearly related to the penetration or depth of the crater. The extrapolation of these relationships to high energy leads to craters which are large in area but shallow in depth. The volume and energy relationship noticed in lead-to-lead impact is also observed where spheres of other materials are impacted into lead. (Contractor's abstract)

3001

Utah U. [Dept. of Electrical Engineering] Salt Lake City.

THE UTAH LIGHT-GAS GUN, by W. A. Boyd, W. S. Partridge, and E. T. Cannon. [1958] [15]p. incl. illus. diagrs. tables. (AF 49(638)462) Unclassified

Published in Proc. Third Symposium of Hypervelocity Impact, Chicago, Ill., (Oct. 7-9, 1958), v. 1: 425-439, Feb. 1959.

Several models of a light-gas gun have been developed. The design consists of a launch tube-mounted at right angles to the pump tube which is capable of developing higher pressures and velocities with much greater ease of operation.

3002

Utah U. Dept. of Electrical Engineering, Salt Lake City.

HIGH VELOCITY IMPACT STUDIES, by R. W. Grow. Final rept. Oct. 31, 1961, 14p. incl. refs. (Technical rept. no. 24) (AFOSR-1937) (AF 49(638)462) AD 271470 Unclassified

Various aspects of the field of high velocity impact are studied. Topics covered are: impact-flash and spray-particle investigations, spectral analysis, impact of copper spheres into copper targets, meteor physics, light-gas gun development, electrostatic acceleration of small particles, and impact and cratering investigations on steel and aluminum in space.

3003

Utah U. Dept. of Electrical Engineering, Salt Lake City.

PRECISION MEASUREMENT OF LEAD-TO-LEAD IMPACT, by C.-h. Chiou, R. W. Grow, and E. P. Palmer. Oct. 31, 1961, 67p. incl. illus. diagrs. tables, refs. (Technical rept. no. 23) (AFOSR-1938) (AF 49(638)462) AD 270009 Unclassified

Lead spheres having a diameter of 3/16 in. were impacted normally upon lead targets at different temperatures. The volume, area, and depth of resulting craters were measured and plotted as a function of either the pellet impacting energy, the pellet momentum, or the pellet velocity. Two sets of experiments were performed. The original results that V/E decreases with the increase of pellet velocity and the later results that crater depth is proportional to the 2/3 power of pellet velocity contradict each other. But the fact that the decrease of V/E at high velocities is less at high temperatures and thus the volume vs energy plot tends to be a straight line show that the contradiction is probably caused by measurement error. The error is greater for high velocities and low target temperatures. A relationship was found to exist between the initial V/E and the target temperature. A linear relationship between the crater area and the pellet momentum was found to exist. (Contractor's abstract)

3004

Utah U. Dept. of Electrical Engineering, Salt Lake City.

A LABORATORY INVESTIGATION OF METEOR PHYSICS, by J. R. Jensen and E. P. Palmer. Oct. 15, 1961, 57p. incl. illus. diagrs. tables, refs. (Technical rept. no. 22) (AFOSR-1939) (AF 49(638)-462) AD 270181 Unclassified

Equations of motion for a single particle traveling in a constant density atmosphere are derived. The aerodynamic drag on the particle and the atmosphere-particle energy transfer resulting in loss of particle mass are considered. It is assumed as an initial condition that steady-state ablation is occurring. Emphasis is placed on determining particle size and absolute luminosity from measurements of distance versus time. Micron-size particles, which travel at velocities in lower meteor range of 10 to 20 km/sec, are produced by impact of spherical steel pellets on a steel target. The leading edge of a cloud of particles was detected and velocities to 15 km/sec were measured. By applying the theory to deceleration measurements, the size of the particles was estimated at approximately 1.0 micron diameter. An improved vacuum firing range was designed to correct for the vacuum and size limitations. An experiment is proposed to utilize the improved system to detect and measure individual particles. Data from the experiments can be compared with theory and the results applied directly to determine in detail the physical phenomena occurring in meteor flight. (Contractor's abstract)

3005

Utah U. Dept. of Electrical Engineering, Salt Lake City.

CHARGING, INITIAL ACCELERATION AND DETECTION OF MICRON DIAMETER PARTICLES, by E. P. Palmer, D. R. Harrison, and R. W. Grow. Dec. 5, 1961 [34]p. incl. diagrs. refs. (Technical rept. no. 21) 21) (AFOSR-1940) (AF 49(638)462) AD 270047 Unclassified

One method by which small particles may be accelerated to high-velocities is to charge the particles electrically and then accelerate them through a high voltage such as that produced by a Van de Graaff generator. Besides producing a high voltage, the chief problems met in electrostatic acceleration are those concerned with handling the particles, placing a charge on them, maximizing their charge-to-mass ratio and measuring particle size and velocity. A system to solve these problems is developed. A measure of the over-all effectiveness of the charging system is given by the particle charge-to-mass ratio since this determines the velocity which can be attained. It was found that for carbonyl-iron spheres of 0.2 to 1.1-micron radius, the attainable charge to mass ratio is given by the expression 6.13×10^6 quantity divided by r, where q is charge, m is mass and r is particle radius. M.K.S. units are used. It is believed that this represents close to the practical maximum value attainable using contact charging and that the limit is imposed by electrical stresses in the particle surface causing surface disruption and ion emission. (Contractor's abstract)

3006

Utah U. [Dept. of Metallurgy] Salt Lake City.

MICROSECOND FRAMING CAMERA OBSERVATIONS OF HIGH VELOCITY, by M. A. Cook and R. T. Keyes. [1958] [27]p. incl. illus. diagrs. table, refs. (AF 18-(603)100) Unclassified

Published in Proc. Third Symposium on Hypervelocity Impact, Chicago, Ill. (Oct. 7-9, 1958), v. 1: 5-31, Feb. 1959.

This paper describes results of high speed photographic studies of cratering, the primary objectives being to look for possible explosions of targets and projectiles in ultra-high velocity impact, and to determine, if possible, the conditions under which these explosions occurred in various metals. In addition, ablation was studied qualitatively by observing characteristics of the wakes from the ultra-high-speed projectiles in various gaseous media. Also some observations of penetration of high speed jets into lucite are described showing the relationships between the penetration and the shocks produced in the type c range of penetration. Finally a correlation between theoretical and experimental hole volumes in cratering in the high velocity (plastic deformation) range is presented.

3007

Utah U. Dept. of Metallurgy, Salt Lake City.

THE EFFECT OF PRESSURE ON IONIZATION IN GASEOUS DETONATION, by M. A. Cook, P. P. Bracke, and R. T. Keyes. Mar. 31, 1961, 30p. incl. diagrs. tables. (AFOSR-704) (AF 18(603)100) AD 258247 Unclassified

Electrical conduction measurements within detonation waves in the gaseous systems, $2H_2 - O_2 - 0.002\ N_2$, $2H_2 - O_2 - N_2$, and $2CO - O_2$ were carried out over a range of detonation pressures up to 340 atm in order to determine the effect of pressure on ion density. Experimentally determined conductivities were compared with theoretical values. In the case of the $2H_2 - O_2 - 0.002\ N_2$ and $2H_2 - O_2 - N_2$ systems theory and experiment were found to agree at low pressure. However, a relatively abrupt rise with pressure of the experimental values above the theoretical ones occurred at about 20 atm and 50 atm for the $2H_2$-O_2-$0.002\ N_2$ and the $2H_2$-O_2-N_2 systems, respectively. This rise was not noted in the $2CO$-O_2 system. Two explanations for the excess ionization at high pressures in the $2H_2$-O_2-N_2 systems were investigated, the first being the increased predominance of H_3O^+ as pressure is increased, and the second was based on the assumption of a tendency toward existence of ions in a quasi-lattice structure in the detonation wave which leads to a cohesive energy for the ions and the electrons that increases with ion density. The existence of a significant cohesive energy in turn leads to a decreased effective ionization potential. Increased predominance of H_3O^+ formation proved unable to account for the experimental results. However, the conductivity vs pressure results were reproduced satisfactorily by the quasi-lattice mechanism. (Contractor's abstract)

3008

Utah U. [Dept. of Metallurgy] Salt Lake City.

IONIZATION WAVES FROM FREE SURFACES OF DETONATING EXPLOSIVES, by A. Bauer, M. A. Cook, and L. A. Rogers. Sept. 7, 1961 [41]p. incl. illus. diagrs. tables, refs. (AFOSR-1335) (AF 18-(603)100) AD 266788 Unclassified

Presented at the Western States Section of the Combustion Inst., Berkeley, Calif., Sept. 7-8, 1961.

Ionization waves ejected from the free surface of condensed high explosives in various gaseous media at ambient about (645 mm) and 0.5 mm Hg pressures are described. Framing camera and streak camera photographs correlated with electrical conduction measurements showed a highly ionized, either highly luminous or completely transparent, precursor wave led both the shock wave and the main products of detonation propagated from the free surface. At 0.5 mm

Hg this wave was transparent and non-luminous, but it always produced a burst of luminosity upon collision with the endplate of the vacuum chamber several microseconds before the opaque detonation products impacted the end plate. Measured ionization wave pressures were in general several times greater than the pressures computed by shock wave theory for the observed velocity and initial pressure and up to 20 times greater than for the shock computed by the impedance mismatch equation. The waves from the explosive free surface appear to be highly ionized material radiated from the free surface of the explosive. (Contractor's abstract)

3009

Utah U. Dept. of Metallurgy, Salt Lake City.

INVESTIGATION OF HIGH VELOCITY IMPACT OF SOME HIGH EXPLOSIVES PHENOMENA, by R. T. Keyes. Final rept. July 1, 1955-Sept. 30, 1961. Dec. 1, 1961, 45p. incl. diagrs. tables, refs. (AFOSR-1933) (AF 18(603)100) AD 269769 Unclassified

A summary of the important results obtained in this research is given. The subject matter included: (1) high explosive generators for fast particles; (2) mechanism of cratering in ultra high velocity impact; (3) observations of vaporization accompanying ultra high velocity impact; (4) mechanism for crater expansion in shaped charge penetration; (5) ionization and electron densities in detonating solid explosives; (6) electrical fields and electromagnetic radiation from chemical detonations; (7) external detonation generated plasmas; (8) the effect of pressure on the degree of ionization in gaseous detonations; (9) ionization and electrical conductivity and its relationship to the deflagration to detonation transition in solid explosives; and (10) transition to detonation in liquid explosives. (Contractor's abstract)

3010

Utah U. [Dept. of Physics] Salt Lake City.

EFFECTS OF EDGE MATERIAL ON WIDE ANGLE DIFFRACTION, by G. R. Orme. June 1961 [64]p. incl. illus. diagrs. tables, refs. (AFOSR-822) (AF 49-(638)799) AD 260251 Unclassified

Precision photometric traces of light diffracted 70° into the shadow region were made for 4 different diffracting edges. Two of the half planes were gold plated, 1 silver plated and 1 copper plated. Light of wavelengths 4358A or 5461A was normally incident on the edge for all cases. Intensity traces as a function of diffracting angle were made for light polarized perpendicularly and parallel to the edge for both wave-lengths. The distance from the edge to the photometer was 19.5 cm. The diffracted light was measured by a liquid-nitrogen-cooled 1P21 electron photomultiplier photometer. A new solid state amplifier system was used to lend high stability to the measurements taken. Although experimental conditions do not rigorously satisfy Sommerfeld boundary conditions, comparison is made with Sommerfeld theory to show in general how the patterns for the different metals vary. The light intensity ranged over 10^9 part of that observed at the geometrical shadow. In general the traces agree to within an order of magnitude with Sommerfeld theory. The different metals and wavelengths exhibit a pronounced effect on the intensity distribution and polarization of the light diffracted into the shadow region. (Contractor's abstract)

3011

Utah U. [Dept. of Physics] Salt Lake City.

WIDE-ANGLE OPTICAL DIFFRACTION AT A WEDGE (Abstract), by F. S. Harris, Jr., H. J. Woodford, and W. T. Silfvast. [1961] [1]p. [AF 49(638)799] Unclassified

Presented at Annual meeting of the Opt. Soc. Amer., Inc., Los Angeles, Calif., 1961.

Published in Jour. Opt. Soc. Amer., v. 51: 1465, Dec. 1961.

Wide-angle optical diffraction at a wedge has been studied using a sensitive photometer. Measurements have been made of various thin coatings on steel and fused silica wedge diffraction patterns including intensity and polarization effects. Experimental results are compared with the Sommerfeld half plane and the various wedge theories, and the differences are discussed. (Contractor's abstract)

3012

Utah U. Inst. for the Study of Rate Processes, Salt Lake City.

THE KINETICS OF THE PYROLYSIS OF CARBON MONOXIDE BORANE, by Y.-C. Fu and G. R. Hill. [1961] [5]p. incl. diagrs. tables. (AFOSR-1212) (AF 49(638)28) AD 456585 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 84: 353-357, Feb. 5, 1962.

An infrared spectrometer study was carried out on the decomposition of carbon monoxide borane in a heated infrared cell. The concentration of each component, carbon monoxide borane and diborane, was followed by means of infrared spectrometric analysis, and the total pressure change was followed simultaneously by means of a pressure transducer attached to the heating cell. The effects of surface, photolysis by the infrared beam, the presence of diborane and the addition of carbon monoxide and hydrogen on the rate of the decomposition were observed. A mechanism for the decomposition of carbon monoxide borane is proposed. This mechanism involves as the slow step, $OCBH_3 \rightarrow BH_3 + CO$, and the equilibrium $BH_3 + BH_3 = B_2H_6$ is followed by the relatively rapid reactions $BH_3 + CO \rightarrow OCBH_3$ and $BH_3 + OCBH_3 \rightarrow B_2H_6 + CO$. The disappearance of $OCBH_3$ is expressed by the rate equation

$\frac{-d(OCBH_3)}{dt} = \frac{2k_1(OCBH_3)^2}{(CO) + (OCBH_3)}$. This is confirmed by linear second order plots with the slopes inversely proportional to the sum of the existing $OCBH_3$ and CO pressures (constant for a given run) at 54 to 64°C.

Small amounts of hydrogen and higher boron hydrides are also formed as the result of the decomposition. The intial first order rate constant for the decomposition of $OCBH_3$ is expressed by the Eyring absolute rate equation $k' = 1.25 \times 10^{12} T \exp(-28,400/RT) \exp(10.2/R)$ min.$^{-1}$. (Contractor's abstract)



3013

Vienna U. Inst. for Theoretical Physics (Austria).

SYMMETRIES OF FUNDAMENTAL PARTICLE INTERACTIONS, by W. [E.] Thirring. Annual summary rept. Sept. 1, 1959-Aug. 31, 1960, 4p. (AFOSR-TN-60-1382) (AF 61(052)265) Unclassified

Brief summaries are presented of 6 technical reports issued during this period (see item nos. 2838-2843, Vol. IV).

3014

Vienna U. Inst. for Theoretical Physics (Austria).

A ONE DIMENSIONAL FIELD THEORY WITH DEGENERATE VACUUM, by K. Baumann and R. Sexl. Jan. 20, 1961, 14p. (Scientific note no. 7) (AFOSR-808) (AF 61(052)265) AD 258080 Unclassified

Also published in Nuclear Phys., v. 26: 117-125, July 1961.

A 1-dimensional field theory is considered corresponding to the continuous limit of a spin chain. The vacuum degeneracy of this theory is explored. Besides, it is shown that the theory can equivalently be formulated in terms of an interacting Fermi field or of a Bose field without interaction. Finally, a theory is discussed briefly which can either be treated as an interacting Bose field or as a free Fermi field. (Contractor's abstract)

3015

Vienna U. Inst. for Theoretical Physics (Austria).

ON FIELD THEORIES WITH DEGENERATE GROUND STATES, by K. Baumann, G. Eder, and R. Sexl. Apr. 20, 1961, 21p. incl. refs. (Scientific note no. 8) (AFOSR-853) (AF 61(052)265) AD 258081 Unclassified

Also published in Ann. Phys., v. 16: 14-25, Oct. 1961.

A model field theory of the superconducting type is solved exactly. The exact solution is compared with the Bardeen-Cooper-Schrieffer solution. The exact ground state is non-degenerate while the Bardeen-Cooper-Schrieffer ground state is degenerate. The connection between the 2 types of ground states, and between their energies, is given. Also some properties of the excited states are discussed. (Contractor's abstract)

3016

Vienna U. Inst. for Theoretical Physics (Austria).

ON THE PARITY NONCONSERVATION INDUCED BY THE UNIVERSAL FERMI INTERACTIONS IN THE PION-NUCLEON VERTEX, by D. Flamm and P. G. O. Freund. May 10, 1961, 12p. incl. diagrs. refs. (Scientific note no. 9) (AFOSR-854) (AF 61(052)265) AD 264840 Unclassified

Also published in Phys. Rev., v. 125: 385-387, Jan. 1, 1962.

The problem whether the interpretation of strong interactions as high energy effects of the Universal Fermi Interactions (UFI) is consistent with experimental evidence on parity conservation in low energy nuclear physics is investigated. The parity non-conserving part of the one nucleon off shell pi-N vertex, which originates in the UFI (which we consider smeared out with a heavy vector boson of such a mass, that they bind an extreme relativistic nucleon-antinucleon pair into a pion) of the nucleons, is evaluated using dispersion methods and is found to have a relative magnitude of order 1/100,000 10-5 when compared with the parity conserving part. This yields a parity non-conserving pi-N scattering amplitude of the same relative order of magnitude, a result which does not contradict the existing experimental data.

3017

Vienna U. Inst. for Theoretical Physics (Austria).

SYMMETRIES OF FUNDAMENTAL PARTICLE INTERACTIONS, by W. E. Thirring. Final rept. Sept. 1959-Aug. 1961. Aug. 31, 1961, 4p. (AFOSR-1502) (AF 61(052)265) Unclassified

A total of 10 technical papers resulting from the investigations undertaken during the period Sept. 1959-Aug. 1961 are listed. The investigations have included general and specific analyses of symmetry properties in quantum field theory, as well as more specific dynamical problems, such as the question of composing pions from fermions. Plans for future research are outlined.

3018

Vienna U. Inst. for Theoretical Physics (Austria).

SYMMETRIES IN QUANTUM FIELD THEORIES, by W. [E.] Thirring, C. Villi, and J. Wess. Nov. 1961, 54p. incl. refs. (Scientific note no. 10) (AFOSR-1886) (AF 61(052)265) AD 272169 Unclassified

There is a great deal of work on symmetries and conservation laws in field theory. Although much of it differs by language and method most of it is identical or equivalent to the original paper by E. Noether. Noether's results were generalized by Schwinger to quantum field theory. The first 2 sections of this paper deal with this formal background. We also discuss what consequences can be derived from the parts of the invariance group which are not continuously connected with unity and for which the methods of Noether and Schwinger do not directly apply. This formalism is illustrated. The groups usually considered fall in 2 categories, those which involve space-time transformations and those which transform only field components belonging to the same

space-time point. Of the former we discuss from our point of view the Galilei-, the Lorentz- and the conformal group. Our general procedure is directly applicable to all 3 examples.

3019

Vienna U. Inst. for Theoretical Physics (Austria).

ON THE $\mu \rightarrow e + \gamma$ DECAY, by D. Flamm. Oct. 20, 1961 [5]p. incl. diagrs. (Scientific note no. 11) (AFOSR-1887) (AF 61(052)265) AD 272437 Unclassified

A phenomenological diagram for the $\mu \rightarrow e + \gamma$ decay containing a virtual π-meson is calculated and by comparison with experimental data an upper limit for the cut off is found, which is of the same order of magnitude as the one obtained by Ioffe for another diagram containing only leptons.

3020

Vienna U. Inst. for Theoretical Physics (Austria).

MODELS FOR COMPOUND PARTICLES, by W. E. Thirring. Nov. 15, 1961 [16]p. incl. diagrs. (Scientific note no. 12) (AFOSR-1888) (AF 61(052)265) Unclassified

Also published in Nuovo Cimento, Series X, v. 23: 1064-1072, Mar. 16, 1962.

Some versions of the Zachariasen model are used to describe mesons as bound particles. The resulting coupling constants are discussed and the resonances associated with the bound state through Levinson's theorem are calculated.

3021

Vienna U. Inst. for Theoretical Physics (Austria).

AN EXAMPLE OF Σ^- CAPTURE WITH EMISSION OF A NEGATIVE PION, by G. Kellner, G. Czapek, and B. Czapp. Mar. 29, 1961, 9p. incl. illus. diagrs. table. (Scientific note no. 1) (AFOSR-856) (AF 61-(052)433) AD 258082 Unclassified

Also published in Acta Phys. Austriaca, v. 15: 262-267, 1962.

An event is described which consists in a slow singly charged particle of superprotonic mass interacting in flight with an emulsion nucleus producing a star with 4 visible prongs, 1 of them being a negative π-meson. The event is consistent with the assumption that a negative hyperon captured by a nucleus interacts according to $\Sigma^- + p \rightarrow \Lambda^0 + n$, the Λ^0 being trapped in the target nucleus giving rise to mesonic breakup of the excited nucleus. (Contractor's abstract)

3022

Vienna U. Inst. for Theoretical Physics (Austria).

HIGH ENERGY PHYSICS, by W. [E.] Thirring. Annual rept. July 1, 1960 - June 30, 1961, 3p. (Technical rept. no. 4) (AFOSR-1043) (AF 61(052)-433) AD 262129 Unclassified

The results obtained under this contract to date are briefly reviewed. The search for elastic scattering events has been carried on and finished. All 2 prong stars have been measured. A rough estimate of the differential cross-section has been made. Concerning the ICEF-program a cascade found in 1 part of the stack has been measured and calculated. The primary particle was a boron nucleus with an energy of 1.7×10^{12} ev/nucleon. It induced a jet of the type (20 + 193) hp. The Castagnoli energy of this event has been calculated and a Walker-Duller plot drawn. Two secondary events in the inner core of type (0 + 7) p and (22 + 8) n have been evaluated also. The work on the projector was started in March. 2700 pictures of 16 bev π^- in a 30 cm hydrogen bubble chamber have been scanned, and evaluated. About 356 events have been found. This gives an interaction mean free path of $(1.05 \pm 0.07) \times 10^3$ cm and a total cross-section of (27.2 ± 2.2) mb for pion-proton interactions. The mean multiplicity of the shower particles turned out to be $n_s = 3.7 \pm 0.5$.

3023

Virginia U. Dept. of Chemistry, Charlottesville.

STUDIES OF ANTIOXIDANTS AND INHIBITION MECHANISMS AT ELEVATED TEMPERATURES, by J. W. Cole, Jr. Apr. 25, 1961, 73p. incl. diagrs. tables, refs. (AFOSR-554) (AF 18(603)103) AD 260345 Unclassified

A study was made of the behavior of some antioxidants and corrosion inhibitors in di(2-ethylhexyl) sebacate under oxidizing conditions at 204°C alone and in the presence of metallic Cu and Cu compounds. Considerable attention was given to kinetic-mechanistic studies with phenothiazine and its derivatives, with phenothiazines containing radioactive S-35 and with N-C-14-methyl phenothiazine. Oxidations with some amines and pyridine derivatives, especially the dipyridylamines were also studied. The presence of Cu and certain Cu compounds enhanced the oxidation inhibiting properties of the additives. Metal coordination complexes appear to be a factor in the mechanism. The syntheses and behavior of 27 new compounds are described.

3024

Virginia U. [Dept. of Mathematics] Charlottesville.

COMPRESSIBILITY AND UNIFORM CONVERGENCE, by G. T. Whyburn. [1961] [5]p. (AFOSR-3239) (AF 49(638)72) AD 456581 Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 47: 1843-1847, Nov. 1961.

Various conditions are given for a sequency of maps $f_n: X \to Y$ to converge uniformly to a map $f: X \to Y$. With terminology as in Whyburn's Analytic Topology (American Mathematical Society, Colloquium Publication, v. 28: 1942) one sufficient condition follows: Let X be a simple closed curve and Y a boundary curve, and let the sequence of non-alternating mappings $f(X)_n = Y_n \subset Y$ converge point-wise on an everywhere dense set in X to a mapping $f(X) = Y' \subset Y$ and suppose the sets Y_n converge 0-regularly to Y'. Then $f_n \to f$ uniformly on X. Applications to functions harmonic on a disk are discussed.

3025

Virginia U. [Dept. of Mathematics] Charlottesville.

MONOTONEITY OF LIMIT MAPPINGS, by G. T. Whyburn. [1961] [6]p. (AFOSR-3738) [AF 49(638)-72] Unclassified

Also published in Duke Math. Jour., v. 29: 465-470, Sept. 1962.

A study is made of general conditions under which the limit map of a uniformly convergent sequence of maps is monotone (1) Monotoneity of individual maps in the sequence is not usually assumed and the results obtained serve to extend, unify, and simplify previously known theorems on the subject. In particular, it is shown that, under suitable conditions, the 0-regularity of convergence of the image sets is both a necessary and (if the maps are ϵ-approximately monotone $\epsilon \to 0$) a sufficient condition for (1).

3026

Virginia U. Dept. of Physics, Charlottesville.

NUCLEAR REACTIONS OF 25-75 MEV PROTONS, by S. Berko, F. L. Hereford, and W. D. Whitehead. Final rept. Jan. 18, 1957-June 1, 1961. June 16, 1961, 5p. (AFOSR-1128) (AF 49(638)176) Unclassified

A brief summary of the work completed during the period of the contract is presented. The research has been divided roughly into 2 main areas of interest, which of necessity sometimes overlap: (a) the measurement of total photoneutron cross sections, and (b) the investigation of the high energy nucleons emitted in photon interactions. The fast photonucleon experiments give information about the direct interactions which take place between the photons and the nuclei, and also about the interactions above the giant resonance energy. A list of publications resulting from the work is included.

3027

Virginia U. [Dept. of Physics] Charlottesville.

ANGULAR DISTRIBUTION OF FAST PHOTONEUTRONS, by G. C. Reinhardt and W. D. Whitehead. [1961] [14]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)176] and Atomic Energy Commission) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II. v. 6: 251, Apr. 24, 1961.

Also published in Nuclear Phys., v. 30: 201-214, Feb. 1962.

The angular distribution of photoneutrons with energies above the ($Si^{28}n, p\ Al^{28}$) threshold has been measured for several elements between yttrium and bismuth. Neutrons were detected at nine angles from 30° to 150° by cylindrical containers holding 50 g of pure silicon, and the 2.54-min Al^{28} activity was measured with geiger counters. Angular distributions were anisotropic and showed marked forward asymmetry. A least squares fit of the data to curves of the type $A + B \sin^2\theta + C \cos\theta$ showed B somewhat smaller and C larger than values determined at bremsstrahlung energies lower than 55 mev. There is evidence in support of previously reported peaking of the ratio B/A at N = 82 and 126. (Contractor's abstract)

3028

Virginia U. Research Labs. for the Engineering Sciences, Charlottesville.

IONIZATION YIELD OF LOW-ENERGY HEAVY IONS IN ARGON, by J. A. Phipps, R. A. Lowry, and J. W. Boring. Final rept. Feb. 1961, 29p. incl. illus. diagrs. tables. (Rept. no. EP-4419-106-61U) (AFOSR-202) (AF 49(638)22) AD 251199; PB 154734 Unclassified

A cylindrical ionization chamber with a differentially pumped open window has been used to measure the total ionization yield of low energy heavy ions stopped in argon gas. Measurements have been made in the energy range 8-100 kev for hydrogen, helium, carbon, nitrogen, oxygen, and argon ions. The average energy loss per ion pairs ranges from 26.8 ev/ip for 50 kev hydrogen ions to 91.8 ev/ip for 25 kev argon ions. A comparison of the ionization yields in argon of various ions having velocities in the same region is presented. (Contractor's abstract)

3029

Virginia U. Research Labs. for the Engineering Sciences, Charlottesville.

ON A METHOD FOR MEASURING THE BASE PRESSURE. MEASUREMENT AND VISUALIZATION ON A

CONE CYLINDER MAGNETICALLY SUSPENDED AT M_o = 7.6, by G. Dubois and C. Rouge, tr. by R. N. Zapata. May 1961 [30]p. incl. illus. diagrs. tables, refs. (Rept. no. AST-4443-102-61U) (AFOSR-1020) [AF 49(638)1022] AD 260634 Unclassified

Also published in Recherche Aeronaut., v. 79: 35-44, Nov.-Dec. 1960.

This paper is concerned with a method for measuring the base pressure of an axially symmetrical body. This method avoids material supports through the use of the magnetic suspension O. N. E. R. A. for keeping the model on the axis of the stream at the test section. Thus, the base pressure is measured, with no interactions, by means of an optical manometer located inside the model. At the same time, the flow can be visualized by a schlieren system. This paper specifies the conditions required for the applicability of the method, analyzes the precision of the measurements, discusses the results obtained with and without sting, and compares them to those previously obtained at lower Mach numbers.

3030

Vitro Corp of America. Vitro Labs., West Orange, N. J.

CONTINUOUS ACCELERATION OF PLASMA GENERATED BY THE HIGH-INTENSITY ARC, by C. Sheer, J. A. Cooney and others. Sept. 29, 1961 [84]p. incl. illus. diagrs. refs. (Technical rept. VL-2120-12-0) (AFOSR-1517) (AF 49(638)329) AD 267866 Unclassified

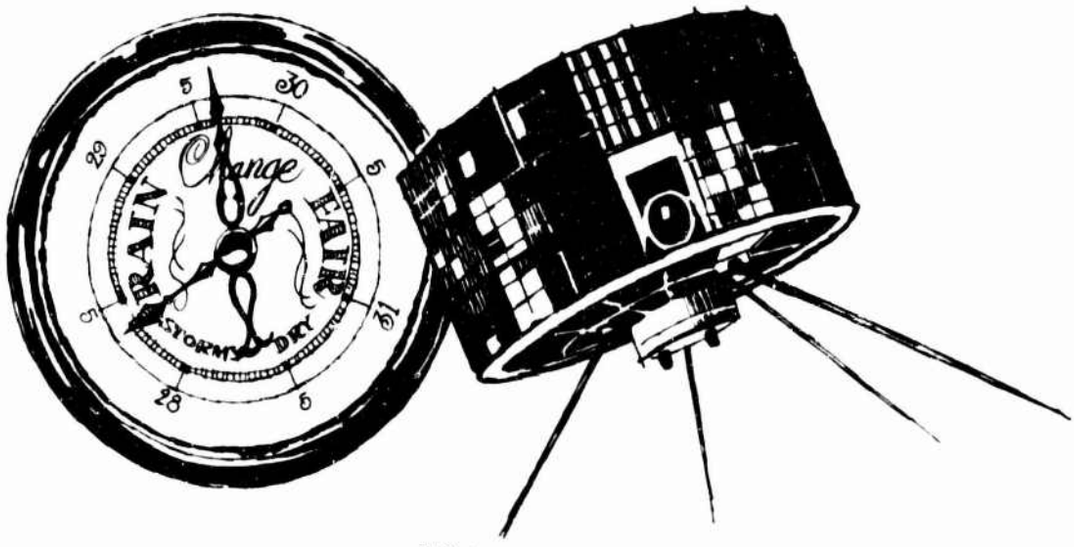
A plasma propulsion system concept is proposed featuring the vaporization of a solid plasma propellant in a high-intensity arc to generate a refractory vapor jet in the maximum field region of a magnetic nozzle. Acceleration of the vapor plasma jet occurs as a result of its interaction with a diverging magnetic field. The theoretical work reviews the single particle case, and proposes a method for developing the more applicable continuum model. The single-particle approach provides a rational model for the conversion of plasma enthalpy into jet kinetic energy by means of the diverging magnetic field. The experimental work concerned design, construction and operation of an accelerator facility to prove the basic technique. Carbon is used exclusively as the propellant. The operational feasibility of the system is proven. The most significant finding is the strong dependence of specific impulse on ambient pressure. Although the maximum I_{sp} obtained is 300 sec at 4 microns pressure, the shape of the Specific Impulse vs pressure curve indicates values in the range of 1,000 to 3,000 sec are obtainable in the high vacuum of outer space.

3031

Vitro Corp. of America. Vitro Labs., West Orange, N. J.

ENERGY EXCHANGE IN THE HIGH-INTENSITY ARC PLASMA, by C. Sheer, J. A. Cooney and others. June 16, 1961, 195p. incl. illus. diagrs. tables, refs. (Technical note no. 1) (AFOSR-860) (AF 49(638)477) AD 266847 Unclassified

Arc phenomena are discussed for the purpose of orientation and definition. Emphasis is placed on the distinction between low-intensity and high-intensity modes of arc operation. Following the preliminary discussion, the fundamental premises for the concept of a fluid transpiration arc are laid down. This concept relates to an arc discharge subject to the forced convection of a fluid medium, but differentiated from other systems of this type by the fact that the fluid is injected into the arc conduction zone via the anodic terminus through a porous anode structure. The postulated effectiveness criteria for this technique of arc heating require (1) that the average pore size be less than the anode fall space thickness, (2) that the transpiration surface be integrally congruent with the anodic discharge boundary, and (3) that the injected gas particle flux density have the same order of magnitude as the opposing drift electron flux density within the anode sheath region. A 2-phase experimental program is described, the first being concerned with the validation of the basic concept and the second with a study of intrinsic characteristics.



3032

Wales U. Coll., Aberystwyth (Gt. Brit.).

ATTEMPTS TO DETECT LYCOPERSENE IN CAROTENOGENIC SYSTEMS (Abstract), by B. H. Davies, T. W. Goodwin, and E. I. Mercer. [1961] [1]p. (AFOSR-3407) (AF 61(052)355) Unclassified

Presented at the 409th meeting of the Biochem. Soc., London (Gt. Brit)., Oct. 6-7, 1961.

Also published in Biochem. Jour., v. 81: 40P, 1961.

In the biosynthesis of triterpenes, isoprene units are built up to form the C_{30} precursor, squalence, which then cyclizes. By analogy, the C_{40} precursor of the carotenoids would be lycopersene. A method is developed for the separation, detection and identification of small quantities of lycopersene, squalene, and related hydrocarbons, and used in attempts to detect lycopersene in carotenogenic systems. The hydrocarbons are separated by ascending adsorption chromatography on thin layers of Kieselgel G supported on glass plates. With light petroleum as solvent, the R_F values of squalene, lycopersene, phytoene and phytofluene are 0.41, 0.30, 0.21 and 0.12, respectively. The plates are stained with iodine vapor, and as little as 0.05% µg of any component can be detected as a yellow or brown spot. By this method, the presence of squalene, phytoene and phytofluene has been demonstrated in the unsaponifiable fraction of cells of Rhodospirillum rubrum in which normal carotenogenesis has been inhibited by diphenylamine. These substances do not occur in the normally pigmented bacteria. Squalene is also present in etiolated maize seedings, carrot root and ripening tomatoes. Lycopersene has not been detected in any of these systems. [2-C^{14}]Mevalonic acid, an effective terpenoid precursor, is incorporated into the hydrocarbon fraction of etiolated maize seedlings. While squalene is heavily labelled, no significant radioactivity could be detected in the 'lycopersene' fraction. The significance of these findings in relation to the problem of carotenogenesis was discussed. (Contractor's abstract)

3033

Wales U. Coll., Aberystwyth. (Gt. Brit.).

THE REACTIONS OF FREE RADICALS CONTAINING NITROGEN, by A. F. Trotman-Dickenson. Oct. 28, 1961, 2p. (Technical rept. no. 1) (AFOSR-2211) (AF 61(052)406) Unclassified

The pyrolysis of benzylamine, N-methylbenzylamine, and the hydrazines has been investigated in an attempt to establish a body of results comparable to that available for alkyl radicals, for the nitrogen-containing free radicals. A value of 60 kcal for D(C-N) in benzylamine has been confirmed by pyrolysis with an improved technique using a toluene-carrier apparatus. The reactions of the dimethylamino radicals have been studied by investigating the photolysis of tetramethylurea and tetramethyltetrazene. These radicals have been found to disproportionate readily.

3034

Wales U. [Coll.] Aberystwyth (Gt. Brit.).

REACTIONS OF FREE RADICALS CONTAINING NITROGEN (Abstract), by A. F. Trotman-Dickenson. [1961] [1]p. [AF 61(052)406] Unclassified

Presented at Second AFOSR Contractors' meeting on Chemical Kinetics of Propulsion, Illinois Inst. of Tech. Armour Research Foundation, Chicago, Sept. 11-12, 1961. (AFOSR-1417; AD 265513)

The purpose of th work being done under this contract presently is to eliminate the lack of knowledge concerning the properties and behavior of small free radicals containing nitrogen and provide convenient sources of the radicals. The 2 sources investigated were the photolysis of tetramethyltetrazene and tetramethylurea. Both are rather involatile, both yield in the primary act the dimethylamino radical, and both yield inert gas that can be conveniently used as an internal actinometer. At low conversions, the major products of both photolyses are dimethylamine and tetramethylhydrazine. It was concluded that the reactions were partially heterogeneous, as is that of hydrazine itself to a lesser extent.

3035

Washington State U. Dept. of Chemistry, Pullman.

KINETIC EVIDENCE FOR THE MECHANISM OF PYROLYSIS OF β-HYDROXYOLEFINS, by G. G. Smith and R. Taylor. [1961] [2]p. incl. diagr. table. (AFOSR-457) [AF 49(638)616] AD 456361 Unclassified

Also published in Chem. and Indus. (London), No. 25: 949-950, June 24, 1961.

Arnold and Smolinsky (Jour. Amer. Chem. Soc., v. 81: 6443, 1959) proposed a 6-membered cyclic transition state for the high temperature degradation of β-hydroxyolefins to olefins and aldehydes (or ketones). In the present note, the mechanism of the pyrolysis of 3-ethyl-6-phenylhex-5-en-3-ol was investigated and found to be both homogeneous and unimolecular, furnishing additional evidence for the cyclic transition state proposed by Arnold and Smolinsky.

3036

Washington State U. Dept. of Chemistry, Pullman.

A RAPID METHOD OF QUALITATIVE AND QUANTITATIVE ANALYSIS OF PRODUCTS FROM PYROLYSIS, by G. G. Smith, W. H. Wetzel, and B. Kösters. [1961] [4]p. incl. diagrs. tables. (AFOSR-3078) (AF 49(638)616) AD 441848 Unclassified

Also published in Analyst, v. 86: 480-483, July 1961.

In a study of the effects of structure on the pyrolysis of esters, a direct method was developed for determining the extent of decomposition and the products from pyrolysis of many compounds. The products from the pyrolysis of micro amounts of organic material were analyzed directly by a gas-chromatographic column attached to a temperature-controlled pyrolysis reactor. Since the method proved particularly suited to a qualitative and quantitative study of pyrolysis products from small amounts (2 to 10 mg) of liquids (or solids that can be dissolved in suitable solvents), it is submitted as a general method for studying the pyrolysis of esters or of other compounds with similar properties. The method is accurate (error ± 2%) and requires only a few min for each test.

3037

Washington U. [Dept. of Mathematics] St. Louis, Mo.

ON THE EXISTENCE OF INVARIANT MEASURES, by H. M. Schaerf. [1961] [3]p. (AFOSR-4107) (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(600)568] and [Army Research Office] under DA 11-022-ORD-2059) Unclassified

Also published in Bull. Amer. Math. Soc., v. 67: 504-506, Sept. 1961.

Three theorems dealing with the proof of the existence of a finitely additive measure invariant under a transformation are presented. Theorem I gives a simple proof, Theorem II strengthens and expands Theorem I, and Theorem III establishes some fundamental properties of the invariant set functions.

3038

Washington U. [Dept. of Mathematics] St. Louis, Mo.

MEAN CONVERGENCE OF ORTHOGONAL SERIES AND CONJUGATE SERIES, by R. Askey. [June 1961] 20p. incl. refs. (AFOSR-696) (AF 49(638)-216) AD 257830 Unclassified

A general theorem on mean convergence is given. Next, the following theorem is proved: If $w(x) = (1-x)^{\gamma}(1+x)^{\delta} t(x)$ where $t \in C'$; $\gamma \geq -1/2$ $\delta \geq -1/2$, α, β, and p satisfy $\max [1/4-1/p + (1/2-1/p)\gamma, 1/4-1/p + (1/2-1/p)\delta] < \beta$ and $\alpha < \min [3/4-1/p + (1/2-1/p)\gamma, 3/4-1/p + (1/2-1/p)\delta]$; $1 < p < \infty$; and $\alpha \leq \beta$ then $\|s_n(f;x)\|_{p,\beta} \leq A\|f(x)\|_{p,\alpha}$ $(n = 0, 1, \dots)$ for all $f \in L^p_\alpha$.

3039

Washington U. Dept. of Mathematics, St. Louis, Mo.

VARIATION DIMINISHING TRANSFORMATIONS AND ULTRASPHERICAL POLYNOMIALS, by I. I. Hirschman, Jr. [1960] [24]p. incl. refs. (AFOSR-2201) [AF 49(638)218] Unclassified

Also published in Jour. Anal. Math. (Jerusalem), v. 8: 337-360, 1960/1961.

For abstract see item no. 2871, (TN-60-640) Vol. IV.

3040

Washington U. [Dept. of Mathematics] St. Louis, Mo.

VARIATION DIMINISHING TRANSFORMATIONS AND ORTHOGONAL POLYNOMIALS, by I. I. Hirschman, Jr. [1961] [17]p. incl. refs. (AFOSR-3357) (AF 49-(638)218) Unclassified

Also published in Jour. Anal. Math. (Jerusalem), v. 9: 177-193, 1961.

Let $P_n^{(\alpha,\beta)}(x)$ be the Jacobi polynomials in the usual normalization. Put $h_{\alpha,\beta}(n) = \frac{2^{\alpha+\beta+1}\Gamma(n+\alpha+1)\Gamma(n+\beta+1)}{(2n+\alpha+\beta+1)n!\,\Gamma(n+\alpha+\beta+1)}$, and $\Omega_{\alpha,\beta}(x) = (1-x)^{\alpha}(1+x)^{\beta}$. Let $l^2_{\alpha,\beta}$ consist of those real functions $f(n)$ defined for $n = 0, 1, 2, \dots$ for which $\|f\|_2 = [\sum_{n=0}^{\infty} |f(n)|^2 h_{\alpha,\beta}(n)]^{1/2} < \infty$. For $f \in l^2_{\alpha,\beta}$ it is defined as $T_M f^{\wedge}(n) = [h_{\alpha,\beta}(n)]^{-1} \int_{-1}^{1} f^{\wedge}(x) P_n^{(\alpha,\beta)}(x) M(x) \Omega_{\alpha,\beta}(x)dx$. Transformations of the form T_M (which are bounded transformations of $l^2_{\alpha,\beta}$ into itself) are called multiplier transformations in $l^2_{\alpha,\beta}$. Let $V[f]$ be the number of changes of sign of $f(n)$ for $n = 0, 1, 2, \dots$ $M(x)$ will be called variation diminishing multiplier if, for every $f \in l^2_{\alpha,\beta}$, $V[T_M f] = V[f]$. It is shown here that $M(x)$ is variation diminishing in $l^2_{\alpha,\beta}$ if and only if it is of the form $M(x) = de^{cx} \prod_{k=1}^{\infty}(1 + a_k x)/\prod_{k=1}^{\infty}(1 - b_k x)$, where $c \geq 0$, $1 \geq a_k \geq 0$, $1 > b_k \geq 0$ and $\sum(a_k + b_k) < +\infty$. Analogous results are also obtained for Laguerre and Hermite polynomials.

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Washington U. [Dept. of Mathematics] St. Louis, Mo.

MULTIPLIER TRANSFORMATIONS. III., by I. I. Hirschman, Jr. [1961] 11p. (AF 49(638)218) Unclassified

Published in Proc. Amer. Math. Soc., v. 13: 851-857, Dec. 1962.

Let F belong to the family S of all complex-valued functions on $\omega = \{0, \pm 1, \pm 2, \pm 3, \dots\}$; set $N_\alpha[F] = [\sum_{n=-\infty}^{\infty} |F(n)|^2(|n|+1)^{2\alpha}]^{1/2}$, and denote by N_α the space of

all $F \in S$ such that $N_\alpha[F] < \infty$. Allow α to be in the open interval $(-1/2, 1/2)$. A β-variation condition is given to ensure the boundedness of multiplier transformations on N_α. Let g be a bounded, complex-valued, measurable function defined on $T = [0,1]$ with $g(0) = g(1)$. If $f \in N_\alpha$, define $P_g(F)$ as the sequence $(a_n)_{n \in \omega}$ such that $a_n = \int_T e^{-2\pi i n\theta} g(\theta)F\hat{}(\theta)d\theta$, where $F\hat{}$ denotes the Fourier transformation of the sequence F. Let P_g denote the multiplier transformation $[F \to P_g(F)]$ defined for all F in $N_\alpha \cap N_0$. Now follows the main result. If $\beta \geq 2$ and if g is of bounded β-variation (as defined below), the P_g is a unique extension which is a bounded endomorphism of N_α whenever $|\alpha| < 1/\beta$. Thus, the entire permissible range of α is obtained when $\beta = 2$. The function g is said to be of "bounded β-variation" if there exists a number $M_0 > 0$ such that $\sum_{k=0}^{m} |f(x_{k+1}) - f(x_k)|^\beta \leq M_0$ whenever $0 \leq x_0 < \ldots < x_{k+1} < \ldots < x_m \leq 1$. The notion of β-variation has been applied to similar purpose in a previous paper (see item no. WAS. 02:034, Vol. II). It is concluded with an attempt to replace the β-variation condition by the following one: There exists a finite number $K_\beta > 0$ such that any $\epsilon > 0$ gives rise to a function g_ϵ on T such that $\operatorname{var} g_\epsilon \leq K_\beta \epsilon^{1-\beta}$ and $\sup_{\lambda \in T} |g(\lambda) - g_\epsilon(\lambda)| \leq \epsilon$; here $\operatorname{var} g_\epsilon$ denotes the total variation of g_ϵ on $[0,1] = T$.

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[Washington U. Dept. of Mathematics, St. Louis, Mo.]

VARIATION DIMINISHING TRANSFORMATIONS AND STURM-LIOUVILLE SYSTEMS, by I. I. Hirschman, Jr. [1961] [20]p. incl. refs. (AFOSR-3292) (AF 49-(638)846) Unclassified

Also published in Comment. Math. Helv., v. 36: 214-233, 1961.

The results have been presented in an earlier paper (Compt. Rend. Séances Acad. Sci., v. 252: 3699-3701, June 1961) without proof. Let $y(x,\lambda)$ be a solution of the differential equation $Ty = \lambda y$, $T = q(x) - d^2/dx^2$, $0 \leq x < \infty$, satisfying initial conditions at $x = 0$. If $q(x)$ is continuous and bounded for $0 \leq x < \infty$, and $\int_0^\infty (1 + x^2)|q(x)|dx < \infty$, the spectrum $S(T)$ of T consists of $0 \leq \lambda < \infty$, all points of which belong to the continuous spectrum and the points $\lambda = -L_j^2$, $j = 1, 2, \ldots, m$, all belong to the point spectrum. Let H and $H\hat{}$ denote, respectively, the space of all real Lebesque measureable functions $u(x)$ and $g(\lambda)$, $\lambda \in S(T)$, with defined $\|u\|$ and $\|g\|$. For the elements of H and $H\hat{}$, it is defined that the mappings $f \to f\hat{}$ and $g \to g\check{}$, by $f\hat{}(x) = \int_0^\infty y(x,\lambda)f(x)dx$, $\lambda \in S(T)$. $g\check{}(x) = (1/\pi) \int_0^\infty y(x,\lambda)g(\lambda)\lambda^{-1/2}|M(\lambda^{1/2})|^{-2}d\lambda + \sum_{k=1}^{m} y(x, -L_k^2)g(-L_k^2)P_k$, where $P_k \int_0^\infty [y(x, -L_k^2)]^2 dx = 1$, $k = 1, \ldots, m$, and $2siM(s) = s \sin\alpha - i\cos\alpha + i\int_0^\infty e^{isx} q(x)y(x, s^2)dx$, $\lambda = s^2$, $-\pi < \alpha \leq 0$. These mappings give rise to an operational calculus which is used to give an elegant demonstration of the following: If $\Lambda^-(T) = \operatorname{Sup}\{-\lambda / \lambda \in S(T)\} < b_1 \leq b_2 \leq \ldots$, $\sum_k b_k^{-1} < \infty$, $c \geq 0$, and if (*) $\varphi(\lambda) = [e^{c\lambda}\prod_k (1 + \lambda(b_k))]^{-1}$, $\lambda \in S(T)$, then (**) $V[\omega(T)u] \leq V(u)$, for all $u \in H$, where $V(a)$ denotes the number of changes of sign of $a(x)$ for $-\infty < x < \infty$. Conversely, every bounded and measurable function ω defined for $\lambda \in S(T)$ and satisfying (**) is essentially of the form (*).

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Washington U. Dept. of Physics, St. Louis, Mo.

POSITRON LIFETIMES AGAINST ANNIHILATION IN METAL AND ALKALI HALIDES, by B. L. D. Poliak. Mar. 1961, 72p. incl. diagrs. tables, refs. (Technical rept. no. 43) (AFOSR-785) (Sponsored jointly by Air Force Office of Scientific Research under AF 18-(603)108 and [Army Research Office] AD 259383 Unclassified

The positron lifetimes against annihilation in 3 metals (Cu, Ag, Mg) and 10 alkali halide crystals (LiF, NaF, NaCl, NaBr, NaI, KCl, KBr, KI, CsBr, CsI) were determined. The lifetimes obtained are in qualitative agreement with the simple theory discussed in Chapter III. Chapter II serves as a general introduction to the use of the phenomenon of positron-electron annihilation as a tool to explore the electronic structure of solids. Chapter III summarizes the work (experimental and theoretical) which is pertinent to the subject of this thesis. Chapter IV describes the experimental technique and the equipment. Analysis of the data is also treated in this section. A summary of the results of this experiment is given in Chapter V. Chapter VI consists of a discussion of the data and comparison with other data as well as the rough theory described in Chapter III for the alkali halides. This section also contains suggestions for further work on the alkali halides.

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Washington U. Dept. of Physics, St. Louis, Mo.

THEORETICAL AND EXPERIMENTAL STUDIES IN NUCLEAR PHYSICS, by E. U. Condon, E. Feenberg and others. Final quarterly status rept. Feb.-Apr. 1961. Oct. 1961, 11p. incl. tables. (Technical rept. no. 48) (AFOSR-1396) (AF 18(603)108) Unclassified

The investigations made in this report include (1) theoretical studies of phonon-phonon interaction in liquid He^4, the theory of solid and liquid He^3 and work on high energy potential scattering, (2) nuclear reaction studies of polarization in deuteron-alpha scattering, elastic scattering of deuterons from B^{10}

and Be^9, proton polarization measurement with the helium-polarimeter, proton polarization using a carbon polarimeter and cyclotron modification, (3) cosmic ray studies with photographic emulsions, and (4) Beta and gamma-ray studies which included longitudinal polarization of Ne-19 positrons, Mössbauer examination of superconductivity transitions, Beta-decay of Cl^{40}, orientation of Be^7 and KL_I transitions in high Z elements.

3045

Washington U. [Dept. of Physics] St. Louis, Mo.

POLARIZATION OF PROTONS IN $Be^9(d,p)Be^{10}$ (Abstract), by R. G. Allas and F. B. Shull. [1961] [2]p. [AF 18(603)108] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 24-25, Feb. 1, 1961.

The polarization of protons from the ground-state $Be^9(d,p)Be^{10}$ stripping reactions was measured for an incident deuteron energy E_d = 10 mev by a technique previously reported (see item no. 2182, Vol. III). The axis of quantization is defined according to the Basel convention as $n = k_d \times k_p$. With this definition the sign of polarization agrees with the rule $P(\pm)$ as $j_n = l_n \pm 1/2$. The measured polarizations were $(18.5 \pm 3.8)\%$ at 15.5° (lab); $(0.1 \pm 2.7)\%$ at 19.5°; $(6.3 \pm 3.2)\%$ at 24.5°; $(10.4 \pm 3.0)\%$ at 29°; $(8.3 \pm 6.4)\%$ at 32.5°; $(17.3 \pm 5.6)\%$ at 37.8°; $(28.5 \pm 9.7)\%$ at 42.5°; $(18.2 \pm 7.4)\%$ at 46°; $(33.4 \pm 12.7)\%$ at 52°; and $(33.0 \pm 13.7)\%$ at 56°.

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Washington U. Dept. of Physics, St. Louis, Mo.

VARIATIONAL CALCULATION OF THE SCATTERING LENGTHS IN ELECTRON-HYDROGEN SCATTERING, by Y. Hara, T. Ohmura, and T. Yamanouchi. [1960] [8]p. incl. tables, refs. [AF 18(603)108] Unclassified

Published in Prog. Theoret. Phys. (Japan), v. 25: 467-474, Mar. 1961.

The non-relativistic Schrödinger equation of electron plus hydrogen-atom system is solved by the Hulthén type variational method at the limit of zero incident electron energy. Eight and 5 parameter trial functions are used for the singlet and triplet states respectively, and the following upper bounds on the scattering length a are obtained, $a_s \leq 6.217\ a_0$ (singlet), $a_t \leq 2.272\ a_0$ (triplet), where a_0 is the Bohr radius. Some discussions are given on the accuracy of the result. It is shown that the relation $a_{OH} > a_{SH} > a_K > a(\text{true})$ holds for trial functions of the same form if a(true) is positive. (Contractor's abstract)

3047

Washington U. [Dept. of Physics] St. Louis, Mo.

POLARIZATION OF COSMIC-RAY MUONS AT SEA LEVEL, by C. S. Johnson. [1961] [7]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(603)108], Atomic Energy Commission, and Office of Naval Research) Unclassified

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 4: 402, Nov. 27, 1959.

Published in Phys. Rev., v. 122: 1883-1890, June 15, 1961.

For abstract see item no. 2188, Vol. III.

3048

Washington U. [Dept. of Physics] St. Louis, Mo.

ELECTRON PARAMAGNETIC RESONANCE STUDY OF DIPHENYL NITRIC OXIDE IN SINGLE CRYSTALS, by Y. Deguchi. [1961] [25]p. incl. diagrs. refs. (AFOSR-133) [AF 49(638)464] AD 288773 Unclassified

Also published in Bull. Chem. Soc., Japan, v. 35: 910-916, July 1961.

Electron paramagnetic resonance experiments of diphenyl nitric oxide single crystals were performed. Variation of exchange narrowed line was measured by changing the magnitude of magnetic dilution in crystals. Angular variations of g-value and of hyperfine spectra were investigated. The value of the exchange integral in pure crystal and the spin density on N^{14} atom in the molecule were determined. From these results and the crystallographic orientation of the benzophenone molecules, it can be concluded that the p-orbital of a nitrogen atom in diphenyl nitric oxide molecule would be almost parallel to 1 crystal axis of the bulk crystal.

3049

Washington U. [Dept. of Physics] St. Louis, Mo.

SPIN AND CHARGE EXCHANGE IN ANIONS OF BIPHENLYL ETHER, by D. H. Eargle, Jr. and S. I. Weissman. Feb. 20, 1961 [1]p. incl. diagrs. (Technical rept. no. 36) (AFOSR-304) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)464 and Office of Naval Research) AD 450824 Unclassified

Also published in Jour. Chem. Phys., v. 34: 1840, May 1961.

In order to test whether the slow spin exchange in the substance formed by joining together 2 triphenylmethyls by an oxygen atom is due to an "insulating" property of the oxygen bridge, the singly and doubly charged anion of biphenlyl ether was investigated. Reduction of the ether by sodium or potassium in 1,2-dimethoxyethane or tetrahydrofuran led first to an orange paramagnetic substance then to a green diamagnetic one. The latter showed no ESR absorption over a wide range of magnetic fields. Treatment of the completely reduced green substance with an equivalent quantity of the unreduced ether led to immediate restoration of the orange paramagnetic material. The orange substance is probably the uninegative anion, the green 1 the dinegative ion. The ESR spectrum of the uninegative ion exhibited 179 resolved components in a span of about 15 gauss. The spectra of the Na and K salts were indistinguishable. The number of lines indicated that the spin migrates rapidly between the biphenyl groups. An odd number of lines could be produced by 1 accidental degeneracy.

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Washington U. [Dept. of Physics] St. Louis, Mo.

ELECTRON SPIN RESONANCE ABSORPTION OF TRIS-p-NITROPHENYLMETHYL, by M. T. Jones. [1961] [1]p. incl. diagr. (AFOSR-616) [AF 49(638)-464] Unclassified

Also published in Jour. Chem. Phys., v. 35: 1146, Sept. 1961.

Ninety-nine and 81 lines of the possible 343 and 196 lines of the N^{14} and N^{15} radicals were solved. The spectra were analyzed in terms of the ortho and meta coupling constants, and the N coupling constants for the nitro group in the para position.

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Washington U. [Dept. of Physics] St. Louis, Mo.

NOTE ON MEASUREMENTS OF RATES OF ELECTRON TRANSFER PROCESSES BY BROADENING OF ESR LINES, by P. J. Zandstra and S. I. Weissman. [1961] [2]p. incl. table. (Technical rept. no. 38) (AFOSR-617) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)464] and Office of Naval Research) AD 611391 Unclassified

Also published in Jour. Chem. Phys., v. 35: 757, Aug. 1961.

Measurements were made of the relative broadenings of several of the ESR lines of naphthalene negative ion in the presence of naphthalene. The results impiy that the electron exchange rate does not depend on nuclear spin states and that the magnetic pulses during transit do not contribute to line breadth.

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Washington U. [Dept. of Physics] St. Louis, Mo.

RATE OF THE MANGANATE-PERMANGANATE EXCHANGE BY PULSED NUCLEAR MAGNETIC RESONANCE, by A. D. Britt and W. M. Yen. [1961] [2]p. incl. diagrs. table. (Technical rept. no. 40) (AFOSR-1094) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)464] and National Science Foundation) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 4516-4517, Nov. 20, 1961.

The electron-exchange between $MnO_4^{=}$ and MnO_4^{-} is investigated by measurements of relaxation times T_1 and T_2 using spin-echo techniques. The results are in agreement with the results of isotopic-tracer techniques as to the value of the rate constant k and the kinetic order of the exchange.

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Washington U. [Dept. of Physics] St. Louis, Mo.

BIRADICALS IN THE KETYL SERIES, by N. Hirota and S. I. Weissman. [1961] [1]p. (AFOSR-1095) [AF 49(638)464] Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 3533, Aug. 20, 1961.

Reduction of xanthone or benzophenone by Mg, Ca, or Ba in ethereal solvents gave a single paramagnetic species with hyperfine couplings to the protons in 1 mol of original ketone and no trace of dissociated ions was observed. Use of 93% Mg^{25} showed splitting by one Mg^{25} nucleus (I = 5/2) in the case of benzophenone magnesium ketyl. The interval between adjacent components was 0.3 gauss. The other ketyls with Mg^{25} exhibited a broadening of all lines, but no well-resolved Mg^{25} splitting.

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Washington U. [Dept. of Physics] St. Louis, Mo.

ELECTRON-SPIN RESONANCE INVESTIGATIONS OF THE NEGATIVE IONS OF FOUR ORGANOSILICON COMPOUNDS, by M. G. Townsend. [1961] [8]p. incl. diagrs. (Technical rept. no. 41) (AFOSR-2478) (AF 49(638)464) AD 278252 Unclassified

Also published in Jour. Chem. Soc. (London): 51-55, Jan. 1962.

Electron-spin resonance spectra of the negative ions of 4-biphenylyltriphenylsilane, di-(4-biphenlyl)diphenylsilane, tetraphenylsilane and tetra-4-biphenylylsilane have been recorded. The unpaired electron is located almost exclusively on the biphenyl substituent in the first radical, but is thought to exchange rapidly between all groups in the third. It has not been

possible to determine the electron distribution in the second and fourth. An analogous all-carbon compound, tetraphenylmethane, is spontaneously reduced to the non-magnetic dinegative ion, which is stable only at low temperature and rearranges rapidly at room temperature to produce the biphenylyl mononegative ion. (Contractor's abstract)

3055

Washington U. [Dept. of Physics] St. Louis, Mo.

ELECTRON SPIN RESONANCE HYPERFINE SPECTRA OF DIPHENYL NITRIC OXIDE, by Y. Deguchi. [1961] [6]p. incl. diagr. tables, refs. (Technical rept. no. 42) (AFOSR-3513) (AF 49(638)464) Unclassified

Also published in Bull. Chem. Soc. Japan, v. 35: 260-264, Feb. 1962.

Electron spin resonance results on solutions of Ph_2NO are reported. The isotropic splitting from the ortho- and para-protons is 1.89 gauss and that from the meta proton, 0.83 gauss. This assignment was confirmed by deuteration. The spectrum is drastically modified by meta methylation. Line widths were calculated by the Kivelson method and depended on the dielectric constant of the solvent.

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Washington U. [Dept. of Physics] St. Louis, Mo.

THE EFFECT OF DISSOLVED PARAMAGNETIC ION ON THE SPECTRA OF DIPHENYL NITRIC OXIDE, by Y. Deguchi. [1961] [5]p. incl. diagrs. table. (AFOSR-3879) [AF 49(638)464] Unclassified

Also published in Bull. Chem. Soc. Japan, v. 35: 598-602, Apr. 1962.

The broadening effect of dissolved oxygen and foreign paramagnetic ions on the ESR spectra of the diphenyl nitric oxide solution has been discussed. Using Bloembergen, Purcell, and Pound theory (see Phys. Rev., v. 6: 679, 1948), it is explained that this effect is mainly caused by the magnetic dipole-dipole interaction of an electron with a proton nuclear spin. (Contractor's abstract)

3057

Washington U. Dept. of Physics, St. Louis, Mo.

THEORY OF RESONANCE ABSORPTION OF ENERGY BY A ROTATING SOLID, by J. [F.] Dreitlein and H. Kessemeier. [1961] [18]p. incl. diagr. refs. (Technical rept. no. 1) (AFOSR-1334) (AF 49(638)808) AD 450841 Unclassified

Also published in Phys. Rev., v. 123: 835-52, Aug. 1, 1961.

The theory of both nuclear resonance energy absorption and the relaxation of a coherent magnetization transverse to an applied external magnetic field is developed for nuclei in a mechanically rotating solid. The consequences of the formalism in the simple case of a solid composed of effectively isolated nuclear pairs is presented. For the more general nuclear lattice, a procedure for isolating and experimentally measuring the exchange interaction between the nuclei in the solid is proposed. Finally, the moments of the energy absorption line shape for the rotating solid are investigated and the second and fourth moments are explicitly calculated. (Contractor's abstract)

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Washington U. [Dept. of Physics] St. Louis, Mo.

PERTURBATION METHOD FOR LOW STATES OF A MANY PARTICLE BOSON SYSTEM, by H. W. Jackson and E. Feenberg. [1961] 50p. incl. diagrs. refs. (Technical rept. no. 1) (AFOSR-315) (AF 49(638)834) Unclassified

Also published in Ann. Phys., v. 15: 266-295, Aug. 1961.

The many particle boson system is studied under the assumption of a strong repulsive force when 2 particles approach closely. A theoretical description of the ground state and low excited states of liquid He^4 is developed in terms of a set of correlated basis functions. A simple correlated trial function ψ_0 and a set of model functions φ_n are used to construct a set, $\psi_n = \psi_0\varphi_n$, of linearly independent correlated basis functions. Matrix elements of the identity and Hamiltonian operator are evaluated by systematic application of a generalized superposition approximation. A normalized, orthogonal basis $|e_n\rangle$ is constructed from linear combinations of the functions ψ_m; the associated matrix elements $\langle e_n|H|e_m\rangle$ vanish everywhere except on the 3 diagonals $m = n$, $n \pm 1$. A final approximate diagonalization, neglecting phonon-phonon interaction, yields explicit formulas for the ground state energy and the momentum dependence of the phonon energy. The analogy with Bogoliubov's treatment of the boson system, using uncorrelated basis functions is very close as is also the relation to Feynman's theory of the excitation energies. A parallel analysis is successful with ψ_0 taken to be the correct ground-state eigenfunction. In this case the matrix elements of the phonon-phonon interaction can be expressed completely in terms of the elementary liquid structure function as given by the analysis of x-ray diffraction at low temperatures. The way is open to an accurate evaluation of the phonon energy as a function of momentum (the Landau curve) and a corresponding accurate evaluation of the thermodynamic properties of the liquid at low temperatures. (Contractor's abstract)

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Washington U. Dept. of Physics, St. Louis, Mo.

HIGH-ENERGY POTENTIAL SCATTERING, by S. Rosendorff and S. Tani. [1961] [11]p. incl. table, refs. (AFOSR-1231) (AF 49(638)834) AD 295923
Unclassified

Also published in Phys. Rev., v. 128: 457-467, Oct. 1, 1962.

The high-energy potential scattering of a Dirac or Klein-Gordon particle has been studied extensively. In the present paper both the asymptotic expansion of the phase shifts in inverse powers of the energy and the asymptotic expansion of the scattering amplitude in inverse powers of the energy and the momentum transfer are derived for a relativistic particle.

3060

Washington U. Dept. of Physics, St. Louis, Mo.

VARIATIONAL METHOD FOR SCATTERING LENGTH, by T. Ohmura. [1961] [5]p. incl. diagr. table. (Technical rept. no. 2) (AFOSR-1718) (AF 49(638)834)
Unclassified

Also published in Phys. Rev., v. 124: 130-134, Oct. 1, 1961.

The properties of the scattering length obtained by Kohn's method, which is 1 of Hulthen's variational methods, are studied by assuming a linear trial function with n adjustable parameters. The scattering length $A^{(n)}$ decreases monotonically as the number of adjustable parameters n increases, if there is no bound state in the system. This conclusion essentially comes from the upper bound theorem of Spruch and Rosenberg. When the system has m bound states, the scattering length increases in value only m times, and otherwise decreases monotonically. Therefore, after verification that the presence of m increases, the calculated value is certain to give an upper bound on the scattering length. The connection between the result above and the condition of Rosenberg, Spruch, and O'Malley is considered. In an appendix, comparison is made of the scattering length $A^{(n)}$ obtained by Hulthen's original method and Kohn's method when m bound states exist in general. (Contractor's abstract)

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Washington U. Dept. of Physics, St. Louis, Mo.

ON THE EINSTEIN CONDENSATION, by C. T. Chen-Tsai and E. T. Jaynes. [1961] [14]p. incl. diagrs. (AFOSR-2565) [AF 49(638)834]
Unclassified

Exact series expressions for the thermodynamic quantities of an ideal Bose gas are found in terms of the theta function of Jacobi. The Einstein condensation thus can be treated by rigorous mathematical argument. The nature of the "integral approximation" and its modification, employed in the usual treatment of the problem, is clearly revealed. For finite volume, the exact expansions of pressure and density in powers of the activity converge in an entirely different way than do the integral approximation expansions. The modified integral approximation, however, becomes exact in the limit $V \to \infty$, $N \to \infty$, V/N - const. (Contractor's abstract)

3062

Washington U. Dept. of Physics, St. Louis, Mo.

POLARIZATION IN NUCLEAR SCATTERING, by R. G. Allas. July 1961, 36p. incl. diagrs. refs. (Technical rept. no. 1) (AFOSR-965) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)843 and Office of Ordnance Research) AD 260595
Unclassified

Any particle with intrinsic spin ($s \neq 0$) can align its spin axis in certain directions relative to an axis of quantization. Beams of identical particles will in general have all possible spin directions randomly represented unless some sorting mechanism has been employed. A beam of particles that has all spin directions represented with equal probability is said to be unpolarized. If all spins align up along some preferred direction we call the beam completely polarized. If some spin direction is more preferred than others we have a partially polarized beam. In order that polarization be a useful concept we must define it in a more systematic way – give it a quantitative measure for the above expressed qualitative ideas. Polarization experiments limited mostly to nuclear scattering are discussed. Physical ideas are used to explain the mathematical formalism. Attention is concentrated on discussing the scattering matrix $M(\theta, \varphi)$. (Contractor's abstract)

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Washington U. Dept. of Physics, St. Louis, Mo.

A MEASUREMENT OF THE LONGITUDINAL POLARIZATION OF NEON-19 POSITRONS, by J. [V.] Jovanovich. Aug. 1961 [83]p. incl. diagrs. (Technical rept. no. 3) (AFOSR-1099) (AF 49(638)843) AD 261907
Unclassified

An experiment whose object is to measure the energy dependence of helicity of positrons emitted from Ne-19 is described. The positron helicity is measured indirectly by transferring it to the annihilation-in-flight photons, whose transmission through a magnetized iron cylinder is dependent on their polarization. The positron helicity therefore results in a difference of the counting rates for opposed directions of the magnetic field. The measured dependence of this asymmetry with pulseheight is compared with a computation which assumes the validity of the 2 component neutrino theory of β decay and neglects the depolarization of positrons. A good fit of theoretical curve to the experimental points is obtained for pulseheights larger than about 1.3 mev. A strong disagreement is found in the pulseheight range between 0.75 and 1.0 mev, where the experimental asymmetries

are much lower than the prediction. The measurement of the asymmetry of bremsstrahlung produced in copper by electrons from a Sr-Y-90 source is used in order to measure the effective number of aligned electrons in the magnetized iron cylinder. (Contractor's abstract)

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Washington U. Dept. of Physics, St. Louis, Mo.

RESONANCE ABSORPTION OF GAMMA RAYS IN NORMAL AND SUPERCONDUCTING TIN, by M. Yaqub and C. Hohenemser. [1961] [34]p. incl. diagrs. refs. (AFOSR-1232) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)843 and National Science Foundation) AD 289844
Unclassified

Also published in Phys. Rev., v. 127: 2028-2035, Sept. 15, 1962.

A study of the resonant absorption of the 23.8-kev γ-rays in Sn^{119} has been made between 373° and 1.1°K by using the Sb^{119} K-capture parent. The source was prepared by bombarding natural Sn with 10-mev deuterons in a cyclotron, and was thick enough to absorb resonantly a large portion of the recoilless photons emitted. By studying the self-absorption in this source between 373° and 60°K and taking into account the contributions to the intensity due to resonant scattering, an average value of the Debye temperature θ has been derived. In order to see if the phonon spectrum undergoes a change in passing from the superconducting to the normal phase, the counting rate was measured at several temperatures between 4.2° and 1.1°K, with and without a magnetic field strong enough to destroy the superconductivity of the source. Using the derived value of 140°K for θ, it was concluded that the change in θ between the 2 phases could not be more than 0.76°K. (Contractor's abstract)

3065

Washington U. Dept. of Physics, St. Louis, Mo.

POLARIZATION OF SPIN ONE PARTICLES SCATTERED FROM SPIN ZERO NUCLEI, by J. Wesolowski. Aug. 1961 [26]p. incl. diagrs. (Technical rept. no. 2) (AFOSR-1346) (AF 49(638)843) AD 264836
Unclassified

This discussion is 2-fold; first, it is to summarize the theoretical work concerning the polarization of spin 1 particles scattered from spin zero nuclei; second, it is to explicitly relate the theoretical formulas to possible double scattering experiments. The discussion will clarify and expand partially upon the work of Stapp (Phys. Rev., v. 107: 607-615, July 1957) who derives the theoretical formula for the differential cross section of a spin one particle twice scattered from a relatively heavy spin zero nucleus.

3066

Washington U. [Dept. of Physics] St. Louis, Mo.

POLARIZATION OF PROTONS IN $C^{12}(d,p)C^{13}$, by R. G. Allas and F. B. Shull. [1961] [1]p. incl. diagr. table. (AFOSR-1457) [AF 49(638)843]
Unclassified

Also published in Phys. Rev., v. 125: 941, Feb. 1, 1962.

The measurement of polarization of protons from the $C^{12}(d,p)C^{13}$ ground-state reaction has been continued and extended to larger angles (see also item no. 2182, Vol. III). The new values obtained are -42% at 42.5° (lab); -35.4% at 46°; -51.5% at 52°; -22.5% at 61.5°; -20% at 64.5°; -6% at 70°; and +35% at 76°. The axis of quantization is taken as $n = k_d \times k_p$. (Contractor's abstract)

3067

Washington U. [Dept. of Physics] St. Louis, Mo.

LONGITUDINAL POLARIZATION OF POSITRONS FROM NEON-19 (Abstract), by J. V. Jovanovich, E. D. Lambe and others. [1961] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)843], National Science Foundation, and Research Corporation) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 50, Feb. 1, 1961.

The longitudinal polarization of Ne^{19} positrons is measured by transmitting the annihilation-in-flight γ-rays through magnetized iron. The experimental method previously described (see item no. 2187, Vol. III) is unchanged except for the detectors and the associated electronics. In the new experiment two (3 x 3) in. NaI crystals and 50-channel pulse-height analyzers are used to measure the energy dependence of the circular polarization of γ-rays from which the energy dependence of positron polarization is inferred. The experimental asymmetries vary from zero to about 3% depending on the measured pulse-height range. The method will be described and results compared with the predication of the 2-component neutrino theory.

3068

Washington U. Dept. of Aeronautical Engineering, Seattle.

SLIP FLOW IN THE LAMINAR BOUNDARY LAYER OVER A FLAT PLATE AT HYPERSONIC SPEEDS, by R. E. Street. Final technical rept. July 1, 1959-Dec. 31, 1960. Apr. 1961 [46]p. incl. diagrs. tables, refs. (AFOSR-558) (AF 49(638)440) AD 257834
Unclassified

First order slip in the boundary layer on a flat plate is obtained by adding on to the no slip solution the normal derivative of the no slip solution multiplied by a suitably small parameter. Although carried out only for the similar solution obtained when the pressure gradient is inversely proportional to the square root of distance along the plate, the method can be extended to non-similar solutions. Two cases of hypersonic flow in differing ambient temperature environment were calculated and they indicated the effects of slip to cover a considerable extent of flow for an inch or 2 downstream of the leading edge. The results were essentially the same as those obtained by Cassaccio. It was found that there is a dependence of the coefficients in the slip boundary conditions upon the form of the similarity transformation of the boundary layer equations. (Contractor's abstract)

3069

Washington U. [Dept. of Chemistry] Seattle.

THE ELECTRONIC SPECTRA OF DIPHENYLMETHANE DYES, by F. C. Adam. [1959] [13]p. incl. diagrs. tables. (AFOSR-J686) (AF 18(600)375) AD 415466 Unclassified

Also published in Jour. Molec. Spectros., v. 4: 359-371, Apr. 1960.

For abstract see item no. 2900, Vol. IV.

3070

[Washington U. Dept. of Chemistry, Seattle].

THE PRESENT STATUS OF THE VIBRONIC ANALYSIS OF THE VISIBLE $n \rightarrow \pi^*$ BAND SYSTEMS OF s-TETRAZINE VAPOR (Abstract), by G. H. Spencer, P. C. Cross, and K. B. Wiberg. [1959] [1]p. (AF 18-(600)1522) Unclassified

Presented at Symposium on Molecular Structure and Spectroscopy, Ohio State U., Columbus, June 15-19, 1959.

Published in Spectrochim. Acta, No. 9: 757-758, Oct. 1959.

The red color that visually characterizes a room temperature assembly of s-tetrazine ($C_2H_2N_4$) molecules is thought to be the collective, chromatic consequence of the lowest singled $n \rightarrow \pi^*$ transitions. Using the third diffraction order of a 21-ft grating spectrograph, vapor path lengths from 0.05 to 48 m, and vapor temperatures from -70 to 70°C, high resolution spectra of s-tetrazine vapor has been photoelectrically recorded. The frequencies of 514 of the best resolved absorption peaks were measured to within one cm^{-1} in the region of 4500-6100A. The outstanding feature of the visible spectrum is a set of 4 vibronic band progressions, each of which is propagated by the consecutive excitation of the same fundamental vibration. This vibration, believed to be the totally symmetric mode 6a, has a ground electronic state frequency of 737 and 720 cm^{-1} for s-tetrazine-d_0 and s-tetrazine-d_2, respectively; in the $n \rightarrow \pi^*$ states, these frequencies drop to about 700 and 690 cm^{-1}, respectively. Although a successful vibronic analysis has not yet been obtained, the presence of 3 relatively intense $n \rightarrow \pi^*$ singlet transitions that are electronically forbidden by molecular symmetry as well as the allowed $^1B_{1u} \rightarrow A_g$ transition is strongly suspected. Theoretical studies pertaining to the electronic-vibrational interaction of the lowest singlet, almost accidentally degenerate, $n \rightarrow \pi^*$ states of the azines have been initiated and will be discussed in terms of simple MO theory.

3071

Washington U. Dept. of Chemistry, Seattle.

INFRARED SPECTRUM AND THERMODYNAMIC PROPERTIES OF GASEOUS SULFUR TRIOXIDE, by R. W. Lovejoy, J. H. Colwell and others. [1961] [6]p. incl. diagrs. tables, refs. (AFOSR-1211) (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(600)1522], Office of Naval Research, and Petroleum Research Fund of Amer. Chem. Soc.) Unclassified

Presented at meeting of the Phys. Chem. Div. of the Amer. Chem. Soc., Chicago, Ill., Sept. 3-8, 1961.

Abstract published in 140th meeting of the Amer. Chem. Soc. Abstracts of Papers, 1961, p. 13T.

Also published in Jour. Chem. Phys., v. 36: 612-617, Feb. 1, 1962.

The infrared spectrum of sulfur trioxide was obtained under prism resolution in the gaseous state and in xenon matrices at liquid-nitrogen temperature. In both cases a satisfactory vibrational assignment of the monomeric SO_3 spectrum could be made on the basis of a simple D_{3h} symmetry model. The observed gas phase fundamentals were $\nu_3(e') = 1391$, $\nu_4(e') = 529$, and $\nu_2(a_2'') = 495$ cm^{-1}. The matrix fundamentals were essentially the same as those of the gas phase except that the $\nu_2(a_2'')$ mode was shifted to 464 cm^{-1}. A normal coordinate treatment of the SO_3 molecule was carried out and potential constants were determined for both Urey-Bradley and simplified valence force fields. Three weak absorption bands of S_3O_9 were also detected in the gas-phase spectrum. From the temperature and pressure variation of the intensities of these bands it was estimated that for the trimerization reaction at 298°K, K_p was approx 1 atm^{-2} and ΔH_{298° was approx 30 kcal/mol of S_3O_9. The values of the thermodynamic properties of monomeric SO_3 were computed for the ideal gaseous state using the rigid rotor harmonic oscillator approximation at 1 atm from 100° to 1500°K. (Contractor's abstract)

3072

Washington U. Dept. of Chemistry, Seattle.

INFRARED SPECTRUM OF CF_3SF_5, by D. F. Eggers, Jr., H. E. Wright, and D. W. Robinson. [1961] [6]p. incl. diagrs. tables, refs. (AFOSR-2821) (In cooperation with Johns Hopkins U., Baltimore, Md.) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)1522 and National Science Foundation) AD 295922 Unclassified

Abstract published in Symposium on Molecular Structure and Spectroscopy, Ohio State U., Columbus, June 12-16, 1961, p. 56.

Also published in Jour. Chem. Phys., v. 35: 1045-1050, Sept. 1961.

Abstract published in Spectrochim. Acta, v. 17: 1129, Oct. 1961.

The infrared spectrum of CF_3SF_5 has been measured and analyzed between 30 and 4000 cm^{-1}. A band found at 218.5 cm^{-1} is believed responsible for satellite lines observed previously in the microwave spectrum; the barrier to internal rotation might then be much lower than obtained previously by assuming these satellites were due to torsional oscillation. Twelve of the 17 fundamentals were assigned in the infrared spectrum and estimates are given for the others. A plausible assignment is given for the overtone and combination bands also observed; this gives no evidence for any of the inactive fundamentals. (Contractor's abstract)

3073

Washington U. Dept. of Chemistry, Seattle.

ASSIGNMENT OF ELECTRONIC TRANSITIONS IN AZO DYE PROTOTYPES, by M. B. Robin and W. T. Simpson. [1960] [9]p. incl. diagrs. tables, refs. (AFOSR-766) [AF 49(638)677] Unclassified

Presented at Molecular Structure Symposium of the Amer. Chem. Soc., Seattle, Wash., June 1960.

Also published in Jour. Chem. Phys., v. 36: 580-588, Feb. 1, 1962.

Quantitative calculations of the absorption frequency, transition moment length, and polarization of the first strong absorption band in the series of compounds $C_6H_5N{=}N(C_6H_4N{=}N)_xC_6H_5$ have been successfully carried out using a model employing delocalization of electronic excitation energy rather than delocalization of electrons. It is found that the compounds can be treated as azo-perturbed phenyl groups interacting with both an electrostatic force and through conjugation. Because of the electrostatic part of the interaction, there results a demonstrable heat of single bond isomerization in phenyl-β-naphthalene, its conformational isomers possessing different colorband spectra. The n-π^* transition in the azo dyes is shown to be, in all probability, the low-frequency component of 2 previously degenerate n-π^* bands which have split. The intensity and polarization of the formally forbidden, low-frequency n-π^* band can be explained by assuming a mixing of the n-π^* band with a strong, low frequency band responsible for the color in azo dyes. A high-frequency band found at 44 kk (kilokayser or 10^3 cm^{-1}) having a constant intensity throughout the series of dyes investigated has been shown to be isolated within the end phenyl groups. (Contractor's abstract)

3074

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. [1961] [14]p. incl. diagrs. tables, refs. (AF 49(638)677) Unclassified

Published in Polyamino Acids, Polypeptides, and Proteins; Proc. Internat'l. Symposium, Madison, Wis. (June 19-24, 1961), Madison, Wisconsin U. Press, 1962, p. 147-160.

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 helix bands and the helix-length dependence of the absorption intensity have been made. (Contractor's abstract)

3075

Washington U. Dept. of Chemistry, Seattle.

INFRARED SPECTRUM AND THERMODYNAMIC PROPERTIES OF GASEOUS SULFUR TRIOXIDE, by R. W. Lovejoy, J. H. Colwell and others. [1961] [6]p. incl. diagrs. tables, refs. (AFOSR-1227) (AF 49(638)723) Unclassified

Also published in Jour. Chem. Phys., v. 36: 612-617, Feb. 1, 1962.

The infrared spectrum of sulfur trioxide was obtained under prism resolution in the gaseous state and in xenon matrices at liquid-nitrogen temperature. In both cases a satisfactory vibrational assignment of the monomeric SO_3 spectrum could be made on the basis of a simple D_{3h} symmetry model. The observed gas phase fundamentals were $\nu_3(e') = 1391$, $\nu_4(e') = 529$, and $\nu_2(a_2'') = 495$ cm^{-1}. The matrix fundamentals were essentially the same as those of the gas phase except that the $\nu_2(a_2'')$ mode was shifted to 464 cm^{-1}. A normal coordinate treatment of the SO_3 molecule was carried out and potential constants were determined for both Urey-Bradley and simplified valence force fields. Three weak absorption bands of S_3O_9 were also detected in the gas-phase spectrum. From

the temperature and pressure variation of the intensities of these bands it was estimated that for the trimerization reaction at 298°K, K_p was approximately 1 atm^{-2} and $\Delta H_{298°}$ was approximately 30 kcal/mol of S_3O_9. The values of the thermodynamic properties of monomeric SO_3 were computed for the ideal gaseous state using the rigid rotor harmonic oscillator approximation at 1 atm from 100° to 1500°K. (Contractor's abstract)

3076

Washington U. Dept. of Chemistry, Seattle.

THIRD- AND FOURTH-ORDER INTERACTIONS OF ARGON WITH A GRAPHITIZED CARBON BLACK, by J. R. Sams, Jr., G. Constabaris, and G. D. Halsey, Jr. [1961] [6]p. incl. diagrs. tables, refs. (AFOSR-2604) [AF 49(638)723] AD 612347 Unclassified

Also published in Jour. Chem. Phys., v. 36: 1334-1339, Mar. 1962.

Data for the third- and fourth-order interactions of argon with the highly graphitized carbon black P33 (2700°) are presented. These data have been analyzed by means of a 2-dimensional gas model to give an estimate of the interaction energy between the adsorbed atoms, and a new method for determining the surface area of the adsorbent. Relations between the 2-dimensional gas model and a model which assumes pairwise additivity of potentials are discussed. (Contractor's abstract)

3077

Washington U. Dept. of Chemistry, Seattle.

SECOND VIRIAL COEFFICIENTS OF ARGON, KRYPTON, AND ARGON-KRYPTON MIXTURES AT LOW TEMPERATURES, by B. E. F. Fender and G. D. Halsey, Jr. [1961] [8]p. incl. diagrs. tables, refs. (AFOSR-3026) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)723] and Petroleum Research Fund) Unclassified

Also published in Jour. Chem. Phys., v. 36: 1881-1888, Apr. 1962.

Second virial coefficients of argon between 80-125°K, and krypton (105-140°K) have been measured. The experimental values are 5-15% larger in magnitude than those calculated from 12-6 or exp-6 potential functions by the substitution of parameters assigned to describe high-ten perature virial coefficients. Second virial coefficients calculated from the potential-distance relationship proposed by Guggenheim and McGlashan are within 1% of the experimental values for argon, but are about 4% smaller in magnitude than the measured krypton coefficients. Argon-krypton mixed virial coefficients have been determined between 105-125°K. These experimental results are best expressed by a 12-6 potential energy parameter combining rule $\epsilon_{12} = 2\epsilon_1\epsilon_2/\epsilon_1 + \epsilon_2$. (Contractor's abstract)

3078

Washington U. Dept. of Chemistry, Seattle.

GAS ADSORPTION NEAR THE BULK CRITICAL TEMPERATURE, by G. D. Halsey, Jr. [1961] [1]p. incl. diagrs. [AF 49(638)723] Unclassified

Published in Jour. Chem. Phys., v. 36: 1688, Mar. 15, 1962.

An experimental estimate of the 2-dimensional critical temperature of an argon film is $T_{2c} = 68°$. There is no measured value of the 1-dimensional virial coefficient B_1, but it can be calculated readily on the basis of the Lennard-Jones 12-6 interaction law for the van der Waals interaction of atoms. On this basis, a calculation shows that $T_{10} = 0.454\ T_{20}$, or 69°K. The critical temperature is near the temperature at which attraction and repulsions are just balanced for pair interactions in the phase boundary.

3079

Washington U. Dept. of Chemistry, Seattle.

ALKENYLBORANES. [III] CHARACTERIZATION OF METHYLVINYLBORANES, by C. D. Good and D. M. Ritter. [1961] [4]p. incl. tables, refs. (AFOSR-2263) (AF 49(638)937) AD 295925 Unclassified

Also published in Jour. Chem. and Eng. Data, v. 7: 418-419, July 1962.

Methylvinylboranes and trivinylborane were characterized as the result of an improved preparative method through observation of their infrared, ultraviolet, nuclear magnetic resonance (NMR), and mass spectra vapor pressures, and by vapor density. The gas-liquid chromatographic (GLC) properties were determined, and with suitable calibration they can be used henceforth for identification. (Contractor's abstract)

3080

Washington U. Dept. of Chemistry, Seattle.

ALKENYLBORANES. II. IMPROVED PREPARATIVE METHODS AND NEW OBSERVATIONS ON METHYLVINYLBORANES, by C. D. Good and D. M. Ritter. [1961] [5]p. incl. diagrs. tables, refs. (AFOSR-3175) (AF 49(638)937) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 84: 1162-1166, Apr. 5, 1962.

Reaction of chlorovinylboranes with dimethyl zinc gave the methylvinylboranes and trivinylborane. A disproportionation reaction gave chloromethylvinylborane. Ultraviolet and nuclear magnetic resonance

(n m r) spectra were observed. An approximate linear combination of atomic orbitals-molecular orbital (l. c. a. o. -m. o.) computation was used as a model to correlate the postulated delocalization with some of the physical properties. (Contractor's abstract)

3081

Washington U. Dept. of Physics, Seattle.

RANDOM MOTION OF DEUTERONS IN KD_2PO_4, by V. H. Schmidt and E. A. Uehling. [1961] [11]p. incl. diagrs. tables, refs. (AFOSR-1704) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)92] and National Science Foundation) Unclassified

Also published in Phys. Rev., v. 126: 447-457, Apr. 15, 1962.

Magnetic resonance studies of the deuteron in KD_2PO_4 have been conducted which show the existence of deuteron jumping between and within hydrogen bonds. The experimental results help to explain electrical conductivity and ferroelectric phenomena in crystals of this type. Pulse magnetic resonance experiments show that the lifetime T_{XY} against deuteron jumping between X- and Y-oriented hydrogen bonds is 15 msec at 70°C with a jump activation energy of approximately 0. 58 ev. The c-axis electrical conductivity of KD_2PO_4 is found to have the same activation energy, with a value of 1.16×10^{-10} (ohm cm)$^{-1}$ at 25°C. The $\Delta m = 1(P_1)$ and $\Delta m = 2(P_2)$ deuteron spin-lattice relaxation transition probabilities due to X-Y jumps have been calculated from the known values of T_{XY} and the electric field gradient tensors at X and Y deuteron sites. Their magnitudes and the dependences of these magnitudes on magnetic field, temperature, and orientation are in good agreement with experiment. Further measurements of P_1 and P_2 separately give a component of transition probability proportional to exp(0. 078 ev/kT) and independent of magnetic field. The orientation dependences of P_1 and P_2 for this component indicate quadrupolar relaxation due to deuteron jumps along hydrogen bonds, with a jump time of order 10^{-11} sec at 215°K. The existence of intrabond jumps governed by an activation energy is shown to be consistent with the Slater theory of KH_2PO_4 as modified by Takagi. (Contractor's abstract)

3082

Washington U. Dept. of Physics, Seattle.

NUCLEAR QUADRUPOLE RESONANCE OF As^{75} IN $Na_2HAsO_4 \cdot 7H_2O$, by E. D. Jones and E. A. Uehling. [1961] [2]p. (AFOSR-3810) [AF 49(638)92] Unclassified

Also published in Jour. Chem. Phys., v. 36: 1690-1691, Mar. 1962.

The As^{75} pure nuclear quadrupole resonance (NQR) has been observed at room temperature and 77°K in $Na_2HAsO_4 \cdot 7H_2O$ (sodium arsenate). The frequency is approximately 44. 2 mc/sec at the higher temperature and decreases by almost 2 mc/sec in going to the lower temperature. The resonance was nearly resolved at 77°K. This indicates a linewidth $\Delta\nu \sim 50$ kv which decreases appreciably with decreasing temperature. The arsenic atom in sodium arsenate is in the pentavalent state. An attempt to observe the pure quadrupole resonance of Na_3AsO_4 was also reported. The failure to observe this resonance is consistent with expectations based on the tetrahedral symmetry of isolated AsO_4 groups and the small contributions to field gradients arising from ionically bonded sodium atoms.

3083

Washington U. Dept. of Physics, Seattle.

NUCLEAR MAGNETIC RESONANCE OF ARSENIC AND ANTIMONY IN LIQUID AsF_5 AND $SbCl_5$, by E. D. Jones and E. A. Uehling. [1961] [1]p. (AFOSR-3811) [AF 49(638)92] Unclassified

Also published in Jour. Chem. Phys., v. 36: 1691, Mar. 1962.

The arsenic and antimony nuclear magnetic resonance (NMR) have been observed in liquid AsF_5 and liquid $SbCl_5$ at room temperatures. The As^{75} NMR was observed using a Knight high-level spectrometer at a frequency of 8. 8 mc/sec and associated lock-in techniques. The linewidth of the resonance was approximately 15 gauss. Both the NMR of the Sb^{121} and Sb^{123} isotopes were easily observed using a self-quenching superregenerative spectrometer. For a measurement of the Sb^{121} linewidth the Knight spectrometer was used, along with associated lock-in equipment, at 11 mc/sec. The observed linewidth for the Sb^{121} resonance was approximately 15 gauss.

3084

Washington U. Dept. of Physics, Seattle.

ZEEMAN MODULATOR FOR NUCLEAR QUADRUPOLE RESONANCE SPECTROSCOPY, by E. D. Jones. [1961] [2]p. incl. diagr. (AFOSR-3812) [AF 49(638)92] Unclassified

Also published in Rev. Scient. Instr., v. 33: 775-776, July 1962.

A system capable of generating field pulses of about 100 oersteds is described schematically. A brief description of the current supply operation is also given.

3085

Wayne State U. [Dept. of Chemistry] Detroit, Mich.

ADVANCES IN THE CHEMISTRY OF THE COORDINATION COMPOUNDS; PROCEEDINGS OF THE SIXTH INTERNATIONAL CONFERENCE ON COORDINATION CHEMISTRY, Detroit, Mich., Aug. 27-Sept. 1, 1961, ed. by S. Kirschner. New York, MacMillan Co., 1961, 682p. incl. diagrs. tables, refs. (AFOSR-1543) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)739, American Chemical Society, and International Union of Pure and Applied Chemistry) Unclassified

The program of the Conference on Coordination Chemistry covers current problems in structure and stereochemistry of coordination compounds, the nature of bonding in coordination compounds, the mechanisms of reactions of coordination compounds, the synthesis and properties of coordination compounds, catalysis and coordination compounds, and thermodynamic properties of coordination compounds.

3086

Wayne State U. [Dept. of Mathematics] Detroit, Mich.

FIBERINGS OF ENVELOPING SPACES. II, by S.-T. Hu. [Aug. 1961] [31]p. (Technical note no. 12) (AFOSR-1048) (AF 49(638)179) AD 262159 Unclassified

Also published in Tohoku Math. Jour., v. 14: 104-120, Apr. 1962.

The objective is the study of the terminal projection from the m-th enveloping space $E_m(X)$ into the m-th residual space $R_m(X)$. It turns out that it is a fibering without assuming the local conditions on X. (Contractor's abstract)

3087

Wayne State U. [Dept. of Mathematics] Detroit, Mich.

ON A THEOREM OF YANO AND NAGANO, by S. I. Goldberg. July 1961, 11p. (AFOSR-1084) (AF 49-(638)967) AD 263313 Unclassified

A complete connected Einstein space of dimension $m > 2$ on which there exists a vector field generating globally a 1-parameter group of non-homothetic transformations is homeomorphic with the m-sphere. This statement is valid for any complete, connected Riemannian manifold if it were known for a manifold of (positive) constant scalar curvature. Evidence is presented strengthening this conjecture. It is shown that if M is a compact Riemannian manifold which is not a homology sphere, then an infinitesimal conformal transformation of M is an infinitesimal isometry. In particular, if a compact, simply connected symmetric space of a connected Lie group admits a non-homothetic transformation (belonging to the connected component of the group of conformal transformations of M) then M is isometric with the m-sphere. (Contractor's abstract)

3088

[Wayne State U. Dept. of Mathematics, Detroit, Mich.]

THE CONFORMAL TRANSFORMATION GROUP OF A COMPACT RIEMANNIAN MANIFOLD, by S. I. Goldberg and S. Kobayashi. [1961] [5]p. (AFOSR-3252) (AF 49(638)967) Unclassified

Published in Amer. Jour. Math., v. 84: 170-174, Jan. 1962.

Let M be a Riemannian manifold, $C_0(M)$ the largest connected group of conformal group of isometries of M. The aim here is to prove the following theorem: Let M be a complete Riemannian manifold. If $C_0(M) \neq I_0(M)$, then there exists no harmonic form of degree p, $0 < p < \dim M$, whose length is a non-zero constant. From this theorem, a corollary is deduced: Let M be a compact homogeneous Riemannian manifold. If $C_0(M) \neq I_0(M)$, then M is a relative homology sphere.

3089

[Wayne State U. Dept. of Mathematics, Detroit, Mich.]

THE CONFORMAL TRANSFORMATION GROUP OF A COMPACT RIEMANNIAN MANIFOLD, by S. I. Goldberg and S. Kobayashi. [1961] [2]p. (AFOSR-3253) (AF 49(638)967) Unclassified

Published in Proc. Nat'l. Acad. Sci., v. 48: 25-26, Jan. 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. (2) Let M be a compact homogeneous Riemannian manifold. If $C_0(M) \neq I_0(M)$, then M is a rational homology sphere.

3090

Wayne State U. [Dept. of Physics] Detroit, Mich.

THE DIFFUSION OF HYDROGEN IN SINGLE-CRYSTAL GERMANIUM, by R. C. Frank and J. E. Thomas, Jr. [1960] [8]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)158] and General Motors Laboratories) Unclassified

Published in Jour. Phys. and Chem. Solids, v. 16: 144-151, Nov. 1960.

Single-crystal germanium diffusion specimens were prepared by a special process of drilling and crystal growing. The hollow cylindrical specimen was sealed at 1 end and attached to a mass spectrometer at the other. By surrounding the thin cylinder with hydrogen gas and observing it diffuse through into the mass spectrometer permeation rates and diffusion coefficients were measured in the temperature range of 800 to 910°C. The excellent agreement between diffusion coefficients measured by the "time lag" and decay curve methods indicates that trapping effects by lattice defects were small or non-existent. The activation energy for diffusion is 8.7 ± 0.8 kcal/g atom and the heat of solution is 52.8 ± 1.4 kcal/g atom. The permeation rate was found to vary as the square root of the gas pressure, which indicates that the hydrogen exists in the germanium lattice as hydrogen atoms or ions. (Contractor's abstract)

3091

Wayne State U. [Dept. of Physics] Detroit, Mich.

EFFECT OF GASEOUS AMBIENTS UPON 1/f NOISE IN GERMANIUM FILAMENTS, by V. E. Noble and J. E. Thomas, Jr. [1960] [6]p. incl. diagrs. [AF 49-(638)158] Unclassified

Published in Jour. Appl. Phys., v. 32: 1709-1714, Sept. 1961.

The variation of low frequency noise in thin, single crystal germanium filaments was investigated by using gaseous ambients to change the surface potential of the sample. The noise samples, having a thickness of only 4 μ, were extremely sensitive to variations in the surface potential and exhibited large fractional changes of the total sample conductance as a result of the surface conductance fluctuations which were interpreted as the 1/f noise. These results showed a definite noise minimum when the sample surface potential corresponded to the sample conductance minimum. The rms conductance fluctuation varied roughly linearly with ΔG, where ΔG is the increase of the sample conductance with respect to the minimum value. The slope of the curve for the condition of an accumulation layer on the sample surface was an order of magnitude less than that for the inversion layer. The amplitude of the accumulation noise agreed (within a factor of two) with the prediction of McWhorter's majority carrier trapping effect, but the inversion noise was an order of magnitude greater. (Contractor's abstract)

3092

Wayne State U. Dept. of Physics, Detroit, Mich.

METAL-TO-GLASS VACUUM SEAL FOR LOW TEMPERATURES, by N. H. Horwitz and H. V. Bohm. [1961] [2]p. incl. diagr. (AFOSR-959) [AF 49(638)-932] AD 451554 Unclassified

Also published in Rev. Scient. Instr., v. 32: 857-858, July 1961.

A mechanical glass-to-metal seal is used which is vacuum tight (even when immersed in a helium II bath), and can readily be taken apart when access to the interior of the experimental chamber is desired. In common with some other demountable vacuum seals an indium O-ring is employed. The construction of this seal is shown. A standard wall Pyrex tube of approximately 1 in. diam is sealed off at 1 end, and the other end is thickened and flared to provide a collar. The face of this collar is ground flat, after which a 15° bevel is lapped around the outer edge. The tube is carefully annealed. The glass tube mates with a brass cap assembly. A locking ring compresses the indium O-ring between the collar of the glass tube and the inner surface of the cap. A phosphor bronze wave washer between the locking ring and the glass collar maintains pressure and also allows for slippage between ring and collar during tightening. Alternatively, one might consider using a bolted flange instead of the threaded ring.

3093

Wayne State U. Dept. of Physics, Detroit, Mich.

MAGNETOACOUSTIC MEASUREMENTS IN SILVER AT 230 MC/SEC AND 4.2°K, by V. J. Easterling and H. V. Bohm. [1961] [7]p. incl. diagrs. tables, re' (AFOSR-1753) (AF 49(638)832) Unclassified

Also published in Phys. Rev., v. 125: 812-818, Feb. 1, 1962.

Measurements of acoustic attenuation in silver have been made with 150-233 mc/sec longitudinal sound waves in magnetic fields up to 15,000 oersteds and at a temperature of 4.2°K. Plots of the ultrasonic pulse height as a function of the reciprocal of the magnetic field strength show from 10 to 15 maxima and minima for several orientations. Numerical data are presented and discussed in some detail. The Pippard type theoretical model of the silver Fermi surface is compared with our measurements. (Contractor's abstract)

3094

Wayne State U. [Dept. of Physics] Detroit, Mich.

MAGNETOACOUSTIC MEASUREMENTS IN SILVER, COPPER, AND GOLD AT 200 TO 350 MC (Abstract), by H. V. Bohm and V. J. Easterling. [1961] [1]p. [AF 49(638)832] Unclassified

Presented at meeting of the Amer. Phys. Soc., Chicago, Ill., Nov. 24-25, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 436, Nov. 24, 1961.

Magnetoacoustic measurements are reported on all 3 noble metals with both transverse and longitudinal sound waves at frequencies up to 350 mc. Plots of the ultrasonic pulse height, h, vs the reciprocal of the magnetic field strength, 1/H, show 15 or more maxima and minima for several orientations in each metal. The Fermi surface dimensions calculated from the

periods in the 1/H of the magnetoacoustic oscillations are interpreted in terms of the Pippard type Fermi surface model, and details of the Fermi surface topology in some regions are presented. Some anomalous results obtained with sound propagated along the 111 direction are discussed. The positions of pulse height extrema in the h vs 1/H plots are compared with theory.

3095

Wayne State U. [Dept. of Physics] Detroit, Mich.

ULTRASONIC ATTENUATION MEASUREMENTS IN ALUMINUM (Abstract), by G. N. Kamm and H. V. Bohm. [1961] [1]p. [AF 49(638)832] Unclassified

Presented at meeting of the Amer. Phys. Soc., Chicago, Ill., Nov. 24-25, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 438, Nov. 24, 1961.

Magnetoacoustic oscillations of the ultrasonic attenuation in ultra-high purity aluminum single crystals have been studied at 4.2°K and at frequencies between 200 and 350 mc. Three crystal samples were prepared with opposite faces accurately parallel to the (100), (110), and (111) planes. Longitudinal sound waves were propagated perpendicular to the sample faces while a variable magnetic field was rotated in the plane of the faces. The precision of the measurements permits a more detailed comparison with the free electron model Fermi surface. The topology of the second zone of this simple model is confirmed in considerable detail. A variety of oscillations is observed at all angles, and interpreted as central orbits, off-center orbits, and orbits in the third zone. The rf system, sample holder, and automatic recording system used in the measurements is described briefly.

3096

Weizmann Inst. of Science. Dept. of Applied Mathematics, Rehovoth (Israel).

NUMERICAL INTEGRATION OF THE NAVIER-STOKES EQUATIONS, by J. Gillis. Jan. 15, 1961 [33]p. incl. tables. (Technical rept. no. 1) (AFOSR-322) (AF 61(052)352) AD 252942 Unclassified

A description is presented of the relaxation solution for the flow of a viscous liquid in the inlet region of a straight circular pipe at high Reynolds number, and analytical work on the application of Laguerre functions to the solution of non-linear differential equations over a semi-infinite range. Preliminary work on flow between non-parallel plane walls is also discussed. (Contractor's abstract)

3097

Weizmann Inst. of Science. Dept. of Applied Mathematics, Rehovoth (Israel).

TRIPLE PRODUCT INTEGRALS OF LAGUERRE FUNCTIONS, by J. Gillis and M. Shimshoni. [1961] [13]p. incl. tables. [AF 61(052)352] Unclassified

Published in Math. Comput., v. 16: 50-62, Jan. 1962.

This paper is concerned with the quantities $C_{rst} = \int_0^\infty \lambda_r(x)\lambda_s(x)\lambda_t(x)\,dx$, which are required in the solution of mildly non-linear ordinary differential equations, in semi-indefinite intervals, in series of Laguerre functions $\lambda_n(x) = e^{-x/2}L_n(x)$, $n = 0, 1, 2, \ldots$ Explicit expressions and recurrence relations are derived for the C_{rst}, and generation on an automatic computer by means of the recurrence relations is discussed. An 8-decimal table of C_{rst} is given for $t = 0(1)10$, $s = 0(1)t$ and $r = 0(1)s$, together with explicit expressions for the C_{rst} as functions of t when $s = 0(1)3$ and $r = 0(1)s$. The Blasius equation $y''' + yy'' = 0$, with the conditions $y(0) = y'(0) = 0$ and $y'(\infty) = 2$, is chosen as an example. The computation of the coefficients of successive approximations in series of the $\lambda_n(x)$ is described, and numerical values of y obtained this way are compared with values obtained by Hamel's method.

3098

Weizmann Inst. of Science. Dept. of Applied Mathematics, Rehovoth (Israel).

THE SPECTRUM OF Li^+, by C. L. Pekeris. Oct. 20, 1961 [4]p. incl. tables. (Technical note no. 1) (AFOSR-1826) (AF 61(052)510) AD 272436 Unclassified

The ionization energy of the 2^3S state of Li^+ was computed as 134044.12 cm^{-1} in excellent agreement with the experimental value of 134044.19 ± 0.10 cm^{-1}, determined by Herzberg and Moore. The theoretical ionization energy of the 2^1S state of Li^+ came out 118704.88 cm^{-1}, as against the value of 120008.30 ± 0.10 cm^{-1} determined by Herzberg and Moore. It appears that the 8517.4A line measured by Series and Willis, and later by Herzberg and Moore, was wrongly identified as the 2^1S - 2^1P transition. The correct line should be looked for at 9583.99A. (Contractor's abstract)

3099

Weizmann Inst. of Science. Dept. of Applied Mathematics, Rehovoth (Israel).

1^1S, 2^1S, AND 2^3S STATES OF Li, by C. L. Pekeris. [1961] [3]p. incl. tables. (AFOSR-3168) (AF 61(052)-510) AD 613795 Unclassified

Also published in Phys. Rev., v. 126: 143-145, Apr. 1, 1962.

The ionization energy J, excluding the Lamb shift, of

the ground state of Li^+ has been evaluated for determinants up to order n = 444. J(444) = 610087.449 cm^{-1}, and an extrapolated value J(∞) = 610087.445 cm^{-1} are obtained. A theoretical ionization energy of 118704.88 cm^{-1} is obtained for the 2^1S state as against the experimental value of 120008.30 ± 0.10 cm^{-1} determined by Herzberg and Moore. It appears that the 8517.4A line first measured by Series and Willis and later by Herzberg and Moore has been incorrectly identified as the 2^1S - 2^1P transition. It should be looked for at 9584A. For the 2^3S state, the ionization energy obtained is 134044.12 cm^{-1} and is in excellent agreement with the experimental value of 134044.19 ± 0.10 cm^{-1} determined by Herzberg and Moore. (Contractor's abstract)

3100

Weizmann Inst. of Science. Dept. of Applied Mathematics, Rehovoth (Israel).

FINE STRUCTURE OF THE 2^3P AND 3^3P STATES OF HELIUM, by C. L. Pekeris, B. Schiff, and H. Lifson. [1961] [2]p. incl. tables, refs. (AFOSR-3876) [AF 61-(052)510] Unclassified

Also published in Phys. Rev., v. 126: 1057-1058, May 1, 1962.

Using an extension of the method of Pekeris for S states, eigenvalues and eigenfunctions have been obtained for the 2^1P, 2^3P, 3^1P, and 3^3P states of helium. The fine-structure splittings of the 2^3P and 3^3P states have been computed, including the α^3 quantum electrodynamic correction and the singlet-triplet correction. Determinants up to order n = 220 were solved, and when the results were extrapolated to n → ∞ good agreement was obtained with recent accurate measurements of the fine-structure splittings, substantiating the correctness of the α^2 terms. (Contractor's abstract)

3101

Weizmann Inst. of Science. Dept. of Biochemistry, Rehovoth (Israel).

THE MECHANISM OF PHOTOPHOSPHORYLATION IN CHLOROPLASTS, by M. Avron. Apr. 30, 1961, 13p. incl. refs. (Technical rept. no. 1) (AFOSR-1032) (AF 61(052)390) AD 262091 Unclassified

Utilizing O^{18} labelled substrates, it was established that 1 atom of O enters from the water of the medium into each ATP molecule produced. In addition the location of the phosphate oxygens, the possibility of interfering side reactions and the source of the new bridging oxygen atom in the ATP molecule were determined. The inhibitory effect of UV irradiation on the Hill reaction and photophosphorylation was quantitatively determined. A positive correlation was established between the destruction of the coenzyme Q_{255} and the inactivation of the photosynthetic reactions brought about by UV irradiation. By taking advantage of the properties of a photophosphorylative system, ATP or ADP labelled at specific and different sites with P^{32} labelled compounds was synthesized. Light activated Pi-ATP exchange was discovered to be present in chloroplasts. (Contractor's abstract)

3102

Weizmann Inst. of Science. Dept. of Biophysics, Rehovoth (Israel).

PREPARATION, PROPERTIES AND APPLICATIONS OF SOME WATER-INSOLUBLE DERIVATIVES OF PROTEOLYTIC ENZYMES, by E. Katchalski. [1961] [7]p. incl. refs. (AFOSR-4186) (AF 61(052)391) Unclassified

Also published in Polyamino Acids, Polypeptides, and Proteins; Proc. Internat'l. Symposium, Madison, Wis. (June 19-24, 1961), Madison, Wisconsin U. Press, 1962, p. 283-289.

A description is given of the preparation, properties, and applications of some water-insoluble derivatives of proteolytic enzymes. Wherever possible, their use in protein and polypeptide research is illustrated. To insure high enzymatic activity different synthetic procedures are employed in the preparation of the various water-insoluble proteolytic enzymes. A direct coupling of the enzyme with the chemically reactive polymer has been carried out in the case of papain. A water-insoluble pepsin has been obtained by reacting pepsinogen with a water-insoluble polymer and subsequent acid activation of the insoluble pro-enzyme. The attachment of the enzyme to the carrier by polymeric side chains which ensure free movement of the catalyst molecules in the reaction mixture has been used in the case of trypsin and chymotrypsin. In all the enzymatic preparations investigated a copolymer of p-amino-DL-phenylalanine and L-leucine has been used as a carrier.

3103

Weizmann Inst. of Science. Dept. of Biophysics Rehovoth (Israel).

THE HYDRODYNAMIC BEHAVIOR AND MOLECULAR CONFIGURATION OF POLY -ε, N-CARBOBENZOXY-L-LYSINE IN DIMETHYLFORMAMIDE SOLUTION, by E. Daniel and E. Katchalski. [1961] [11]p. incl. diagrs. tables, refs. [AF 61(052)391] Unclassified

Published in Polyamino Acids, Polypeptides, and Proteins; Proc. Internat'l. Symposium, Madison, Wis. (June 19-24, 1961), Madison, Wisconsin U. Press, 1962, p. 183-193.

A survey is given of the viscosity, sedimentation, and diffusion behavior in dimethylformamide (DMF) of 9 samples of poly-ε, N-carbobenzoxy-L-lysine (PCBL) in the molecular weight range of 20,000 to 500,000.

An analysis of the molecular weight dependence of the various hydrodynamic parameters obtained was carried out taking into account the various theories dealing with corpuscular particles and flexible threadlike molecules. From this analysis it was concluded that the PCBL molecules exist in DMF solution as helical rods possessing a marked flexibility.

3104

[Weizmann Inst. of Science. Dept. of Physics, Rehovoth (Israel)]

COLLECTIVE MOTION IN MANY-PARTICLE SYSTEMS. PART I. THE VIOLATION OF CONSERVATION LAWS, by H. J. Lipkin. [1959] [20]p. incl. refs. (Sponsored jointly by [Air Force Office of Scientific Research under AF 61(052)337], Atomic Energy Commission, and Office of Naval Research) Unclassified

Published in Ann. Phys., v. 9: 272-291, Feb. 1960.

A method for treating collective motion is proposed which allows the use of wave functions violating conservation laws which are valid for the system. The reasons for the use of such wave functions are discussed and a simple physical interpretation is given. The method is illustrated by applications to center-of-mass motion, the electron gas in the random phase approximation, nuclear rotation, and the violation of the conservation of the number of particles. (Contractor's abstract)

3105

[Weizmann Inst. of Science. Dept. of Physics, Rehovoth (Israel)]

SOME SIMPLE FEATURES OF THE MÖSSBAUER EFFECT, by H. J. Lipkin. [1959] [8]p. (Sponsored jointly by [Air Force Office of Scientific Research under AF 61(052)337], Atomic Energy Commission, and Office of Naval Research) Unclassified

Published in Ann. Phys., v. 9: 332-339, Feb. 1960.

A simple description is given in the state of a crystal lattice upon emission or absorption of a nuclear gamma ray. A sum rule is derived for the average energy transfer to the lattice. The probability of zero energy transfer is calculated. The results are general and do not assume a particular model for the crystal. Conclusions are presented as simple principles which may be useful as a guide to experimentalists. (Contractor's abstract)

3106

Weizmann Inst. of Science. Dept. of Physics, Rehovoth (Israel).

ON THE USE OF FORMAL OPERATOR TECHNIQUES IN QUANTUM STATISTICAL MECHANICS, by A. S. Reiner. Apr. 1, 1960, 27p. incl. refs. (Technical note no. 3) (AFOSR-TN-60-727) (AF 61-(052)337) AD 244302 Unclassified

Also published in Physica, v. 26: 700-716, Sept. 1962.

An alternative derivation of the linked cluster expansions for the partition function of a grand canonical ensemble is given. It is shown that the cluster coefficients in that expansion are related to connected Bloch diagrams. In a time-independent approach the contributions of those diagrams may be expressed in terms of the generalized scattering matrix of Watson. This t-matrix for a hard core interaction has been applied in a calculation of the first 3 cluster coefficients of a boson gas of inpenetrable spheres. The results accord with those obtained by the binary collision methods. The relation and differences in the various approaches are discussed. (Contractor's abstract)

3107

Weizmann Inst. of Science. Dept. of Physics, Rehovoth (Israel).

ON THE TREATMENT OF A PERTURBATION IN A SYSTEM OF PAIRED FERMIONS, by A. Katz. [1961] [13]p. (Technical note no. 9) (AFOSR-227) (AF 61-(052)337) AD 253344; PB 155424 Unclassified

Also published in Nuclear Phys., v. 26: 129-135, July 1961.

A straightforward variational calculation with BCS wave functions yields expressions formerly obtained by Migdal (Nuclear Phys., v. 13: 655, 1959) and Blatt (Prog. Theor. Phys., v. 24: 851, 1960) by more complicated methods. As was shown by Migdal and Blatt, these expressions lead to a correct rotational moment of inertia of the system at the limit of a large system, to a correct mass in the pushing model and to a gauge invariant description of the Meissner effect. (Contractor's abstract)

3108

Weizmann Inst. of Science. Dept. of Physics, Rehovoth (Israel).

LINEAR RESPONSE FUNCTION OF A MANY FERMION SYSTEM, by A. J. Glick. May 1, 1961, incl. diagrs. refs. (Technical note no. 10) (AFOSR-1163) (AF 61(052)337) AD 262092 Unclassified

Also published in Ann. Phys., v. 17: 61-92, Jan. 1962.

The properties of a many body system are studied by means of a linear response function which depends on frequency and wave number. It is shown how the expectation value of two body operators, the rate of transitions induced by one body operators or weak external fields acting on the system, and information about the energy spectrum can be found from this function. As a result, the formalism suggests many relationships between apparently dissimilar quantities, and suggests indirect ways of experimentally

measuring internal properties of a system. In the present formalism, all of the difficulties inherent in many body calculations are related to the determination of the response function. However, there exist some rules and a priori conditons on this function which can be used to estimate the validity of approximate calculations and to indicate what must be done to improve the results. The response function is calculated for a Fermi gas by using a combined diagrammatic perturbation theory and Green's function technique. (Contractor's abstract)

3109

Weizmann Inst. of Science. Dept. of Physics, Rehovoth (Israel).

THE ANALYTIC STRUCTURE OF MANY-BODY PERTURBATION THEORY, by A. Katz. May 10, 1961 [33]p. incl. diagrs. (Technical note no. 11) (AFOSR-1164) (AF 61(052)337) AD 262093 Unclassified

Also published in Nuclear Phys., v. 29: 353-372, Jan. 1962.

The Goldstone linked cluster expansion is used to determine the energy as an analytic function of the coupling constant. This function is many valued and describes the various energy levels of the system. The energy of each level can be obtained from the Goldstone expansion by continuing it analytically along a properly chosen path in the complex plane. The Brueckner ladder approximation is shown to be an approximation to an analytic continuation along a path which always leads to the normal state—the state in which no binding occurs. (Contractor's abstract)

3110

Weizmann Inst. of Science. Dept. of Physics, Rehovoth (Israel).

USE OF THERMAL GREEN'S FUNCTION FOR THE ELECTRON-ION INTERACTION IN SUPERCONDUCTORS, by T. Nishiyama. June 20, 1961 [44]p. incl. diagrs. refs. (Technical note no. 12) (AFOSR-1440) (AF 61(052)337) AD 264835 Unclassified

Starting with the Bardeen and Pines Hamiltonian for metals, the screening effect of the electron-ion interaction and the change of frequency of the ionic oscillation in superconductors have been considered by introducing a Hartree field in place of the pairing interaction of Cooper. Use is made of the method of thermal Green's functions which affords us analytically tractable results. A method has been proposed to determine a number of parameters involved in the Hartree field in a self-consistent way. (Contractor's abstract)

3111

Weizmann Inst. of Science. [Dept. of Physics] Rehovoth (Israel).

ELECTRON EXCITATION OF COLLECTIVE NUCLEAR TRANSITIONS (Abstract), by L. J. Tassie and A. S. Reiner. [1961] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 61(052)337] and Atomic Energy Commission) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 57, Feb. 1, 1961.

The form factors for the inelastic scattering of high-energy electrons are calculated by use of the collective model of the nucleus. For large momentum transfers the scattering depends on the form of the nuclear charge density. If it is assumed that the collective nuclear motion is irrotational and incompressible, the usual collective model can be extended to an arbitrary static charge distribution, and the inelastic scattering thus can be related to this charge distribution. Experiments are suggested which should provide a test of the assumption of nuclear incompressibility. In particular, electric monopole excitation is considered, as this should be the most sensitive to any compression effects.

3112

Weizmann Inst. of Science. Dept. of Physics, Rehovoth (Israel).

MANY-BODY PERTURBATION METHODS IN A SOLUBLE MODEL, by A. J. Glick, H. J. Lipkin, and N. Meshkov. [1961] [2]p. incl. diagr. [AF 61(052)337] Unclassified

Published in Proc. Rutherford Jubilee Internat'l. Conf., Manchester (Gt. Brit.) (Sept. 4-8, 1961), New York, Academic Press, 1961, p. 299-300.

A model with particles in 2 shells with a monopole-monopole force is solved exactly and by the following many-body perturbation methods: (a) ordinary second order perturbation theory, and (b) summation of bubble graphs to all orders. Results indicate that although the bubble sum should be a good approximation when the number of particles is large, it is not so good when the number is small, as in light nuclei. Exact results for systems up to 8 particles indicate that second order perturbation theory gives better results than the bubble sum, and extrapolation indicates that this should hold up to about 20 particles. (Contractor's abstract)

3113

[Weizmann Inst. of Science. Dept. of Physics, Rehovoth (Israel)]

FLUX QUANTIZATION AND THE CURRENT-CARRYING STATE IN A SUPERCONDUCTING CYLINDER, by H. J. Lipkin, M. Peshkin, and L. J. Tassie. [1961] [2]p. incl. refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 61(052)337] and Atomic Energy Commission) Unclassified

Published in Phys. Rev , v. 126: 116-117, Apr. 1, 1962.

London's phenomenological theory is modified to include quantization of angular momentum in the boson gas model of a superconductor. The modified London equation is solved in ring geometry to find the magnetic field in the penetration region. The unit of flux quantization is obtained for all thicknesses of the superconductor. The relation between angular momentum and kinetic energy in the current-carrying state is discussed briefly. (Contractor's abstract)

3114

Western Ontario U. Dept. of Chemistry, London (Canada).

THE IRRADIATION OF UNSATURATED SULTONES, by E. Henmo, P. de Mayo and others. [1961] [2]p. incl. diagrs. (AFOSR-769) (AF AFOSR-61-6) Unclassified

Published in Proc. Chem. Soc. (London): 238-239, July 1961.

Irradiation of unsaturated diphenyl sultones in methanol produces ring cleavage yielding a methyl sulfonic ester which can be identified from its hydrolysis compound. Ozonolysis followed by cyclization with warm alkali produces the known phenalene derivatives. The products in all cases were characterized by the preparation of derivatives and by nuclear magnetic resonance spectra, infrared and ultraviolet spectra. The cyclic dimethyl sultone $C_6H_8SO_3$, upon irradiation gave the open-chain unstable keto-sulfonic ester $C_6H_9SO_3X$, where X = OCH_3, which was characterized by its 2,4-dinitrophenylhydrazone derivative and also by the previously mentioned spectrophotometric methods.

3115

Western Ontario U. Dept. of Physics, London (Canada).

EXCITATION OF THE FIRST NEGATIVE SYSTEM OF O_2^+ BY A PROTON BEAM IN AIR AND OXYGEN, by L. Herman, H. I. S. Ferguson, and R. W. Nichols. [1961] [2]p. incl. illus. refs. (AFOSR-209) [AF 49-(638)640] Unclassified

Also published in Canad. Jour. Phys., v. 39: 476, Mar. 1961.

The excitation of the bands of the O_2^+ first negative ($b^4\Sigma_g^- - a^4\Pi_u$) system by 40-kev proton beams in air and oxygen at low pressures is discussed. The resulting emission spectra are investigated over the pressure range 10^{-1} to 10^{-3} mm Hg, and over the wavelength range 2300 to 7000A. The identified spectral features indicate that the main emitters are N^+, O^+, N_2^+, and O_2^+. The leading two or three bands in each of the $\Delta v = -2$, -1, and 0 sequences of the N_2^+ first negative ($B^2\Sigma - X^2\Sigma$) system, and of the $\Delta v = -1$, 0, and +1 sequences of the O_2^+ first negative ($b^4\Sigma_g^- - a^4\Pi_u$) system are excited together with lines of NII, OII, and HI. In air, the O_2^+ bands are much weaker than those of N_2^+. The proton beam is very sharply defined at these low pressures and the bands arise from the center of the beam, evidently from direct proton excitation.

3116

Western Ontario U. Dept. of Physics, London (Canada).

TRANSITION PROBABILITIES OF MOLECULAR BAND SYSTEMS. XVIII. FRANCK-CONDON FACTORS TO HIGH VIBRATIONAL QUANTUM NUMBERS I: N_2 AND N_2^+, by R. W. Nicholls. May 15, 1961 [26]p. incl. tables, refs. (Scientific rept. no. 3) (AFOSR-674) (Sponsored jointly by Air Force Cambridge Research Center under AF 19(504)4560, Air Force Office of Scientific Research under AF 49(638)-640, and Office of Naval Research under Nonr-289500; and the Department of Defence Production of Canada, the National Research Council of Canada, and the Ontario Research Foundation) AD 262591 Unclassified

Also published in Jour. Research Nat'l. Bur. Stand., v. 65A: 451-460, Sept.-Oct. 1961.

Franck-Condon factor arrays are computed to the highest vibrational quantum numbers that are spectroscopically realistic, for a number of important molecular band systems. Morse potentials are assumed and the integrations are performed on an electronic computer.

3117

Western Ontario U. Dept. of Physics, London (Canada).

TRANSITION PROBABILITIES OF MOLECULAR BAND SYSTEMS. XIX. FRANCK-CONDON FACTORS TO HIGH VIBRATIONAL QUANTUM NUMBERS II: SiO, MgO, SrO, AlO, VO, NOβ, γ, by R. W. Nicholls. May 15, 1961 [13]p. incl. tables, refs. (Scientific rept. no. 4) (Sponsored jointly by Air Force Cambridge Research Center under AF 19(504)4560, Air Force Office of Scientific Research under AF 49(638)-640, and Office of Naval Research under Nonr-289500; and the Department of Defence Production of Canada, the National Research Council of Canada, and the Ontario Research Foundation) AD 262592 Unclassified

Also published in Jour. Research Nat'l. Bur. Stand., v. 66A: 227-231, May-June 1962. (Title varies)

Franck-Condon factor arrays have been computed numerically to high vibrational quantum numbers for the band systems of the following diatomic oxides of interest in astrophysics and atmospheric physics:

SiO: ($A^1\Pi$ — $X^1\Sigma^+$), MgO: ($B^1\Sigma - A^1\Pi$), MgO: ($B^1\Sigma - X^1\Sigma$), SrO: ($A^1\Sigma - X^1\Sigma$), AlO: ($A^2\Sigma^+ - X^2\Sigma^+$), VO: ($A^2\Delta - X^2\Delta$), NO$\beta$: ($B^2\Pi - X^2\Pi$), and NO$\gamma$: ($A^2\Sigma^+ - X^2\Pi$). (Contractor's abstract)

3118

Western Ontario U. Dept. of Physics, London (Canada).

RESEARCH ON GAS SCINTILLATIONS FROM IONISING RADIATIONE, by R. W. Nicholls. Final technical rept. June 1, 1959-May 31, 1961. Nov. 7, 1961 [13]p. (AFOSR-1715) (AF 49(638)640) Unclassified

Research performed emphasized the spectroscopy of ion beams, plasma jets, and the luminosity from shock excited powdered solids. This resulted in the growth of a supporting experimental program on intensity measurements of important band systems together with a start in the preparatic of an atlas of molecular spectra. Liste of journ... ublications, scientific reports, and theses are given. Information is also given on the personnel participating in the research program.

3119

Western Ontario U. Dept. of Physics, London (Canada).

THE λ2763A (0, 9) BAND OF THE O_2 SCHUMANN-RUNGE SYSTEM, by G. R. Hébert and R. W. Nicholls. [1961] [3]p. incl. table, refs. (AFOSR-J108) (Sponsored jointly by Air Force Cambridge Research Center, Air Force Office of Scientific Research under [AF 49(638)640], Department of Defence Production of Canada, National Research Council of Canada, and Ontario Research Foundation) AD 400464 Unclassified

Also published in Jour. Atm. and Terrest. Phys., v. 21: 213-215, June 1961.

A table of the Schumann-Runge (0, 9) band of straight forward rotational analysis is given. It may be of use in the interpretation of emission and absorption spectra of hot oxygen and hot air, and when available, spectra of high altitude nuclear explosions.

3120

Western Ontario U. Dept. of Physics, London (Canada).

FRANCK-CONDON FACTORS AND r-CENTROIDS FOR SOME BANDS OF THE SiO $A^1\pi$-$X^1\Sigma^+$ BAND SYSTEM, by A. T. McGregor, R. W. Nicholls, and W. R. Jarmain. [1961] [2]p. incl. table. (AFOSR-J110) (Sponsored jointly by Air Force Cambridge Research Center, Air Force Office of Scientific Research under [AF 49(638)640], and Office of Naval Research; and National Research Council and the Ontario Research Foundation) AD 400185 Unclassified

Also published in Canad. Jour. Phys., v. 39: 1215-1216, Aug. 1961.

Calculations were made for the vibrational bands $v' + v'' \leq 8$ and the results are tabulated.

3121

Western Ontario U. Dept. of Physics, London (Canada).

INTENSITY MEASUREMENTS IN EMISSION ON 29 BANDS OF THE O_2 SCHUMANN-RUNGE SYSTEM, by G. R. Hébert and R. W. Nicholls. [1961] [14]p. incl. diagrs. tables, refs. (AFOSR-J113) (Sponsored jointly by Air Force Cambridge Research Center, Air Force Office of Scientific Research under [AF 49(638)640], National Research Council of Canada, Office of Naval Research, and Ontario Research Foundation) AD 400054 Unclassified

Also published in Proc. Phys. Soc. (London), v. 78: 1024-1037, Nov. 15, 1961.

Relative integrated photoelectric intensity measurements have been made upon each of the $v' = 0$, $v'' = 9$-19; $v' = 1$, $v'' = 8$-12; 16-20; $v' = 2$, $v'' = 7$-9, 15, 16, 19-21, bands of the Schumann-Runge System. These measurements have been interpreted, with the aid of Franck-Condon factors $q_{v'v''}$ and r-centroids $\bar{r}_{v'v''}$, to determine the variation of electronic transition moment $R_e(r)$ with internuclear separation r as $R_e(r) = \text{const.}\ (1 - 1.1807r + 0.35047r^2)$; $1.44(A) < r < 1.76(A)$. A 'smoothed' array of relative vibrational transition probabilities $p_{v'v''} = R_e^2 \bar{r}_{v'v''} \lambda_{v'v''}$ and band oscillator strengths $f_{v'v''}$ have thereby been determined for all bands of the system between 2450 and 5000A. (Contractor's abstract)

3122

Western Ontario U. Dept. of Physics, London (Canada).

THE SCATTERING OF LOW-ENERGY ORTHO-POSITRONIUM BY HYDROGEN ATOMS, by P. A. Fraser. [1960] [23]p. incl. diagrs. tables. (AFOSR-J518) [AF 49(638)640] AD 414432 Unclassified

Also published in Proc. Phys. Soc. (London), v. 78: 329-347, Sept. 1, 1961.

When ortho-positronium collides with a hydrogen atom not only may it be scattered, but there is also the possibility of conversion of the ortho-positronium to para-positronium by electron exchange. The total elastic cross section and the conversion cross section have been calculated for positronium kinetic energies 0 to 9.8 ev, for the $l = 0$ partial wave only. A particular choice of trial wave function explicitly satisfying the Pauli principle and a variational argument lead to integro-differential equations, with no 'ordinary force', from which the phase shifts have been obtained by a numerical method. The cross sections are very strongly energy dependent: the total cross section ranges from $192\pi_0^2$ at zero energy to $2.92\pi a_0^2$ at 6.8 ev, while the (conversion)/(total) ratio ranges from 0.176

to 0.070 over these energies. These ratios are well below the value 1/4 expected at high energies from the Born approximation. The total cross section results of Massey and Mohr for this problem using Born approximation were $230\pi a_0^2$ at zero energy and $25\pi a_0^2$ at 6.8 ev, with the (conversion)/(total) ratio 1/4. (Contractor's abstract)

3123

Western Ontario U. Dept. of Physics, London (Canada).

TRANSITION PROBABILITIES OF MOLECULAR BAND SYSTEMS. XX: TABULATED KLEIN-DUNHAM POTENTIAL ENERGY FUNCTIONS FOR TEN STATES OF $C_2(4)$, $O_2(2)$, OH(2) AND SiO(2), by W. R. Jarmain. July 1, 1961 [18]p. incl. tables, refs. (Scientific rept. no. 1) (AFOSR-1124) (Sponsored jointly by Air Force Cambridge Research Center under AF 19(604)4560, Air Force Office of Scientific Research under AF AFOSR-61-88, and Office of Naval Research under Nonr-289500) AD 262593 Unclassified

Sets of classical turning points, together with the corresponding vibrational energies, are given at an interval of one half a unit of quantum number for the following states: C_2, $X^3\pi_u$, $A^3\pi_g$, $B^3\pi_g$, $c^1\pi_g$; O_2, $X^3\Sigma_g^-$, $B^3\Sigma_u^-$; OH, $X^2\pi_i$, $A^2\Sigma^+$; SiO, $X^1\Sigma^+$, $A^1\pi$. These numbers, representing points on potential curves, were derived from Klein's formulae by analytical differentiation, and numerical integration with a necessary analytic approximation over a small part of the range. (Contractor's abstract)

3124

Western Ontario U. Dept. of Physics, London (Canada).

THE EFFECT OF VIRTUAL EXCITATION OF THE 2s STATE ON THE ELASTIC SCATTERING OF ELECTRONS BY ATOMIC HYDROGEN, by K. Smith, R. P. McEachran and P. A. Fraser. [1961] [25]p. incl. diagrs. tables, refs. (AFOSR-1403) (Sponsored jointly by Air Force Cambridge Research Center, Air Force Office of Scientific Research under [AF AFOSR-61-88] Atomic Energy Commission, Defence Research Board of Canada, Department of Defence Production of Canada, National Research Council of Canada, Office of Naval Research and Ontario Research Foundation) Unclassified

Also published in Phys. Rev., v. 125: 553-556, Jan. 15, 1962.

The elastic scattering of electrons by hydrogen atoms, for electron energies below the first threshold of excitation of the atom (10.2 ev), is investigated numerically making full allowance for exchange and for the virtual excitation of the 2s state. Singlet and triplet phases for the s, p, and d partial waves have been obtained. While the calculation is essentially preliminary to a more extensive eigenfunction expansion calculation for this problem, which would allow for non-spherical distortion of the atom, the results do show that significant changes from the first exchange approximation may be expected as more states are included in the expansion. In particular, just below the n = 2 excitation threshold the singlet s phase and the triplet p phases begin to increase sharply, and what may be a Wigner cusp shows in the total cross section. Predicted angular distributions are compared with the recent measurements of Gilbody, Stebbings, and Fite. The phase shifts are compared with those of the exchange approximation, and also with those of Geltman, who performed a variational calculation allowing for the virtual excitation of the 2s and 3s states. (Contractor's abstract)

3125

Western Ontario U. Dept. of Physics, London (Canada).

TRANSITION PROBABILITIES OF MOLECULAR BAND SYSTEMS. XXI. NUMERICAL SOLUTION OF THE SCHRÖDINGER WAVE EQUATION, by W. R. Jarmain. Nov. 15, 1961 [11]p. incl. tables, refs. (Scientific rept. no. 2) (AFOSR-1903) (Sponsored jointly by Air Force Cambridge Research Center under AF 19(604)-4560, Air Force Office of Scientific Research under AF AFOSR-61-88, and Office of Naval Research under Nonr-289500; Department of Defence Production of Canada) AD 276405 Unclassified

Tests are made of the Runge-Kutta and (especially) Numerov methods of solving the reduced Schrödinger wave equation for a tabulated Morse potential. This is preliminary to numerical solution of the equation for a Klein-Dunham potential. Normalized wave functions for N_2, $\beta^3\pi$ of order 0 and 5, given at an interval of 0.01Å in internuclear separation, agree closely with those obtained analytically. A criterion for goodness of wave functions generated numerically, depending on observed rotational constants, is described. (Contractor's abstract)

3126

Western Ontario U. Dept. of Physics, London (Canada).

FRANCK-CONDON FACTORS AND r-CENTROIDS TO HIGH QUANTUM NUMBERS FOR BANDS OF THE $^2\pi_g$-$A^2\pi_u$ SYSTEM OF N_2^+, by R. W. Nicholls. [1961] [5]p. incl. tables, refs. (AFOSR-J111) (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-61-88], National Research Council of Canada, and Ontario Research Foundation; and Air Force Cambridge Research Center, Department of Defence Production of Canada, and Office of Naval Research) AD 400183 Unclassified

Also published in Canad. Jour. Phys., v. 40: 523-527, Apr. 1962.

Experimental data from several sources is used to extend previous calculations (see item no. 2959, Vol. IV), using a Morse model. Franck-Condon factors, r-centroids, wavelengths and eye estimate intensities are tabulated and discussed.

3127

Western Ontario U. Dept. of Physics, London (Canda).

EMISSION SPECTRA FROM SOLIDS CONDENSED AT VERY LOW TEMPERATURES FROM THE ELECTRICAL DISCHARGE PRODUCTS OF NITROGEN-CARBON MONOXIDE AND NITROGEN ACETYLENE MIXTURES, by S. L. N. G. Krishnamachari, R. W. Nicholls, and H. P. Broida. [1961] [9]p. incl. illus. diagrs. tables. [AF AFOSR-61-88] Unclassified

Published in Proc. Indian Acad. Sci., v. 54A: 61-68, Aug. 1961.

Two unidentified series of emission bands (sharp and diffuse) between 4900 and 4900A were observed at 4.2° and 20.4°K. These bands were emitted from the condensed products of microwave discharges in carbon monoxide and nitrogen-acetylene mixtures. The sharp series are characterized by a frequency difference of 2280 cm^{-1} and the diffuse series by a frequency of 670 cm^{-1}. Isotopic substitution shows at least one carbon atom is present in the emitting species. (Contractor's abstract)

3128

Western Reserve U. [Dept. of Physics] Cleveland, Ohio.

PAIRING PLUS LONG RANGE FORCE FOR SINGLE CLOSED SHELL NUCLEI, by L. S. Kisslinger. [1960] [82]p. (AF 18(603)61) Unclassified

Published in Kgl. Danske Selskab, Mat.-Fys. Skrifter, v. 32: 1960.

The low energy properties of nuclei are calculated, using a model which combines certain important features of the unified nuclear model and the independent-particle model with a 2-body residual interaction. The residual interaction used has 2 parts, a pairing force and a long-range part. Calculations are made for nuclei with major closed proton or neutron shell, A > 48, for various values of the 2 strength parameters, using single-particle levels taken from experimental results. In each region, the calculated energy levels and spins agree in considerable detail with systematic experimental data. In addition, the even-odd A mass difference, the electromagnetic transition rates, and other properties are calculated and compared with experiments. The approximate 1/A dependence of the parameters is consistent with a volume force.

3129

Western Reserve U. Dept. of Physics, Cleveland, Ohio.

A STUDY OF THE GAMMA-RAY SPECTRUM OF Sn^{113}, by R. E. McGaughy. [1961] 82p. incl. diagrs. tables, refs. (AFOSR-96) (AF 18(603)61) Unclassified

The gamma-ray spectrum of 112-day Sn^{113} was measured with a NaI(Tl) crystal scintillation spectrometer using a 60-channel pulse height analyzer. The intensity of the 225-kev gamma-ray relative to the strong 393-kev transition was found with a 4-pi summing spectrometer to be (3.45 ± 0.43)%, after correcting for absorption in the aluminum covering of the crystal, total detection efficiency, and our measured peak-to-peak ratios. Using this quantity along with other information the value of the K conversion coefficient for the 255-kev transition was found to be (3.02 ± 0.45) x 10^{-2} and the branching ratio to be (2.36 ± 0.3)%. Next, a measurement of the gamma-ray spectrum of Sn^{113} in coincidence with In x-rays was made, and the intensity of the 255-kev coincidence peak was compared with the 393-kev non-coincidence peak. From this ratio the probability that the electron capture transition to the 648-kev state of In^{113} is a K capture was calculated. After correcting for capture from higher shells than the L shell and neglecting the internal bremsstrahlung intensity, the ratio of L to K is found to be 2.41 + 0.77 or -0.64. This indicates that the energy of the electron capture transition is 35.6 + 1.8 or -1.2. Therefore the log ft value for this transition is found to be 5.26 + 0.21 or -0.07, whereas the log ft value for the electron capture transition to the 393-kev state in In^{113} is 6.31. It is concluded from the systematics of odd-A tin nuclei that the ground state of Sn^{113} is a $1/2^+$ state. Since the conversion coefficient for the 255-kev gamma-ray transition to the 393-kev state, which is known to be $1/2^-$, clearly indicates M1 transition (involving no change in parity), it follows that the 648-kev state must be odd, with a spin of 1/2 or possibly 3/2. It is concluded that both electron capture transitions are first forbidden even though a value of log ft = 5.26 is rather low for first forbidden transitions in general. The total energy of the decay $Sn^{113} + e^- \rightarrow In^{113} + \nu$ is found to be 648-kev. (Contractor's abstract)

3130

Western Reserve U. Dept. of Physics, Cleveland, Ohio.

MAGNETIC DIPOLE MOMENTS OF ODD-A NUCLEI IN THE SPHERICAL REGION, by N. Freed and L. S. Kisslinger. [1961] [22]p. incl. diagrs. refs. (AFOSR-173) (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(603)61] and National Science Foundation) AD 255930 Unclassified

Also published in Nuclear Phys., v. 25: 611-623, June 1961.

The magnetic dipole moment of odd-A nuclei are calculated and compared to the experimental data for nuclei with particles in the 28-126 shells, except for the deformed region where 150 ≤ A ≤ 190. The wave functions upon which the calculation is based are admixtures of seniority one wave functions produced by a pairing interaction and obtained by projecting eigenfunctions of the number operator out of Bardeen-type wave functions. Perturbation theory is used to compute the seniority-three admixtures produced by a delta-function residual interaction. (Contractor's abstract)

3131

3131

Western Reserve U. [Dept. of Physics] Cleveland, Ohio.

A PULSE RESOLVER USING TUNNEL DIODES, by J. D. McGervey. [1961] [2]p. incl. diagrs. (AFOSR-1029) (AF 49(638)760) Unclassified

Also published in Nuclear Instr. and Methods, v. 14: 351-352, 1961.

The new design of resolver has a three count tunnel diode memory which enables closely spaced counts to be stored. With slow counting rates a mechanical register rather than a fast scaler can be used.

3132

Western Reserve U. [School of Library Science] Cleveland, Ohio.

INTERMEDIATE LANGUAGES IN RETRIEVAL AND TRANSLATION SYSTEMS, by J. W. Perry. [1959] [14]p. incl. refs. (AF 49(638)357) Unclassified

Presented at Internat'l. Conf. for Standards on a Common Language for Machine Searching and Translation, Cleveland, Ohio, Sept. 6-12, 1959.

Published in Advances in Doc. and Library Sci., v. 3(Pt. 2): 1145-1158, 1961.

The development of intermediate languages, which is perhaps the single most important phase in developing practical systems for retrieval or translation employing automatic equipment, must take into account a variety of factors, some practical in nature, others of an intellectual or philosophical character. The practical factors indicate that a family of compatible languages rather than a single all-purpose language is the realistic goal. It seems likely that, in the future, this family of languages will include members based on Boolean algebra and others based on other non-Boolean algebras and related logics. In formulating such languages it is necessary to take into account not only the inherent impossibility of achieving complete precision in assigning meaning to the operations to be performed by machines as well as in attaining complete uniformity and reliability in the performance – particularly the human performance of the various operations involved in information retrieval and in translation.

3133

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. [1961] [92]p. incl. diagrs. tables, refs. (AFOSR-1210) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)357 and National Science Foundation) AD 263126 Unclassified

A study was made of the semantic factors used in the Western Reserve U. system, to determine the incidence of new terms in the semantic code dictionary, the type of semantic factor most frequently appearing in encoded abstracts, and the type of factor most frequently appearing in encoded questions. There is a low incidence of new terms, less than 1% over a 2 yr period, decreasing to less than one half of 1%, at the end of that period, of the total terms encoded. There is a close correlation between the factors most often used in the abstracts and those most used in the questions. Tables showing the results of analyses are provided.

3134

Western Reserve U. [School of Library Science] Cleveland, Ohio.

MATHEMATICAL MODELS IN SYSTEMS DESIGN FOR INFORMATION RETRIEVAL (Abstract), by J. Verhoeff, W. Goffman and J. Belzer. May 16, 1961 [2]p. (AFOSR-1645) (AF 49(638)357) Unclassified

After discussing the nature of mathematical models in general, 4 probabilistic models are constructed relating to 4 different situations in information retrieval. In the first case (linear), the evaluation function is given in terms of a merit for giving "relevant" documents and a penalty for giving "irrelevant" ones. It is shown when a document should go into an answer in terms of the merits and penalties. Case 2 considers the situation in which a customer probes the answer to a given question and stops when he finds a document which satisfies his need. The evaluation function is given in terms of a merit times the chance of success and a penalty times the average number of probings. If the answer was required to contain documents, the best answer consists of the documents with the highest probabilities. It was proved that this function can be maximalized, for if adding a document makes the answer worse, it will continue to get worse no matter how many documents are added. Situation 3 considers the case of partial success since it is assumed here that it requires more than 1 document to satisfy the need. The evaluation function differs from that of case 2 since the customer must now probe the entire answer. Merit is given in terms of the degree of success. The fourth case takes up the situation in which the customer wants to have an exhaustive reference list or none at all. This is shown to be unrealistic since trying to maximalize the evaluation function leads to nonsensical results. A mixed strategy is discussed in order to evaluate a situation in which the customers fall into the different cases. It is finally proved that in the linear case for complex questions the Boolean relations do not hold, although the order is preserved. (Contractor's abstract, modified)

3135

Western Reserve U. [School of Library Science] Cleveland, Ohio.

META-LANGUAGE IN LITERATURE SEARCHING SYSTEMS, by J. Verhoeff, W. Goffman, and J. Belzer. Feb. 29, 1961 [1]p. (AFOSR-1774) (AF 49(638)357) Unclassified

This note attempts to point out the usefulness of meta-language in literature searching systems. Some basic requirements of an information retrieval system designed for a large number of users are first discussed. Great pains are taken to give a proper understanding of the subtleties of meta-language in general.

3136

Western Reserve U. [School of Library Science] Cleveland, Ohio.

INEFFICIENCY OF THE USE OF BOOLEAN FUNCTIONS FOR INFORMATION RETRIEVAL SYSTEMS, by J. Berhoeff, W. Goffman, and J. Belzer. [1961] [3]p. (AFOSR-1775) (AF 49(638)357) AD 612853 Unclassified

Also published in Commun. Assoc. Computing Mach., v. 4: 557-559, Dec. 1961.

This paper points out why Boolean functions are in general not applicable in information retrieval systems. The following theorem is proved. The optimal answer satisfies the following inequalities. $A(a \wedge b) \subseteq A(a) \cap A(b)$ and $A(a) \cup A(b) \subseteq A(a \vee b)$. This means that if the system responds to a conjunction by giving the intersection it is giving too much irrelevant material and if it responds to a disjunction by giving the union it risks leaving out relevant material.

3137

Western Reserve U. School of Medicine, Cleveland, Ohio.

ISOLATED BRAIN AND ACTH RELEASE IN CATS (Abstract), by E. S. Redgate, S. Yoshida and M. de la Lastro. [1961] [1]p. (AFOSR-1648) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)443 and National Institutes of Health) Unclassified

Also published in Physiologist, v. 4: 92, Aug. 1961.

The concept that rapid release of ACTH is under control of neural structures located in the hypothalamus has been tested by several investigators in experiments involving lesions and stimulations in preparations with intact central nervous systems. One of the problems involved in the interpretation of the results of these experiments is that direct effects of the lesion or stimulation be distinguished from indirect effects. To overcome this difficulty experiments have been carried out in cats 90 min after C_1 cord section, carotid sinus denervation and high cervical vagosympathetic nerve section. Adenohypophyseal ACTH release has been estimated by collecting jugular vein blood samples from which ACTH is extracted by resin chromatography and assayed in hypophysectomized rats by the adrenal ascorbic acid depletion method. This method of ACTH assay in a standardized preparation (the hypophysectomized rat) avoided the problem of alteration in sensitivity of the adrenal of the assay animal during the course of an experiment involving extensive surgery. Blood pressure was recorded and remained constant during the experimental procedures by injecting defibrinated donor cat blood. EEG activity and cortical evoked potentials were monitored. Results indicate: (1) that ACTH output in the partially isolated brain in absence of inhibitory input from baroceptors is not maximal, (2) stimulation through an electrode near the central tegmental tract in the midbrain reticular formation elicits an elevation of jugular vein blood ACTH levels, (3) stimulation under the same conditions in the pes pedunculus does not elicit elevation in jugular vein blood ACTH.

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Western Reserve U. School of Medicine, Cleveland, Ohio.

SPINAL CORD AND ACTH RELEASE IN ADRENALECTOMIZED RATS (Abstract), by E. S. Redgate. [1961] [1]p. (AFOSR-1649) (AF 49(638)443) Unclassified

Presented at Forty-fifth annual meeting Fed of Amer. Soc. for Experimental Biol., Atlantic City, N. J., Apr. 10-14, 1961.

Published in Fed. Proc., v. 20: 185, Mar. 1961.

The role of spinal cord pathways in regulation of ACTH release has been investigated in 2 wk adrenalectomized rats. Rats with intact cords were compared with 3, 19, 48 hr and 21 day cord-sectioned rats and were subjected to either forepaw or hindpaw electrical stimulation or no experimental treatment. ACTH content of aortic blood samples of donor rats was assayed in hypophysectomized recipient rats by adrenal ascorbic acid depletion (AAAD) method. The aortic blood samples were obtained immediately after stimulation and decapitation with a large forceps. Blood samples from intact rats with no experimental treatment induced 14 ± 12(9) mg AAAD per 100 gm adrenal; forepaw stimulated rats, 115 ± 13(8); hindpaw stimulated rats, 106 ± 15(9). In contrast, blood samples from 3 hr cord-sectioned rats with no experimental treatment induced 40 ± 8(14) AAAD; forepaw stimulated, 94 ± 10(9); hindpaw stimulated, 39 ± 6(17). The absence of ACTH release after hindpaw stimulation indicates the neural paths in the cord are essential for rapid ACTH release. Blood ACTH levels did not respond to forepaw stimulation in the 19 and 48 hr cord-sectioned rats. This depression in ACTH release is partially relieved at 21 days.

3139

Western Reserve U. School of Medicine, Cleveland, Ohio.

FAILURE OF ANGIOTENSIN TO DEPLETE ADRENAL ASCORBIC ACID (Abstract), by D. S. Gann and E. S. Redgate. [1961] [1]p. (AFOSR-1650) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)443, Cleveland Area Heart Society, and National Institutes of Health) Unclassified

Also published in Physiologist, v. 4: 39, Aug. 1961.

It has been shown recently that angiotensin II stimulates secretion of hydrocortisone, corticosterone and

aldosterone in hypophysectomized nephrectomized dog. Since ACTH has similar effects, the present study was undertaken to see if angiotensin induces adrenal ascorbic acid depletion in hypophysectomized rats, a standard assay for ACTH. Both aspartyl (Bumpus, Cleveland) and asparaginyl (CIBA) angiotensin II were assayed. Neither form of angiotensin induced significant ascorbic acid depletion with doses ranging from 0.1 to 40 μg per rat. This is in marked contrast to the effect seen with ACTH. The angiotensin preparations used were assayed for pressor response in dogs and rats and corticosteroid response in dogs, and were effective in all cases. Maximum doses of angiotensin (10 μg) and ACTH (1 unit) produced comparable rates of corticosteroid secretion in nephrectomized dogs. The results suggest that angiotensin and ACTH may act at different sites to stimulate corticosteroid biosynthesis. The adrenal ascorbic acid depletion test affords a useful means of distinguishing the 2 substances in crude mixtures such as plasma.

3140

Western Reserve U. School of Medicine, Cleveland, Ohio.

ISOLATION OF VASOPRESSIN-CONTAINING GRANULES FROM THE NEUROHYPOPHYSIS OF THE DOG, by H. Weinstein, S. Malamed, and H. Sachs. [1961] [4]p. incl. illus. table, refs. (AFOSR-J283) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)764 and National Institutes of Health) AD 400878 Unclassified

Also published in Biochim. et Biophys. Acta, v. 50: 386-389, June 24, 1961.

Electron micrographs of the mammalian neurohypophysis have indicated that the nerve fibers contain membrane-bound vesicles that range from 0.1 - 0.2μ in diam. These structures have been interpreted as neurosecretory granules which may contain oxytocin and vasopressin. Attempts were made to isolate these granules from sucrose homogenates of rat or rabbit neurohypophysis by means of differential centrifugation at forces ranging from 3000 gravity to 30,000 gravity. Although particulate preparations, containing vasopressin and oxytocin were obtained, no evidence was presented concerning the chemical, biochemical, or morphological characteristics of these particles. In this communication the results of research report on the isolation and characterization of a particulate fraction which is rich in vasopressin, morphologically identical with the neurosecretory granules, and apparently free of other known cellular organelles are presented. These particles were isolated by means of differential and density-gradient centrifugation procedures. The various stages of purification were followed by electron microscopy and simultaneous assays for vasopressin, protein, cytochrome oxidase, nucleic acids, and β-glucuronidase. (Contractor's abstract)

3141

Western Reserve U. School of Medicine, Cleveland, Ohio.

INACTIVATION OF ARGININE VASOPRESSIN BY RAT-KIDNEY SLICES, by M. W. Smith and H. Sachs. [1960] [7]p. incl. diagrs. table, refs. (AFOSR-J284) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)764, Foundation for the Study of Diabetes and Related Metabolic Disorders, and National Institutes of Health) AD 400876 Unclassified

Also published in Biochem. Jour., v. 79: 663-669, June 1961.

Highly purified arginine vasopressin, in the presence of rat-kidney slices, was shown to disappear at a rapid rate from the incubation medium. The disappearance of vasopressin from the incubation medium was not due to the presence of degradative enzymes in the medium which were liberated from either broken or intact cells. The apparent first-order rate constant was consistently reproducible with slices taken from different animals on successive days and was shown to be proportional to the weight of kidney tissue. Below pH 6.0, little or no loss of vasopressin occurred, whereas the optimum rate of disappearance of hormone was observed over the pH range 7-10. The vasopressin which disappeared from the incubation medium could not be recovered from the kidney slice and had apparently undergone inactivation. This was confirmed by the use of [^{35}S] vasopressin prepared biosynthetically.

3142

Western Reserve U. School of Medicine, Cleveland, Ohio.

ISOLATION AND CHARACTERIZATION OF VASOPRESSIN CONTAINING PARTICLES (Abstract), by H. Weinstein, S. Malamed and H. Sachs. [1961] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)764 and Public Health Service) Unclassified

Presented at Forty-fifth annual meeting Fed. of Amer. Soc. for Experimental Biol., Atlantic City, N. J., Apr. 10-14, 1961.

Published in Fed. Proc., v. 20: 195, Mar. 1961.

Differential centrifugation of dog hypothalamic or neurohypophysial homogenates in 0.4 or 0.8 M sucrose yields a particulate fraction containing relatively little RNA but rich in both pressor activity and cytochrome oxidase. Separation of the cytochrome oxidase from the pressor activity in this particulate fraction was achieved by means of density gradient centrifugation methods. The maximum concentration of vasopressin was always associated with the more dense material. Similar findings were obtained with either hypothalamic or neurohypophysial homogenates. Vasopressin containing particles isolated by isopycnic density gradient centrifugation have been studied with respect to their morphologic, chemical and enzymic properties. Data dealing with the manner in which vasopressin is contained within and released from these particles will be presented.

3143

Western Reserve U. School of Medicine, Cleveland, Ohio.

VASOPRESSIN BIOSYNTHESIS II. IN VIVO STUDIES (Abstract), by H. Sachs, H. Weinstein, and E. S. Redgate. [1961] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)764 and Public Health Service) Unclassified

Presented at Forty-fifth annual meeting Fed. of Amer. Soc. for Experimental Biol., Atlantic City, N. J., Apr. 10-14, 1961.

Published in Fed. Proc., v. 20: 195, Mar. 1961.

In order to study the path of vasopressin from biosynthesis, to storage, to release, it was necessary to first define the nature of vasopressin within the cell and secondly, to devise a test system and isotope methods amenable to such investigations. Physiological and morphological studies have indicated that intracellular vasopressin is largely contained within neurosecretory particles. By means of differential and density gradient centrifugation procedures, these neurosecretory particles (contained in homogenates of dog hypothalamic and neurohypophysial tissue) have been isolated, purified and characterized. The distribution of vasopressin among a number of other cell organelles was also studied. Subsequently, the specific activity of S^{35}-labelled vasopressin associated with the various cell fractions was determined after relatively short term incorporation experiments. Extensive labeling of the vasopressin fractions was achieved by the use of highly labelled, S^{35} cysteine (prepared biosynthetically) which was infused directly into the third ventricle of the dog. Each labelled vasopressin fraction was purified to constant specific activity by a variety of ion exchange and degradative procedures.

3144

Westinghouse Electric Corp. [Air Arm Div.] Baltimore, Md.

FUNCTION-THEORETIC ANALYSIS OF KEPLER'S EQUATION, by E. W. Paul. Aug. 16, 1961. 14p. incl. illus. (AFOSR-1123) (AF 49(638)1002) AD 263123 Unclassified

Kepler's equation M = E - e sin E is investigated from the function-theoretic standpoint. The complex representation leads to the conformal mapping of the complex E-plane onto the complex M-plane and shows the region of regularity of the function; that is, the region of validity. Single-valuedness of the mapping is shown by construction of a Riemann surface. (Contractor's abstract)

3145

Westinghouse Electric Corp. Air Arm Div., Baltimore, Md.

ORBITS WITH LOW TANGENTIAL THRUST, by G. Shapiro. Sept. 5, 1961, 17p. incl. diagrs. (Rept. no. C-95249-Y-2[illegible]) (AFOSR-147[illegible] (AF 49(638)100[illegible]) AD 265324 Unclassified

The method of Krylov-Bogoliuboff is used to analyze orbits with an additional low tangential thrust. It is shown that, initially, circular orbits remain circular to the first approximation while elliptical orbits become less elliptic (thrust in the direction of motion). A complete set of curves relating significant orbit parameters is also presented. (Contractor's abstract)

3146

Westinghouse Electric Corp. [Air Arm Div.] Baltimore, Md.

A SERIES EXPANSION OF THE TRUE ANOMALY, by E. W. Paul. Nov. 9, 1961, 12p. (AFOSR-1797) (AF 49(638)1002) AD 269726 Unclassified

A series expansion of the true anomaly as a Fourier series in the mean anomaly is derived. The coefficients are in a form different from Bessel's representation. However, it appears that for practical application there is no special advantage to either form. (Contractor's abstract)

3147

Westinghouse Electric Corp. [Air Arm Div.] Baltimore, Md.

ORBITS WITH FIXED LOW THRUST, by G. Shapiro. Nov. 30, 1961, 8p. (AFOSR-1823) (AF 49(638)1002) AD 269725 Unclassified

The method of Krylov-Bogoliuboff is used to analyze orbits with an additional low thrust in a fixed direction in the orbit plane. Algebraic formulas for orbital elements are obtained. It is shown that eventually the orbital eccentricity increases to 1 with the orbit approaching a straight line through the center of the earth. However, in a practical case, it is likely that collision would occur before escape. (Contractor's abstract)

3148

Westinghouse Electric Corp. [Air Arm Div.] Baltimore, Md.

SUMS OF SERIES INVOLVING BESSEL COEFFICIENTS, by E. W. Paul. Nov. 16, 1961 [10]p. (AFOSR-1872) (AF 49(638)1002) AD 270035 Unclassified

Also published in Duke Math. Jour., v. 30: 95-100, Mar. 1963.

Various mathematical sums with members containing Bessel coefficients are presented. The derivations are based on Kepler's equation of celestial mechanics and its inverse function. Several of the sums presented are of the Kapteyn type and could not be related to previously known formulas. (Contractor's abstract)

3149

Westinghouse Electric Corp. [Air Arm Div.] Baltimore, Md.

THE HODOGRAPH AND BALLISTIC MISSILE TRAJECTORY PROBLEMS, by E. W. Paul. [1961] [5]p. incl. diagrs. tables. [AF 49(638)1002] Unclassified

Published in Aero/Space Eng., v. 20: 24-25, 70-72, Feb. 1961.

A graph which permits a quick determination of the velocity, path angle, angle to apogee, altitude of a ballistic missile at any instant, and the range along the surface of the earth is presented. The values to calculate the time at any instant to or from the position at apogee may also be found in the graph.

3150

Westinghouse Electric Corp. Westinghouse Research Labs., Pittsburgh, Pa.

[FUNDAMENTAL RESEARCH ON THE STUDY OF MECHANISMS OF DENDRITIC CRYSTAL GROWTH IN THE ZINCBLENDE LATTICE], by R. L. Longini and A. I. Bennett. Final rept. June 7, 1961 [9]p. incl. diagr. table. (AFOSR-960) (AF 49(638)599) AD 262598 Unclassified

Research was concerned with crystal growth mechanisms through the study of dendritic growth in diamond-lattice semiconductors, specifically germanium, silicon, and indium antimonide. Dendrites of these materials grow, in a supercooled melt, as long, narrow ribbons having a central core of twin planes. The ribbon faces can be made to be nearly atomically flat. The process of elongation of the dendrite involves the twinned core structure as a necessary part of the growth. Thickening and widening appear to depend on other growth mechanisms which do not involve the twin planes. The presence of impurities at concentrations of the order of 10^{18} atoms/cc or more affect the growth habit in a fashion not yet quantitatively understood. (Contractor's abstract)

3151

Westinghouse Electric Corp. Westinghouse Research Labs., Pittsburgh, Pa.

PRINCIPLES OF SOLIDIFICATION, by W. A. Tiller. Nov. 14, 1961, 137p. incl. illus. diagrs. tables, refs. (AFOSR-2221) (AF 49(638)1029) AD 272048 Unclassified

The term "solidification" is commonly understood to imply the formation of a crystalline phase from a liquid or melt, although, to be general the nutrient phase could also be gaseous. In this article we are concerned only with the formation of a solid from a melt. Here, the phase transformation is driven by the extraction of heat from the melt and the progress of the transformation is properly separated into 2 parts: (1) the initial nucleation of crystals and (2) the growth of these initial nuclei by the accretion of atoms from the melt. The main concern of this article is with the growth of a crystal once it has been formed. Attention has been given to 3 important aspects of crystal growth from the melt: (1) solute manipulation during crystal growth, (2) solid-liquid interface morphologies and (3) defects introduced during crystal growth. (Contractor's abstract)

3152

Westinghouse Electric Corp. Westinghouse Research Labs., Pittsburgh, Pa.

DETERMINATION OF THE ATOMIC KINETICS OF THE FREEZING PROCESS. PART I. THEORY, by J. J. Kramer and W. A. Tiller. Dec. 29, 1961 [31]p. incl. diagrs. refs. (AFOSR-2354) (AF 49(638)1029) AD 276091 Unclassified

Also published in Jour. Chem. Phys., v. 37: 841-848, Aug. 1962.

A new method for determining the mechanisms and kinetics of atomic exchange across a liquid-solid interface during the freezing process is proposed and evaluated. The limitations of the method are entirely experimental making the method effective only at freezing velocities less than 5×10^{-3} cm/sec. (Contractor's abstract)

3153

Westinghouse Electric Corp. Westinghouse Research Labs., Pittsburgh, Pa.

SEEING DISLOCATIONS WITH X-RAY MICROGRAPHY, by J. M. Schultz and R. W. Armstrong. [1961] [4]p. incl. illus. (AFOSR-3813) [AF 49(638)1029] Unclassified

Also published in Direct Observation of Imperfections in Crystals; Proc. of a Technical Conf., St. Louis, Mo. (Mar. 1-2, 1961), New York, Interscience Publishers, 1961, p. 569-572.

This report describes some details of the procedure used and some of the observations of dislocations in zinc crystals. These results on zinc, in addition to the results on other materials, substantiate the view that, at least, some elements with intermediate or high atomic number can be favorable for detailed studies with the Berg-Barrett x-ray technique. The low penetration of x-rays in zinc permits good resolution of dislocations by allowing only a limited superposition of the many dislocations which occur in depth below the crystal surface.

3154

[Westinghouse Electric Corp.] Westinghouse Research Labs., Pittsburgh, Pa.

PREFERRED ORIENTATIONS DEVELOPED DURING

THE SOLIDIFICATION OF HIGH-PURITY LEAD, by G. F. Bolling, J. J. Kramer, and W. A. Tiller. [1961] [5]p. incl. illus. diagrs. (AFOSR-J602) (AF 49-(638)1029) AD 414007 Unclassified

Also published in Trans. Metall. Soc. AIME, v. 227: 47-51, Feb. 1963.

The solidification of polycrystalline zone-refined lead has been examined. A novel casting technique was used, with several advantages such as unidirectional heat flow, atmosphere control, and decanting of the liquid during any stage of growth. The experimental results show the separate existence of 2 textures, a {111} surface texture at the chill surface and a <111> texture in the columnar zone, in the absence of conditions which would produce dendritic growth. (Contractor's abstract)

3155

Wisconsin U., Madison.

SPECIAL REPORT ON DRUGS AND SENSORY-FEEDBACK ANALYSIS IN SPACE SCIENCE, by R. U. Smith. [1961] [40]p. incl. diagrs. refs. (AFOSR-4882) (AF AFOSR-61-56) AD 415117 Unclassified

The present project constitutes an initial program in the science of developmental psychopharmacology. This program has emphasized application of new methods of environmental research and computer-controlled methods of motion study as the foundation of systematic research on brain biochemistry, development, and aging. A primary program with specific experimental objectives has included studies in three main areas: (a) biochemical analysis of brain neurohormones in development; (b) drug depletion of brain neurohormones in development and aging, using reserpine to deplete the brain catecholamines; and (c) development of analytic sensory feedback systems in animals and in man for studies on drugs and development and aging. New techniques of computer-controlled delayed and displaced sensor-feedback analysis of motions in man have been developed under this project and work is being completed in constructing these systems for drug studies as well as for general investigations of motion in man.

3156

Wisconsin U. Dept. of Bacteriology, Madison.

STUDIES ON THE KINETICS OF PROTEIN SYNTHESIS IN YEAST, by R. J. Young, H. K. Kihara and H. O. Halvorson. [1961] [9]p. incl. diagrs. tables, refs. (AFOSR-1789) (AF 49(638)314) Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 47: 1415-1423, Sept. 1961.

Curves were made to show the kinetics of incorporation of $S^{35}O_4^=$ and totally labeled C^{14} amino acids into exponentially growing yeast. Distribution of S^{35} in yeast ribosomes, in % weight was 0.30 in structural ribosomes containing 96% protein, and 0.53 in solid ribosomes with 4% protein. The isotopes were incorporated into protein within a few seconds, first in the ribosomes as nascent protein. After 80 sec exposure of the yeast to C^{14} or S^{35}, the addition of unlabeled cysteine, methionine, and $SO_4^=$ caused a rapid decrease in C^{14} or S^{35} held by ribosomes. Results indicated that nascent protein, a small fraction of the ribosomes, has a turnover rate sufficient to account for the over-all rate of protein synthesis of the cell.

3157

Wisconsin U. Dept. of Bacteriology, Madison.

THE ROLE OF A LARGE PARTICLE FRACTION FROM YEAST IN PROTEIN SYNTHESIS, by J. G. Hauge and H. O. Halvorson. [1961] [7]p. incl. illus. diagr. tables, refs. (AFOSR-4230) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)314, National Institutes of Health, and National Science Foundation) Unclassified

Presented at 418th meeting of the Biochem. Soc., Cambridge (Gt. Brit.), July 12-13, 1962.

Also published in Biochim. et Biophys. Acta, v. 61: 101-107, Aug. 1962.

Also published in Biochem. Jour., v. 84: 108P-109P, Sept. 1962.

Yeast cells were observed to incorporate in vivo radioactive sulfate into the proteins of a lipo-protein particulate fraction at rates several times that of the ribosomal particles. Over half the newly incorporated sulfate was rapidly displaced by the addition of unlabelled sulfur amino acids. The lipo-protein fraction is rich in mitochondrial fragments and membranes with attached ribosomal particles. (Contractor's abstract)

3158

Wisconsin U. Dept. of Bacteriology, Madison.

THE EFFECT OF GLUCOSE REPRESSION ON THE LEVEL OF RIBOSOMAL-BOUND β-GLUCOSIDASE, by J. G. Hauge, A. M. MacQuillan and others. [1961] [3]p. incl. table. (AFOSR-4291) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)314, National Institutes of Health, and National Science Foundation) Unclassified

Also published in Biochem. and Biophys. Research Commun., v. 5: 267-269, July 26, 1961.

The effect of glucose inhibition on β-glucosidase synthesis was examined in the yeast diploid Saccharomyces dobzanskii grown in a synthetic-succinate or synthetic-glucose (2%) medium. Glucose reduced the level of solution of β-glucosidase concentration from 1480 to an average of 142 units/mg protein. The ribosomal level was increased from 0.009 to 0.019

β-glucosidase units/ml/E_{260}. Control of β-glucosidase formation, at glucose concentrations = 10^{-3} M, operates through blocking release of finished β-glucosidase from the ribosome.

3159

Wisconsin U. Dept. of Chemistry, Madison.

A STEREOCHEMICAL FACTOR IN CYCLOPROPYL CONJUGATION, by E. M. Kosower and M. Ito. [1961] [2]p. incl. diagrs. tables, refs. (AFOSR-64-1400) (AF 49(638)282) AD 444448 Unclassified

Also published in Proc. Chem. Soc. (London): 25-26, Jan. 1962.

Ultraviolet absorption data on spiro[4.2]heptan-1-one (I) and bicyclo-[3.1.0]hexane-2-one (II) indicated that interaction between a cyclopropyl ring and a C:O group is most effective when the plane of the ring and the p-orbitals of the C:O groups are parallel, as in I. Thus the $\pi \rightarrow \pi^*$ transition energy (E_T) for II was 5.1 kcal/mol > E_T for I in isooctane. Differences in E_T values for RCH:CHCO⁻ system in spiro [2.5]octa-1,4-dien-3-one, 1-dehydrocyclooctanone, and a related 5,9-cyclosteroid.

3160

Wisconsin U. Dept. of Chemistry, Madison.

ELECTRONIC ABSORPTION SPECTRA OF IODO- AND BROMOMETHANES, by M. Ito, P.-K. C. Huang, and E. M. Kosower. [1961] [12]p. incl. diagrs. tables, refs. (AF 49(638)282) Unclassified

Published in Trans. Faraday Soc., v. 57: 1662-1673, Oct. 1961.

A careful study has been made of the light absorption of the iodomethanes in the spectroscopic region between 1900-5000A. The compounds used, methyl iodide, methylene iodide, iodoform, and carbon tetraiodide, were all carefully purified and precautions were taken against photolytic decomposition prior to the spectroscopic measurements. It was possible to resolve the absorption curves for the last 3 iodomethanes into Gaussian components with the aid of an analog computer designed for this purpose. Using the resolved components as a guide to count the number of electronic transitions, a symmetry treatment yielded results in satisfactory qualitative agreement with experiment. Solvent effects were studied, the results being consistent with an assignment of all of the "low-intensity" bands to $n \rightarrow \sigma^*$ transitions, in agreement with the previous assignments for methyl iodide. The bromomethanes, methylene bromide, bromoform, and carbon tetrabromide were also examined in a series of solvents, with results that appeared to fit the expectations for the iodomethanes. (Contractor's abstract)

3161

Wisconsin U. Dept. of Chemistry, Madison.

THE PREPARATION AND CHARACTERIZATION OF THE CIS- AND TRANS-METHYLSILYLCYCLOHEXANES, by T. G. Selin and R. West. [1961] [4]p. incl. table, refs. (AFOSR-1577) (AF 49(638)285) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 84: 1858-1859, May 1962.

The pure cis and trans isomers of 1-methyl-2-silylcyclohexane, 1-methyl-3-silylcyclohexane and 1-methyl-4-silylcyclohexane have been prepared and characterized. Hydrogenation of the various tolyltriethoxysilanes over Raney nickel followed by lithium aluminum hydride reduction to the free silanes produced principally the cis isomers. The coupling of the 3- and 4-methylcyclohexyl Grignard reagents with silicon tetrachloride again followed by reduction to the silane yielded predominantly the diequatorial isomers. The methylsilylcyclohexanes were resolved and purified by means of preparative gas chromatography. Configurational assignments were made using the modified von Auwers-Skita rule, and were consistent with predictions based on the mode of synthesis. The Grignard reagents from 1- and 2-methylcyclohexyl halides did not couple with silicon tetrachloride but instead reacted to form olefins and Si-H containing products. 1-Methylcyclohexylmagnesium chloride also reacted abnormally with tetraethoxysilane. (Contractor's abstract)

3162

Wisconsin U. Dept. of Chemistry, Madison.

STEREOCHEMISTRY AND MECHANISM OF SILANE ADDITION TO OLEFINS. I. ADDITION OF TRICHLOROSILANE TO 1-METHYLCYCLOHEXANE UNDER FREE RADICAL AND THERMAL CONDITIONS, by T. G. Selin and R. West. [1961] [4]p. incl. diagrs. tables, refs. (AF 49(638)285) Unclassified

Published in Jour. Amer. Chem. Soc., v. 84: 1860-1863, May 1962.

The addition of trichlorosilane to 1-methylcyclohexane initiated with peroxides or ultraviolet light proceeds stereoselectively yielding principally cis-1-methyl-2-(trichlorosilyl)-cyclohexane. Thermal additions with and without free radical inhibitors were less selective and yielded some (cyclohexylmethyl)-trichlorosilane in addition to cis- and trans-1-methyl-2-(trichlorosilyl)-cyclohexane. Based on the observed stereochemistry, mechanisms are proposed for the various reactions. (Contractor's abstract)

3163

Wisconsin U. Dept. of Chemistry, Madison.

STEREOCHEMISTRY AND MECHANISM OF SILANE ADDITIONS TO OLEFINS. II. CHLOROPLATINIC

ACID-CATALYZED ADDITION OF TRICHLOROSILANE TO ALKYLCYCLOHEXENES, by T. G. Selin and R. West. [1961] [6]p. incl. diagrs. table, refs. (AF 49-(638)285) Unclassified

Published in Jour. Amer. Chem. Soc., v. 84: 1863-1868, May 1962.

The addition of trichlorosilane to a number of alkylcyclohexenes was examined using chloroplatinic acid as a catalyst. Terminal adducts were obtained exclusively with 4-methylcyclohexene, 1-methylcyclohexene and 1-ethylcyclohexene. The addition to 4-methylcyclohexene proceeded through rearrangement to 1-methylcyclohexene. Both 1-n-propylcyclohexene and 1-n-octylcyclohexene were unreactive under the same conditions. A product resulting from addition to the ring was obtained from 4,4-dimethylcyclohexene. The reaction of trichlorosilane and 1-methyl-d_3-cyclohexene yielded (cyclohexylmethyl-d_3)-trichlorosilane and trans-1-methyl-d_3-2-(trichlorosilyl)-cyclohexane indicating that the addition proceeded with complete retention of deuterium and stereospecific cis addition of trichlorosilane to the ring. Mechanisms are proposed to account for the above observations. (Contractor's abstract)

3164

Wisconsin U. [Dept. of Mathematics] Madison.

CERTAIN CONVEXITY CONDITIONS ON MATRICES WITH APPLICATIONS TO GAUSSIAN PROCESSES, by J. Chover. May 17, 1961, 15p. (AFOSR-768) (AF 49-(638)868) AD 261640 Unclassified

Also published in Duke Math. Jour., v. 29: 141-150, Mar. 1962.

Two theorems are presented concerning matrices which are positive definite and whose rows satisfy certain convexity conditions. The theorems are applied to get in-equalities for absorption probabilities for Gaussian processes. (Contractor's abstract)





3165

[Yale U. Dept. of Mathematics] New Haven, Conn.

[ON THE ANALYTICAL FUNCTIONS DEFINED BY THE HERMITE SERIES] Sur les fonctions analytiques définies par des séries d'Hermite, by E. Hille. [1961] [6]p. (AFOSR-3052) (AF 49(638)224) Unclassified

Also published in Jour. Math. Pures et Appl., v. 40: 337-342, Oct.-Dec. 1961.

Two theorems belonging to the same order of ideas as a previous work on Hermitian series (Trans. Amer. Math. Soc., v. 47: 80-94, 1940) are proved. Define $h_n(z) = (-1)^n \exp(\frac{1}{2}z^2)(d/dz)^n \exp(-z^2)$. $A_n = +\{h_n(0)^2 + (2n+1)^{-1}h_n'(0)^2\}^{\frac{1}{2}}$. Let G(t) be regular in the right half-plane, and suppose that there are positive constants A and B such that, for $|\theta| < \frac{1}{2}\pi$, $\lim_{r\to\infty} \sup r^{-\frac{1}{2}} \log|G(re^{i\theta})| \leq A(\tan|\theta|^{\frac{1}{2}} - B$. Then $\Sigma A_n^{-1} G(n) h_n(z)$ converges for $|y| < 2^{-\frac{1}{2}} B$ ($z = x + iy$) and represents an integral function. A similar theorem is proved for series $\Sigma t^n A_n^{-1} G(n) h_n(z)$, which in general are shown to represent functions having singularities in the finite part of the plane.

3166

[Yale U. Dept. of Mathematics] New Haven, Conn.

GREEN'S TRANSFORMS AND SINGULAR BOUNDARY VALUE PROBLEMS, by E. Hille. [1958] [19]p. incl. refs. (AFOSR-65-0346) (AF 49(638)224) Unclassified

Presented at Internat'l. Cong. of Mathematicians, Edinburgh (Gt. Brit.), Aug. 14-21, 1958.

Also published in Jour. Math. Pures et Appl., v. 42: 431-449, Oct.-Dec. 1961

H. Weyl's singular boundary problem, $u'' - [\lambda + q(x)] = 0$ ($0 \leq x < \infty$), $\cos\alpha\, u(0,\lambda) + \sin\alpha\, u'(0,\lambda) = 0$, $u(x,\lambda) \in L_2(0,\infty)$, is studied. Here $q(x)$ is assumed to be real and continuous. The Green's transform of the boundary problem is $[\overline{u(x,\lambda)}u'(x,\lambda)]_a^b - \int_a^b |u'(s,\lambda)|^2 ds - \int_a^b [\lambda - q(s)]|u(s,\lambda)|^2 ds = 0$. Taking the imaginary part, one obtains an expression which is basic in Weyl's methods. The author proposes to exploit the companion expression which is the real part of the Green's transform. Thus, new proofs are obtained of known facts about the boundary problem, especially when $q(x)$ is bounded below, e.g., some properties of the spectrum; and the behavior at ∞ of the solution u. The following result seems to be new: Let $m(\lambda, \alpha)$ be Weyl's limit point function and let $\lambda = i\nu$ be pure imaginary. Then when $\alpha \neq 0 \pmod{\pi}$, the expression $\nu^{\frac{1}{2}}[m(i\nu,\alpha) + \cot\alpha]$ is bounded away from zero and infinity as $\nu \to +\infty$. When $\alpha = 0$, the expression $\nu^{-\frac{1}{2}}|m(i\nu,\alpha)|$ is similary bounded.

3167

Yale U. [Dept. of Mathematics] New Haven, Conn.

A NOTE ON AUTOMORPHISMS OF LIE ALGEBRAS, by N. Jacobson. [1961] [13]p. (AFOSR-J629) (AF 49(638)-515) AD 415130 Unclassified

Also published in Pacific Jour. Math., v. 12: 303-315, 1962.

F. Gantmacher (Mat. Sbornik, v. 5: 101-146, 1939) made a thorough study of automorphisms of semi-simple Lie algebras over the field of complex numbers. Among other things, he defined the index $n(G_i)$ of a connected component G_i of the automorphism group $G = G(\mathfrak{L})$ as the minimum multiplicity of the characteristic root 1 for elements of G_i. The main purpose of this note is the determination of these indices. It is somewhat surprising that this does not appear in Gantmacher's paper since all the methods for deriving the formula for index G_i are available in his paper. The secondary purpose of this note is to extend Gantmacher's theory to the case of Lie algebras over algebraically closed base fields of characteristic O. This can be done by using algebraic group concepts and techniques which are by now well known. Nevertheless, it seems worthwhile to carry out the program in detail since Gantmacher's results give a real insight into the action of an automorphism in a semi-simple Lie algebra. For example, as we indicate, they can be used to give a new derivation and sharpening of theorems on fixed points which are due to Borel and Mostow. (Contractor's abstract)

3168

Yale U. [Dept. of Mathematics] New Haven, Conn.

DERIVED FUNCTORS IN ABELIAN CATEGORIES, by S. A. Amitsur. [1961] [24]p. (AF 49(638)515) Unclassified

Published in Jour. Math. and Mech., v. 10: 971-994, 1961.

Homological algebra as an abstract theory of functions from one (domain) category to a second (range) category is developed here by placing the burden of proof on the range category approach. This approach uses direct limits as a substitution to the projectives and injectives which are the corner stones for the theory of the derived functions. The idea of direct limits is not sufficient and a generalization of directed sets and direct limits (with their duals) which is introduced in the first section seems to be the right tool to develop abstract homological algebra from this point of view and thus avoid the use of projectives and injectives. The main idea is to consider for a given object A the class of all (right) complexes X augmented by A. If T is a (covariant) functor then the collection of all homology groups of the complexes T(X) forms a directed subcategory, the above mentioned generalization of directed set, and the limit of this class, if it exists, constitutes the value of the derived functor at A. The existence of these limits is obtained by modifying the definition of the generalized

limits, with the obvious advantage of preserving the duality procedure within the categories involved, but thus losing the fundamental property of the existence of the derived functors. The latter is replaced by the statement that the derived functors, when they exist, have the required properties. For applications it will remain to prove only the existence of these limits which could be obtained, e.g., by proving the existence of injectives (or projectives) in the domain category; or the existence of the limits in range-category. An example of the latter is provided.

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Yale U. [Dept. of Physics] New Haven, Conn.

THEORY OF PRESSURE SHIFTS OF HCl LINES CAUSED BY NOBLE GASES, by H. Margenau and E. C. Jacobson. [1961] 5p. (AFOSR-J462) (AF 18(603)15) AD 288587; AD 407896 Unclassified

Presented in part at Conf. on Molecular Line Shapes, Rehovoth (Israel), Aug. 1961.

Also published in Jour. Chem. Phys., v. 38: 1259-1260, Mar. 1, 1963.

Observed shifts cannot be explained solely in terms of long-range forces. Exchange forces may be included by choosing a Lennard-Jones potential $\Delta E_l = 4\epsilon_l\left[(\sigma_l/R)^{12} - (\sigma_l/R)^6\right]$ in which ϵ_l and σ_l are allowed to depend on J and on M. Qualitative arguments suggest the inequalities $\sigma(J, |M|) > \sigma(J, |M|+1)$, $\sigma(J, M) < \sigma(J+1, M)$ and similar inequalities for ϵ. Shifts of the R(0) and P(1) lines of HCl caused by argon are reproduced in detail with $\sigma \sim 3A$, $\epsilon \sim 156°K$. The combination rules for Lennard-Jones parameters, $\sigma = \frac{1}{2}(\sigma_1 + \sigma_2)$, $\epsilon = (\epsilon_1 \epsilon_2)^{\frac{1}{2}}$ do not reproduce the observed shifts.

3170

Yale U. [Dept. of Physics] New Haven, Conn.

[PROPERTIES OF HELIUM 3], by J. N. Kidder. Interim final rept. Dec. 21, 1961 [1]p. (AFOSR-1917) (AF 49(638)690) Unclassified

Progress made to date under this contract is reported. An apparatus has been built for measuring the density of solid He^3 in the temperature range of 0.35°K to 3.5°K and over the pressure range of 0 to 200 atmospheres. The thermodynamic properties of the solid that will be calculated from the detailed measurements of the density include the thermal expansion coefficient, the isothermal compressibility, the entropy, and the specific heat. Most of the experimental apparatus has been completed, but before data can be taken some construction details will have to be refined. It is expected that this will take about 1 to 2 months. The apparatus consists of (1) a He^3 and He^4 cryostat for obtaining the desired low temperatures, (2) a system for applying and measuring high pressures, including a secondary gauge system that will measure the pressure directly on the sample, (3) a glass system for holding and transferring the sample of He^3 gas, and (4) microwave electronics for measuring the resonant frequency of the sample cavity containing He^3

3171

Yale U. [Dept. of Physics] New Haven, Conn.

COMPARISON OF THE SCATTERING OF POSITRONS AND ELECTRONS FROM NUCLEAR CHARGE DISTRIBUTIONS, by G. H. Rawitscher and C. R. Fischer. [1961] [8]p. incl. diagrs. table. (AFOSR-175) [AF 49(638)752] Unclassified

Also published in Phys. Rev., v. 122: 1330-1337, May 15, 1961.

Elastic scattering cross sections of 183-mev positrons and electrons are calculated for various charge distributions of the Ca and Au nuclei. The combined use of positron and electron scattering measurements can lead to a determination of the nuclear charge distribution which is more accurate than that derived from either one of the scattering cross sections when used by itself. The scattered particles obey Dirac's equation and the nuclei are assumed to be static spherically symmetric charge distributions whose radial dependence is given in terms of a 3-parameter family of curves. (Contractor's abstract, modified)

3172

Yale U. [Dept. of Physics] New Haven, Conn.

SCATTERING OF μ MESONS FROM THE NUCLEI OF BROMINE AND SILVER, by G. H. Rawitscher. [1961] [4]p. incl. diagrs. tables, refs. (AFOSR-1315) (AF 49(638)752) AD 456603 Unclassified

Also published in Phys. Rev., v. 124: 1978-1981, Dec. 15, 1961.

The μ meson elastic scattering cross section and polarization asymmetry factor are calculated for bromine for positive and negative muons, and for silver for negative muons, for the values of $v/c = 0.4$, 0.6 and 0.7. These results, when combined with the ones available for cadmium, permit the comparison of theory with measurement of the scattering of muons in emulsions. The nuclei are taken to be extended, with a charge distribution as derived from electron scattering, the Dirac equation is assumed valid, and the calculation is done with the aid of an IBM 650 computer utilizing the same program as used previously for the calculations on cadmium and mercury. (Contractor's abstract)

3173

Yale U. [Dept. of Physics] New Haven, Conn.

REVISED CALCULATIONS ON THE PHOTODISINTEGRATION OF DEUTERON, by W. Zickendraht, D. J. Andrews and others. [1961] [3]p. incl. diagrs. tables. (AFOSR-1316) (AF 49(638)752) AD 456575 Unclassified

Also published in Phys. Rev., v. 124: 1538-1540, Dec. 1, 1961.

A numerical error which affected results in 2 of the approximations reported on previously (see item no. 3022, Vol. IV) is taken into account. Revised values of coefficients for formulae and graphs illustrating typical effects of the revision are supplied. The disagreement with experiment at the smaller proton angles and higher energies is accentuated while agreement with experiment at the lower energies and larger as well as smaller angles is, on the whole, improved and is practically unaffected at the lower energies and higher angles. (Contractor's abstract)

3174

[Yale U. Dept. of Physics, New Haven, Conn.]

[ELECTRON NUCLEAR INTERACTIONS AND RELATED ASPECTS OF NUCLEAR STRUCTURE], by G. Breit. Final rept. June 1-Dec. 1, 1961, 47p. incl. table, refs. (AFOSR-2349) (AF 49(638)752) AD 289484 Unclassified

This report contains abstracts of papers which have been published under the auspices of this contract. Several categories of work have been done. Included here is work done under the No Cost Extension which covered the period June 1, 1961 to Dec. 1, 1961. In some instances the publications deal with more or less isolated problems. In the few cases for which short notes have been published without abstracts the notes are reproduced in full. The categories under which the reports fall are: Coulomb Excitation; Hyperfine Structure and Isotope Shift; Proton-Proton and Proton-Neutron Scattering; Electron, Positron and Muon Nuclear Scattering; Photodisintegration of the Deuteron; Interaction of the Electronic System $1s2s\ ^3S_1$ of He I with the Nucleus; and Miscellaneous.

3175

Yale U. [Dept. of Physics] New Haven, Conn.

ATOMIC PROCESSES INVOLVING ANTIMUONIUM; POSSIBLE METHOD OF DETECTING ANTIMUONIUM (Abstract), by V. W. Hughes. [1961] [1]p. [AF 49-(638)752] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 301, Apr. 24, 1961.

Muonium can be produced by stopping positive muons in argon gas, and, if an interaction coupling M to $\overline{M}$ exists, a certain fraction of the decays will occur from the $\overline{M}$ component of the wavefunction. The presence of the argon Ar atoms inhibits the development of the $\overline{M}$ component of the wavefunction due to the different electrostatic interactions of M and $\overline{M}$ in elastic collisions with Ar. The μ^- from $\overline{M}$ can be captured by an Ar atom or the e^+ can annihilate with an electron in an Ar atom, and the rates of these processes in the high-pressure gas are much greater than the muon decay rate. The characteristic feature of $\overline{M}$ disappearance which is probably most easy to detect experimentally is the $2p \rightarrow 1s$ argon mu mesonic x-ray.

3176

Yale U. [Dept. of Physics] New Haven, Conn.

SCATTERING CROSS SECTIONS OF Mu MESONS BY THE EXTENDED NUCLEUS OF BROMINE (Abstract), by G. H. Rawitscher. [1961] [1]p. (AF 49(638)752)

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 301, Apr. 24, 1961.

Recent measurements of the scattering of μ^- mesons in nuclear emulsions were compared with calculations based on the assumption that μ^+ mesons are heavy positrons, and good agreement was found. Differential μ^+ and μ^- scattering cross sections, calculated for the comparison mentioned above, will be presented. The ratio v/c lies between 0.2 and 0.7. The dependence of the cross section σ on the atomic number Z and transfer momentum q will be compared for μ^+ and μ^- mesons. The plot of σ vs q is fairly insensitive to v/c for μ^+_N and not for μ^-. For the latter the plot of σ/σ_{point} vs q is useful in the comparison of different Z at the same v/c, enabling one to extrapolate to Z = 47 (silver) from values for Z = 80 and 48 available in the literature.

3177

Yale U. [Dept. of Physics] New Haven, Conn.

PHOTODISINTEGRATION OF POLARIZED AND ALIGNED DEUTERON, by W. Zickendraht, D. J. Andrews, and M. L. Rustgi. [1961] [4]p. incl. diagrs. table. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)752] and Atomic Energy Commission) Unclassified

Published in Phys. Rev. Ltrs., v. 7: 252-255, Sept. 15, 1961.

Information regarding dynamic and electromagnetic properties of the 2-nucleon system obtainable for the photodisintegration of the deuteron can be extended by employing aligned and polarized deuterons. In the present note a partial and preliminary survey of the possibilities is attempted by confining oneself to unpolarized

gamma rays and to differential cross sections without a consideration of the polarization of elected nucleons. It is hoped that the assumptions underlying the usual theories of the photodisintegration process can receive a more thorough test by comparison of theory and experiment even to the limited extent gone into here. The differential cross-section is calculated for ejected protons, on the basis of a modified Signell-Marshak potential, for six photon energies from 22 to 77 mev, and for different polarizations and alignments of the deuteron magnetic moment. Population numbers w_μ, of the magnetic substates μ, are used to define the polarization parameter $P_1 = w_1 - w_{-1}$ and the alignment parameter $P_2 = w_1 - 2w_0 + w_{-1}$. The differential cross-sections are expressed in terms of 19 coefficients of P_1, P_2 and the polar scattering angles. A table of the coefficients is presented together with specimen differential cross-sections at E_γ = 22.2 mev and 102 mev for deuterons aligned with and perpendicular to the incident photon direction.

3178

Yale U. [Dept. of Physics] New Haven, Conn.

THE GEOMETRY OF INTERSECTING LATTICES, by R. L. Moment and R. B. Gordon. [1961] 27p. incl. diagrs. tables. (AFOSR-1586) (AF 49(638)786) Unclassified

The geometry of the intersection of crystalline lattices is investigated. In particular the range of orientations giving unique configurations of points in the boundary plane are related to the symmetry elements of each lattice, and the conditions for which the boundary is a net are obtained. Equations are worked out for the calculation of the angles at which periodic boundary structures occur in [100], [110], and [111] tilts in simple cubic and face centered cubic lattices. Solutions of the equations are difficult in general, but results are given for the simple and face centered cubic [100] tilts showing those angles for which the boundaries of higher periodicity occur. These results are discussed with respect to their application to real crystals and in particular those of ionic structure. (Contractor's abstract)

3178A

Yale U. [Dept. of Physics] New Haven, Conn.

PHOTODISINTEGRATION OF POLARIZED AND ALIGNED DEUTERONS, by W. Zickendraht, D. J. Andrews, and M. L. Rustgi. [1961] [4]p. incl. diagrs. table. (AFOSR-1318) (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-61-23] and Atomic Energy Commission) AD 449990 Unclassified

Also published in Phys. Rev. Ltrs., v. 7: 252-255, Sept. 15, 1961.

The topic is examined theoretically to assess the additional information which might be obtained from experiment. This note is confined to unpolarized photons and does not consider the polarization of the ejected nucleons. The differential cross-section is calculated for ejected protons, on the basis of a modified Signell-Marshak potential, for 6 photon energies from 22-177 mev, and for different polarizations and alignments of the deuteron magnetic moment. Population numbers w_μ, of the magnetic substances μ, are used to define the polarization parameter $P_1 = w_1 - w_{-1}$ and the alignment parameter $P_2 = w_1 - 2w_0 + w_{-1}$. The differential cross-sections are expressed in terms of 19 coefficients of P_1, P_2 and the polar scattering angles. A table of the coefficients is presented together with specimen differential cross-sections at E_γ = 22.2 mev and 102 mev for deuterons aligned with and perpendicular to the incident photon direction.

3179

Yale U. Sloane Physics Lab., New Haven, Conn.

EXCITON STRUCTURE AND ZEEMAN EFFECTS IN CADMIUM SELENIDE, by J. O. Dimmock and R. G. Wheeler. June 12, 1961 [26]p. incl. diagrs. refs. (AFOSR-829) (AF 49(638)503) AD 258198 Unclassified

Also published in Jour. Appl. Phys. Suppl., v. 32: 2271-2277, Oct. 1961.

Also published in Semiconducting Compounds, Proc. of the Conf., Schenectady, N. Y. (June 14-16, 1961), New York, W.A. Benjamin, Inc., 1961, p. 2271-2277. (AFOSR-2010)

Observations were made of the exciton spectra in wurtzite cadmium selenide. The identification and subsequent interpretation was facilitated by measurements of the magneto-optical effects of the spectra. A qualitative understanding of the spectra is obtained from a review of the allowed band symmetries at K = 0, 0, 0 in crystals of C_{6V}^4 symmetry. The exciton symmetries and selection rules are obtained group theoretically. A quantitative comparison with an anistropic exciton mass theory, which will be outlined, permits evaluation of the electron and hole mass and g value parameters.

3180

Yale U. Sloane Physics Lab., New Haven, Conn.

PROPERTIES OF THE THIRTY-TWO POINT GROUPS, by J. O. Dimmock and R. G. Wheeler. May 27, 1961, 86p. incl. diagrs. tables, refs. (AFOSR-830) (AF 49-(638)503) AD 258039 Unclassified

The 32 single and double point group character tables are given along with the complete compatibility tables and representation multiplication tables. A scheme for the multiplication of barred and unbarred operators is presented in detail. Also the transformation properties and external field reductions are given for each group. The time reversal properties for the point group representations are indicated. (Contractor's abstract)

3181

Yale U. Sloane Physics Lab., New Haven, Conn.

IRREDUCIBLE REPRESENTATIONS OF MAGNETIC GROUPS, by J. O. Dimmock and R. G. Wheeler. [1961] 49p. incl. diagr. tables, refs. (AFOSR-1323) (AF 49-(638)503) AD 264177; AD 445664 Unclassified

Also published in Jour. Phys. and Chem. Solids, v. 23: 729-741, June 1962.

The general considerations of Wigner concerning the irreducible representations of groups containing both linear and anti-linear unitary operators are used to obtain a criterion by which the representations of such groups may be obtained. The results found by Herring for space groups is derived and the properties of the 58 magnetic point groups are determined. (Contractor's abstract)

3182

Yale U. [Sloane Physics Lab.] New Haven, Conn.

EXCITON STRUCTURE AND ZEEMAN EFFECTS IN CADMIUM SELENIDE, by R. G. Wheeler and J. O. Dimmock. [1961] [11]p. incl. diagrs. tables, refs. (AFOSR-3171) [AF 49(638)503] AD 405014 Unclassified

Also published in Phys. Rev., v. 125: 1805-1815, Mar. 15, 1962.

An interpretation of the observed exciton spectra of CdSe and determination of the effective mass parameters of the conduction and valence bands was made. Good quantitative agreement was obtained with few exceptions which can be attributed to toroidal energy surfaces. The significant difference between this spectra and that of CdS is that in CdSe the crystal field splitting is greater than the exciton binding energy, while in CdS it is not. Thus the evidence that transitions are observed in CdS forbidden by the group theoretical optical selection rules considering isolated bands, while in CdSe only allowed transitions are observed supports the assumption of less valence band mixing due to the exciton states in CdSe than in CdS.

3183

Yale U. [Sloane Physics Lab.] New Haven, Conn.

TIME DEPENDENT IONIC POLARIZATION OF NaCl CRYSTALS (Abstract), by P. H. Sutter and A. S. Nowick. [1961] [1]p. [AF 49(638)503] Unclassified

Presented at meeting of the Amer. Phys. Soc., Monterey, Calif., Mar. 20-23, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v 6: 131, Mar. 20, 1961.

It is widely believed that the time dependent polarization which occurs upon application of a dc field to alkali halide crystals is due to the blocking of ionic discharge at the electrodes, the quantitative theory for which was given by Jaffé. Jaffé's equations are nonlinear and predict severe deviation from Ohm's law and failure of the superposition principle for ordinary values of applied potential. The present work covers the range 25° to 200°C for pure NaCl crystals. The polarization is found to be structure sensitive, depending on annealing, cold working, and impurity content. It is consistently found, however, that Ohm's law and the superposition principle are obeyed. The temperature dependence of the polarization is studied and it is found that the polarization magnitude is approximately independent of temperature but that the process occurs more rapidly at higher temperatures in accord with an activation energy of about 1.1 ev. The following conclusions are drawn: (1) Polarization in this range is not related to electrode effects but originates in a time dependent volume polarization phenomenon. (2) The true ionic conductivity is that obtained from the final current, i.e., after the transient polarization process has ceased.

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Yale U. [Sloane Physics Lab.] New Haven, Conn.

EXCITON SPECTRA AND ZEEMAN EFFECTS IN CADMIUM SELENIDE (Abstract), by R. G. Wheeler and J. O. Dimmock. [1961] [1]p. [AF 49(638)503] Unclassified

Presented at meeting of the Amer. Phys. Soc., Monterey, Calif., Mar. 20-23, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 148, Mar. 20, 1961.

The exciton spectra of cadmium selenide has been observed and identified by optical reflection, absorption, and Zeeman effects at 1.8°K. The results of the reflection experiments indicate the presence of 2 nonoverlapping exciton series. From the observed optical selection rules relative to the crystal C axis, the conduction band is identified as having a Γ_7 symmetry. The 2 series correspond to the $\Gamma_9 - \Gamma_7$ valence band splitting of approximately 210 cm^{-1}. The absorption and magnetic effects have identified the n = 1; n = 2, p_z, p_{xy}; n = 3 states of the lowest energy series. By using the analysis of item no. 3185, Vol. V., the following band parameters have been obtained:
E_g = 14851 cm^{-1}; the exciton mass $m_{ex\perp}^* = 0.11m_e$, $m_{ex\parallel}^* = 0.14m_e$; the electron mass $m_e^* = 0.13m_e$; the hole mass $m_h^* \sim 0.5m_e$. The electron g values are anisotropic with $g_\parallel = |1.65|$ and $g_\perp = |0.45|$. It is also estimated that $g_\parallel$ must be negative implying a spin-orbit splitting of the valence band of the order of 5000 cm^{-1}. The effect of the finite photon momentum is observed in the Zeeman splitting of the n = 2p states upon 180° rotation of the magnetic field perpendicular to the crystal C axis.

3185

Yale U. [Sloane Physics Lab.] New Haven, Conn.

EXCITON STRUCTURE AND ZEEMAN EFFECTS IN UNIAXIAL CRYSTALS OF SMALL ANISOTROPY (Abstract), by J. O. Dimmock and R. G. Wheeler. [1961] [1]p. [AF 49(638)503] Unclassified

Presented at meeting of the Amer. Phys. Soc., Monterey, Calif., Mar. 20-23, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 148, Mar. 20, 1961.

The presence of an external magnetic field has been included in a Hamiltonian for the exciton system in the effective mass approximation obtained by Dresselhaus. This has been approximated to the case of uniaxial crystals of small anisotropy by the assumption that the effective mass tensor for both the electron and hole is diagonal, the transverse mass components are equal within each tensor, the remaining anisotropy is small, and the anisotropy in the dielectric constant is cylindrical and small. A brief calculation puts the resulting Hamiltonian in a form sufficiently close to that of the Hamiltonian for the hydrogen atom that first order perturbation techniques may be employed to obtain the zero field deviation of the spectrum from hydrogen-like in terms of the mass and dielectric anisotropies. If the components of the dielectric constant are presumed known, the magnetic field perturbations for H parallel and perpendicular to the crystal C axis depend only on the longitudinal and transverse electron and hole masses such that a comparison of this theory with experiment will yield values for the electron and hole mass tensors in the above approximation.

3186

Yale U. [Sloane Physics Lab.] New Haven, Conn.

THEORETICAL VALUES FOR MAGNETIC MOMENTS OF μ-MESONIC ATOMS, by K. W. Ford, V. W. Hughes, and J. G. Wills. [1961] [2]p. incl. table, refs. (AF-OSR-1542) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)545] and National Science Foundation) Unclassified

Also published in Phys. Rev. Ltrs., v. 7: 134-135, Aug. 15, 1961.

The corrections to the gyromagnetic ratio of the muon bound in a spin-zero nucleus and surrounded by a spin-zero electron cloud are calculated. Results are tabulated for C^{12}, O^{16}, Mg^{12}, Si^{14}, and S^{16}.

3187

Yale U. [Sloane Physics Lab.] New Haven, Conn.

RADIO-FREQUENCY ZEEMAN TRANSITIONS IN THE $2^3P_{2,1}$ STATES OF He^4 (Abstract), by B. B. Aubrey, L. Y. Chow and others. [1961] [1]p. [AF 49(638)545] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 248, Apr. 24, 1961.

The optical-rf atomic beam magnetic resonance method has been used to observe rf transitions between the Zeeman sublevels of the $2^3P_{2,1}$ states of helium in weak magnetic fields. A beam of helium atoms in the metastable 2^3S_1 state is formed. The C-field region is illuminated with resonance radiation for the $2^3S \leftrightarrow 2^3P$ transition so that atoms are excited to the 2^3P states in which they have a lifetime of about 10^{-7} sec. The excitation of the atoms to the ^3P states and their subsequent decay back to the $^3S_1$ state produces a "light flop". While the atoms are in the 2^3P state they are subjected to a radio-frequency magnetic field so that transitions are induced between the Zeeman sublevels of the 2^3P states and can be observed as changes in the light flop. At the weak magnetic fields of 10 to 30 gauss employed, the transitions between the $^3S_1$ Zeeman sublevels are not resolved, and the observed line shape is not a simple superposition of independent Zeeman transitions in the ^3P and $^3S_1$ levels, but indicates interference effects which must arise from the strong coupling by optical and radio-frequency fields between all the states.

3188

Yale U. Sterling Chemistry Lab., New Haven, Conn.

THE KINETICS OF THE THERMAL DECOMPOSITION OF METHYLENECYCLOBUTANE, by J. P. Chesick. [1961] [4]p. incl. diagrs. table, refs. (AFOSR-974) (AF 49(638)722) AD 611451 Unclassified

Also published in Jour. Phys. Chem., v. 65: 2170-2173, Dec. 1961.

Methylenecyclobutane undergoes a homogeneous thermal decomposition to allene and ethylene. This reaction has been studied in the gas phase by static methods from 430 to 470° over a pressure of 0.1 to 25 mm. The reaction is first order with a high pressure rate constant $k = 4.76 \times 10^{15} \exp(-63.3 \text{ kcal/RT}) \text{ sec}^{-1}$. At low pressures the rate decreases as predicted for unimolecular reactions in pressure regions where collisional activation starts to become rate controlling. Added nitrogen has the effect of increasing the rate in the low pressure region. (Contractor's abstract)

3189

Yale U. Sterling Chemistry Lab., New Haven, Conn.

THE KINETICS OF THE THERMAL DECOMPOSITION OF [2,2,1] BICYCLOHEPTADIENE, by J. H. Birely and

J. P. Chesick. [1961] [3]p. incl. tab'e. (AFOSR-1553) (AF 49(638)722) AD 611450 Unclassified

Also published in Jour. Phys. Chem., v. 66: 568-570, Mar. 1962.

An approximately equimolar mixture of acetylene and cyclopentadiene was prepared and heated at 360° for a time which would correspond to 50% decomposition of BCH (bicycloheptadiene), and at a total pressure of 1 cm. Sixteen runs at BCH pressures between 0.3 and 1.2 cm were made at 353° and were analyzed using the hexamethylphosphoramide column to check the cyclopentadiene-acetylene ratio. The cyclopentadiene-acetylene ratio was 0.93 with a rms deviation of 2.0%. A plot of -log (fraction BCH unreacted) vs time for a series of runs at 352.0° and another series at 356.7° gave straight lines with deviations of less than 2% from linearity except for 2 runs at 62 and 67% conversion which were off by 7% each. It was concluded that the disappearance of BCH is a first-order reaction. An absence of important polymerization reactions is found in the total chromatogram peak areas. Two runs were made at 329.8° with the reaction vessel packed with 4-mm diameter glass beads which increased the surface to volume ratio by a factor of 55. The apparent first-order rate constant for production of cyclopentadiene plus acetylene was unchanged, and the rate constant for formation of toluene + CHT was increased by 12%. It therefore seemed safe to conclude that the reaction observed in the unpacked vessel is homogeneous. It proved difficult to sort out trends in the toluene formation except that it increased relative to CHT with an increase in temperature. Four runs were made with added nitrogen. The chief result was the increase in CHT formation rate by 12%. Activation energies were calculated for the first-order formation of cyclopentadiene plus acetylene from BCH and cycloheptatriene formation from BCH.

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Yale U. Sterling Chemistry Lab., New Haven, Conn.

ULTRAVIOLET SPECTRUM OF DIBENZENE CHROMIUM VAPOR, by R. S. Berry. [1961] [4]p. incl. illus. table. (AFOSR-1068) [AF AFOSR-61-25] AD 429275 Unclassified

Also published in Jour. Chem. Phys., v. 35: 2025-2028, Dec. 1961.

The ultraviolet spectrum of dibenzene chromium vapor has been observed under medium resolution conditions. At least 3 separate band systems are found, at least 2 of which display progressions of the totally symmetric vibration frequencies. Possible assignments are considered and compared with alternative level structures. It is concluded that the $3de_{2u}$ level probably lies below the metal a_{1g} orbital, and that term splitting may play a considerable role in determining the order of the excited states. (Contractor's abstract)

3191

Yale U. Sterling Chemistry Lab., New Haven, Conn.

ABSORPTION SPECTRUM OF GASEOUS Cl^- AND ELECTRON AFFINITY OF CHLORINE, by R. S. Berry, C. W. Reimann, and G. N. Spokes. [1961] [2]p. (AFOSR-1413) [AF AFOSR-61-25] Unclassified

Also published in Jour. Chem. Phys., v. 35: 2237-2238, Dec. 1961.

Observations of ultraviolet absorption spectra of several alkali halide vapors heated by shock waves are reported. The shock tube is conventional. Salt samples (0.1 - 1.0 g) are introduced into the shock tube as dried deposits on strips of cellulose tissue or on thin perforated aluminum foil, which are placed across the shock tube about 90 cm upstream from the observation window. The most intense absorption has come with the strongest shocks. In all cases comparison spectra of the flash lamp have been taken. Spectra of shock-heated alkali vapors display the principal series of the alkalis; the rubidium series to 14p, and the cesium series to 16p have definitely been observed. In the case of both the chloride salts, 2 sharp decreases in plate density appear, at 3424 and 3225A. The intensity of the continuous absorption is significantly greater for CsCl than for RbCl. The conditions under which the absorption is found, its 2 sharp thresholds with their seemingly constant relative intensity, and the energy separation between the thresholds all lead to the assignment of the spectrum to the photodetachment process of the chloride ion. The lower threshold obtained with a Debye-Hückel correction of 0.7 ± 0.4 kcal/mol is 84.2 ± 0.4 kcal/mol.

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Yeshiva U. [Graduate School of Science] New York.

ELECTRON TRANSPORT IN A SEMICONDUCTOR, by H. L. Frisch and J. L. Lebowitz. [1961] [34]p. (AFOSR-434) (AF 49(638)753) AD 252636 Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 28, Feb. 1, 1961.

The linear transport properties of electrons in a solid are investigated when both phonon and impurity scattering are important. The problem is treated for the case where Maxwellian statistics apply and the electrons are described by a classical distribution function in position and velocity. f(r, v) satisfying a space dependent equation in which the phonon scattering only is described by a linear Boltzmann type collision term. This equation is solved formally in the presence of a weak external electric field in a form convenient for perturbation expansions in the relative strength of the different scattering mechanisms, some of which are carried out explicitly. When the kernel describing collision with phonons is randomizing the change in mobility due to the presence of impurities is always negative. (Contractor's abstract)

3193

Yeshiva U. Graduate School of Science, New York.

ELECTRON TRANSPORT AT HIGH TEMPERATURES IN THE PRESENCE OF IMPURITIES, by H. L. Frisch and J. L. Lebowitz. [1961] [8]p. (AFOSR-1451) (AF 49(638)753) Unclassified

Presented at meeting of the Amer. Phys. Soc., Mexico City (Mexico), June 22-24, 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 360, June 22, 1961.

Also published in Phys. Rev., v. 123: 1542-1549. Sept. 1, 1961.

The electrical transport properties of a solid at high temperature are often determined primarily by the scattering of electrons by phonons and impurities. The problem is treated for the case where Maxwellian statistics apply and the electrons are described by a classical distribution function in position and velocity, f(r, v). This function satisfies a space-dependent equation in which the interaction with the impurities is treated as part of the Hamiltonian and the phonon scattering is described by a linear Boltzmann-type collision term. This equation is solved formally in the presence of a weak external electric field in a form convenient for perturbation expansions in the relative strength of the different scattering mechanisms, some of which are carried out explicitly. It is also shown rigorously that the change in conductivity due to the presence of impurities is negative. (Contractor's abstract)

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Yeshiva U. [Graduate School of Science] New York.

INVESTIGATION OF A VARIATIONAL PRINCIPLE FOR OPEN SYSTEMS, by J. L. Lebowitz and E. Morris. [1961] [14]p. incl. refs. (AFOSR-1619) (AF 49(638)753) AD 269141 Unclassified

An attempt to obtain information about the stationary nonequilibrium state of a fluid through which the heat is flowing is described. The fluid is in contact with several heat reservoirs at different temperatures and is assumed to be described by an ensemble density which satisfies a generalized Liouville equation. The method consists of minimizing a positive functional which vanishes only when the correct stationary space distribution is assumed. (Contractor's abstract)

3195

Yeshiva U. Graduate School of Science, New York.

[STATISTICAL MECHANICS OF TRANSPORT PROPERTIES IN NON-EQUILIBRIUM AND DISSIPATIVE SYSTEMS] by J. L. Lebowitz. Final rept. Nov. 1961, 10p. (AFOSR-1869) (AF 49(638)753) AD 269142 Unclassified

The work carried out during the period Oct. 1, 1959 - Oct. 1, 1961 is covered. Brief descriptions of work achieved are given with respect to (1) the construction and application of Gibbs-type phase-space ensembles for nonequilibrium system with special emphasis on the stationary state; and (2) the application of the general principles of equilibrium statistical mechanics to specific systems encountering the greatest difficulty in the case of dense fluids. Three papers entitled H-Theorem for Plasma; Dissociation Rate of a Diatomic Molecule in an Inert Gas and Dynamical Study of Brownian Motion are included. A list of 14 articles published is also included.

3196

Yeshiva U. Graduate School of Science, New York.

THERMODYNAMIC PROPERTIES OF SMALL SYSTEMS, by J. L. Lebowitz and J. K. Percus. [1961] [9]p. (AFOSR-4113) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)753 and Atomic Energy Commission) Unclassified

Also published in Phys. Rev., v. 124: 1673-1681, Dec. 15, 1961.

The dependence of the pressure of a homogeneous system is investigated at a given density ρ and temperature T, on the number of particles N. The particles of the system are assumed to interact via forces of finite range a and are confined to a periodic cube of volume L^3, $\rho = N/L^3$. It is found that there are generally 2 types of N dependencies in the pressure and other intensive properties of the system. There is a simple dependence which goes essentially as a power series in (1/N) and may be computed explicitly in terms of the grand-ensemble averages of these properties where it is absent. The other, more complex, dependence comes from the volume dependence of those cluster integrals which are large enough to wind at one around the periodic torus. These do not appear in a virial expansion for terms $k \leq (N/\rho a^3)^{1/3}$. They play however a dominant role in the N dependence observed by Alder and Wainwright in their machine computations on a hard-sphere gas. While the explicit calculation of these terms is very difficult and has been carried through only in a few special cases, they may be related, approximately at least, to the radial distribution function in an infinite system. An expression is also derived for the correlation between the particles of an ideal gas represented by a microcanonical ensemble. (Contractor's abstract)

3197

Yeshiva U. Graduate School of Science, New York.

STATISTICAL MECHANICS OF OPEN SYSTEMS, by J. L. Lebowitz and A. Shimony. [1961] [14]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)753] and National Aeronautics and Space Administration) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 14, Feb. 1, 1961. (Title varies)

Published in Phys. Rev., v. 128: 1945-1958, Nov. 15, 1962.

Kubo's treatment of isolated nonequilibrium systems to open systems in contact with thermal reservoirs is generalized. When the system is in contact with 1 reservoir and is subject to a weak external field, the deviation of the average of any quantity from its equilibrium value is related to a time-correlation function which incorporates the effect of the reservoir. A corollary is an isothermal fluctuation-dissipation theorem, which gives an explicit expression in terms of a time-correlation function for the rate at which energy flows from the driving field into the reservoir via the system. As an application, the complex conductivity of a Lorentz gas is computed. An expression is obtained for the stationary nonequilibrium distribution of a system in contact with several reservoirs at slightly differing temperatures and chemical potentials. The Onsager coefficients, which relate the heat and particle fluxes to the differences among the reservoir parameters, are then explicitly expressed in terms of suitable time-correlation functions and their symmetry is exhibited. The validity of perturbation theory in finding the linear deviation from equilibrium of the Γ-space ensemble density is also discussed. (Contractor's abstract)

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Yeshiva U. Graduate School of Science, New York.

N-DEPENDENCE OF LOW-ORDER DISTRIBUTION FUNCTINNS (Abstract), by J. L. Lebowitz and J. K. Percus. [1961] [1]p. [AF 49(638)753] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 15, Feb. 1, 1961

One of the features characterizing a fluid is the existence of a finite correlation length λ. For molecular separations large compared to λ the low-order Ursell functions F_n approach values which are of o(N): in a closed system containing N particles. A simple general expression is obtained for the N^{-1} term in this asymptotic region and used it to prove the local nature of the low-order distributions in an inhomogeneous system. For systems with periodic boundary conditions there are no shape-dependent corrections to F_2, and the N^{-1} correction applies also to small separations. This should be detectable, in principle, in the recent machine computations of the radial distribution function for a wide range of values of N. The asymptotic value of the radial distribution function also may be used to obtain the high-temperature equation of state of a fluid consisting of particles having a hard core and a wide shallow square well potential. (Contractor s abstract)

3199

Yeshiva U. Graduate School of Science, New York.

H-THEOREM AND VARIATIONAL PRINCIPLES FOR PLASMAS, by J. L. Lebowitz and E. Morris. [1961] [4]p. (Bound with its AFOSR-1869; AD 269142) (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., Washington, D. C., Apr. 24-27, 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 289, Apr. 24, 1961.

The distribution functions $f^i(r, \xi)$ of the components of an ionized plasma are generally assumed to obey a Fokker-Planck type equation. This equation like the Boltzmann equation is quadratic in the distribution functions. Unlike the Boltzmann equation, however, the distribution functions do not enter symmetrically here and it becomes somewhat complicated to prove the H theorem for these equations. The proof results showed that the rate of entropy production due to collisions is proportional to $\Sigma \int d\xi \int d\eta \{(\eta - \xi) \times [\nabla \ln f^i(\xi)/m_i - \nabla \ln f^j(\eta)/m_j]\}^2$ which is positive and vanishes only for the case of Maxwellian distributions. The extension of the H theroem for more general equations of this form and the use of some variational principles for obtaining solutions of these equations will also be discussed. (Contractor's abstract)

3200

Yeshiva U. Graduate School of Science, New York.

PHASE SPACE DESCRIPTION OF NON-UNIFORM SYSTEMS, by J. L. Lebowitz. [1960] [8]p. [AF 49-(638)753] Unclassified

Published in Rend. Scuola Internaz. Fiz. "Enrico Fermi", v. 14: 177-194, 1962.

This is primarily a review paper dealing with very general commentary on the present status of the kinetic theory of gases. The emphasis is on foundations, particularly in relation to the theory of plasmas. There are also speculations concerning stability. (Math. Rev. abstract)

3201

Zaragoza U. (Spain).

ACTION PRINCIPLE FOR CLASSICAL MECHANICS, by L. M. Garrido. [1961] 22p. (AFOSR-302) (AF 61-(052)438) AD 253350; PB 155425 Unclassified

Also published in Jour. Math. Anal. and Appl., v. 3: 295-314, Oct. 1961.

A differential action principle is presented which yields Hamilton's equations of motion and provides a general method of treating perturbations in classical mechanics. (Contractor's abstract)

3202

Zaragoza U. (Spain).

APPROXIMATE CONSTANCY OF ADIABATIC INVARIANTS IN PLASMA PHYSICS, by L. M. Garrido and F. Gascon. [1961] 15p. (AFOSR-924) (AF 61(052)-438) AD 262957 Unclassified

Also published in Prog. Theoret. Phys. (Japan), v. 28: 573-584, Oct. 1962.

The interaction representation is introduced for classical mechanics starting from an operational formulation of the same. General criteria are given to be satisfied by a slowly time dependent Hamiltonian in order to possess adiabatic invariants of m^{th} order, and a general method is presented based on techniques similar to those used to evaluate time dependent perturbations in quantum mechanics to calculate the degree of approximate constancy of such adiabatic invariants for Hamiltonians depending slowly but at a finite rate on time. Finally these methods are applied to the adiabatic invariants that appear in thermonuclear plasma, evaluating the errors made in the guiding center approximation. (Contractor's abstract)

3203

Zaragoza U. (Spain).

APPROXIMATE CONSTANCY OF ADIABATIC INVARIANTS, by L. M. Garrido. [1959] 21p. (AFOSR-1039) (AF 61(052)438) AD 262956 Unclassified

Also published in Prog. Theoret. Phys. (Japan), v. 26: 577-588, Nov. 1961.

The approximate constancy of adiabatic invariants is explored through application of harmonic oscillations of charged particles in a magnetic field. (Contractor's abstract)

3204

Zaragoza U. (Spain).

DEGREE OF APPROXIMATE VALIDITY OF THE ADIABATIC INVARIANCE IN QUANTUM MECHANICS, by L. M. Garrido and F. J. Sancho. [1961] 15p. (AFOSR-1825) (AF EOAR-61-33) AD 272165 Unclassified

Also published in Physica, v. 28: 553-560, June 1962.

The conditions that make the quantum mechanical adiabatic theorem valid to m^{th} order and the degree of approximate validity of the same when the time-dependent Hamiltonian varies at a slow though finite rate are studied. (Contractor's abstract)

3205

Zaragoza U. (Spain).

[ACTION PRINCIPLE FOR CLASSICAL MECHANICS] Principio de accion para mecanica clasica, by L. M. Garrido. [1961] [16]p. (AFOSR-1834) [AF EOAR-61-33] Unclassified

Also published in Anal. Real Soc. Espan. Fis. Quim., v. 62: 55-70, Mar.-Apr. 1961.

A differential action principle is presented. It yields Hamilton's equations of motion and provides a general method to treat perturbations in classical mechanics. (Contractor's abstract)

3206

Zator Co., Cambridge, Mass.

RESEARCH IN INDUCTIVE INFERENCE, by R. J. Solomonoff. Progress rept. Apr. 1, 1959-Nov. 30, 1960. Jan. 1961, 18p. incl. refs. (Rept. no. ZTB-139) (AFOSR-160) (AF 49(638)376) AD 252446 Unclassified

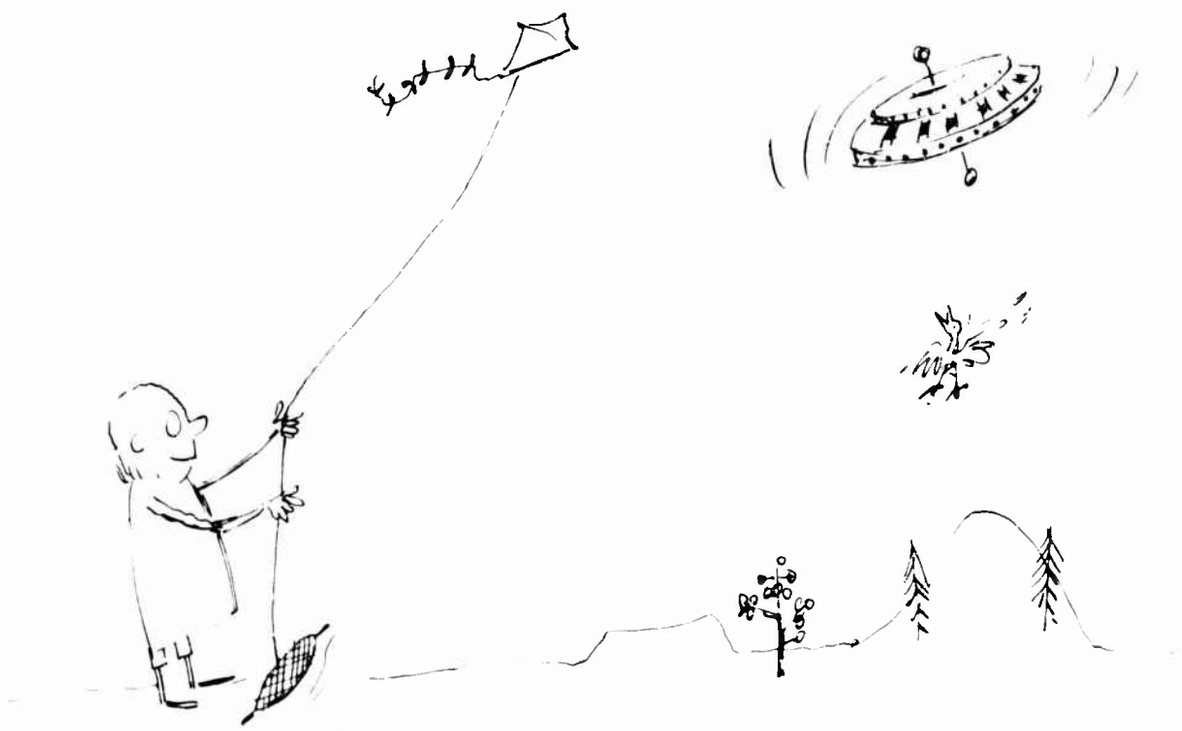
The principal progress made was in the discovery of what are apparently several equivalent formal solutions to the general inductive inference problem. These solutions are applicable to numerical and/or non-numerical and/or analog and/or digital data. Any type of information that is available can be made part of the evidence upon which the inferences are made. These general induction methods were applied to several specific problems in non-numerical prediction. Some computer programs were written for the discovery of regularities in English text and any other sequence of symbols. Some work was done toward programming a computer to learn to assign descriptors to documents. Before the new inference methods were discovered, much time was spent on the problem of discovering the grammars of phrase structure languages from a body of text alone. Since then, the general inference methods have cleared up a serious point of difficulty in this problem. Another problem upon which considerable progress was made is the problem of programming a computer to improve its own inference methods.

3207

Zator Co., Cambridge, Mass.

A CODING METHOD FOR INDUCTIVE INFERENCE, by R. J. Solomonoff. Apr. 1961, 11p. (Rept. no. ZTB-140) (AFOSR-510) (AF 49(638)376) AD 256886
Unclassified

A new general inductive inference method has been described in which the a-priori probability of a sequence of symbols is computed on the basis of the lengths of various code strings that could be used to describe that sequence to a universal Turing machine. A coding method is displayed for a simple Bernoulli sequence and the inference technique is applied to the computation of probabilities of symbols in that sequence. The results obtained in this case are shown to be identical to Laplace's rule of succession. The probabilities correspond to Shannon's entropy if the Bernoulli sequence is a very long one. (Contractor's abstract)



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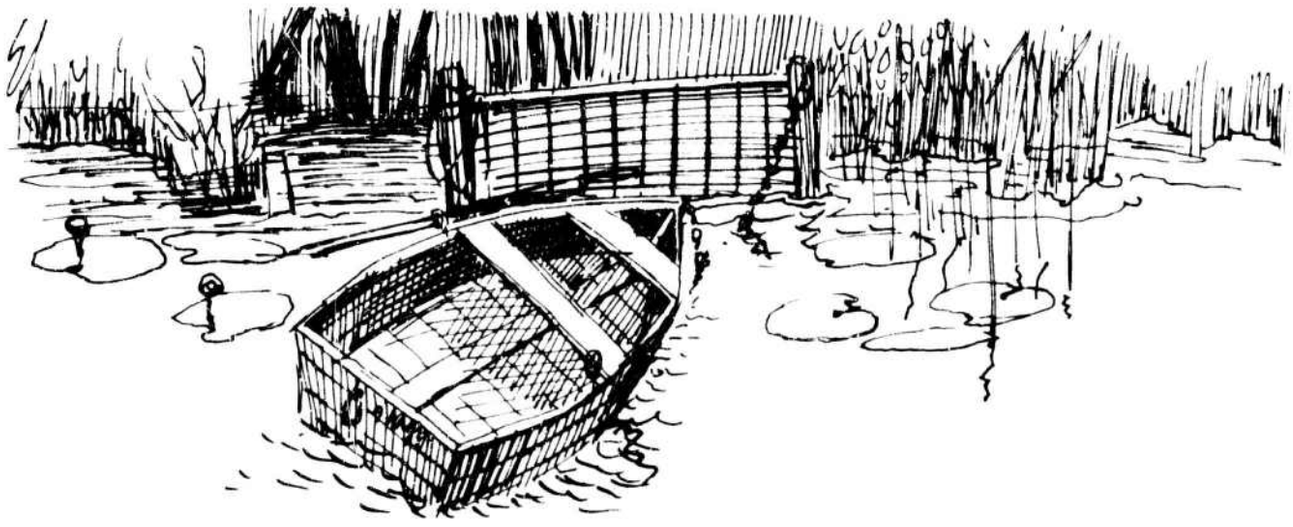
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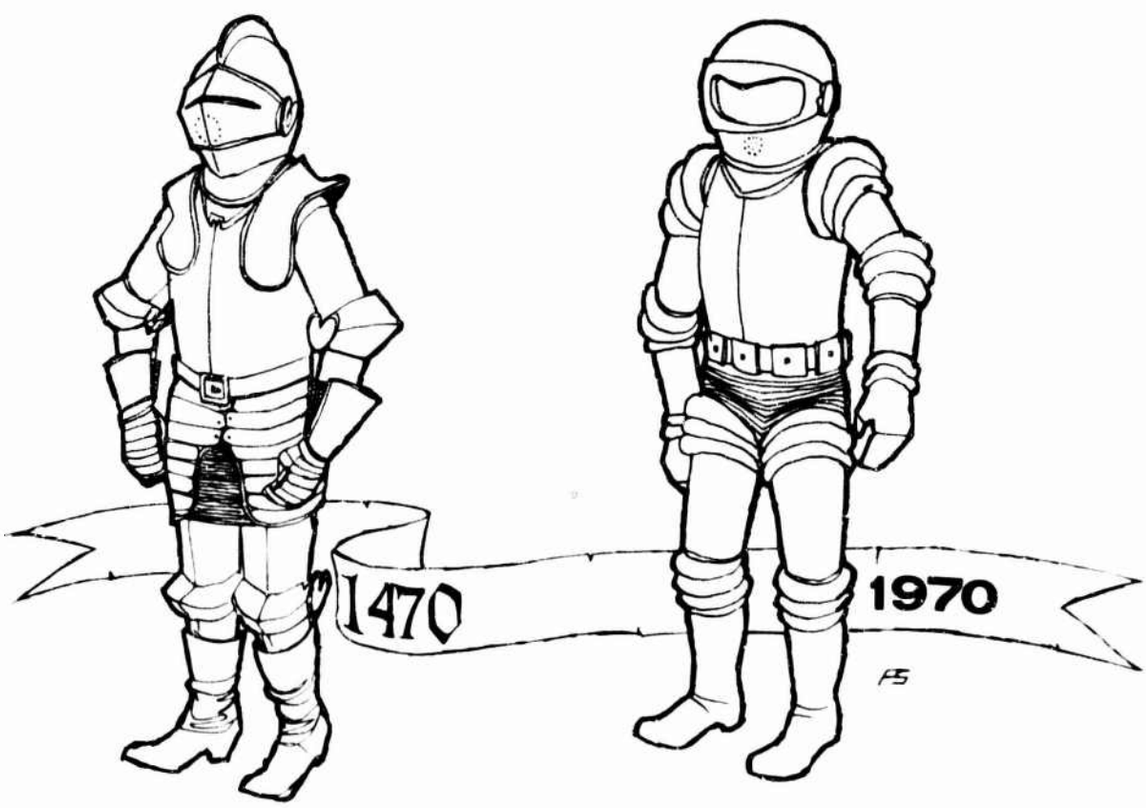
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