Proceedings of the American Physical Society

MINUTES OF THE 1954 FALL MEETING OF THE NEW ENGLAND SECTION AT HANOVER, NEW HAMPSHIRE, ON OCTOBER 23, 1954

THE New England Section of the American Physical Society held its annual Fall Meeting on Saturday, October 23, 1954, in Wilder Laboratory of Dartmouth College, Hanover, New Hampshire. The morning session was opened with a welcoming address by Dean Donald H. Morrison of the Faculty of Dartmouth College. There followed four invited papers:

"Some Optical Analogues in Microwave Experiments," GORDON F. HULL, *Dartmouth.*

"Optically Induced Polarization of Atoms and Nuclei," ROBERT H. DICKE, *Princeton.*

"Recent Results in Magnetic Analysis of Nuclear Reactions," WILLIAM W. BUECHNER, *M.I.T.*

"Servomechanisms," PHILIPPE E. LECORBEILLER, *Harvard.*

At the business meeting, following lunch, the following officers were elected to serve until the Fall Meeting of 1955:

William W. Watson, Yale University, Chairman
Harold Krauss, University of Connecticut, Vice Chairman
William M. Preston, Harvard University, Secretary-Treasurer
Gerald Holton, Harvard University, Council
Karl Woodcock, Bates College, Council

Following the business meeting, nine contributed papers were presented. The abstracts follow.

W. M. PRESTON
Secretary-Treasurer, New England Section
Harvard University
Cambridge, Massachusetts

1. Physics and Oceanography. F. T. DIETZ, *University of Rhode Island.*—The relatively new science of oceanography has many facets of interest to the physicist. Some contributions of physicists to oceanography are mentioned and certain current problems of interest are presented.

2. Energy Levels from Some (α,n) Type Reactions.* W. T. DOYLE AND A. R. QUINTON, *Yale University.*—Targets of B^{10}, B^{11}, F^{19}, and P^{31} have been bombarded with an 8-Mev cyclotron beam and the energies of the resulting neutron groups measured by means of a proportional counter telescope fitted with a proton radiator and aluminum absorbers. The boron targets give results agreeing with the known level structure for N^{13} and N^{14}. Levels at 0.4, 1.1, 2.2 Mev of excitation are observed in Na^{22} with a ground state Q value of -2.0 Mev. The negative Q value levels have been checked by the threshold method using a BF_3 filled counter. This latter technique yields the result $Q=-5.7$ Mev for the reaction $P^{31}(\alpha,n)Cl^{34}$ and hence the mass value 33.9854 amu for Cl^{34}.

* Supported by the Office of Naval Research.

3. Total Cross Sections for High Energy Neutrons. VAUGHN CULLER AND R. W. WANIEK, *Harvard University.*—The total cross sections for high energy neutrons have been determined for 12 elements (H, D, C, O, Al, Si, Cl, Ti, Fe, Cu, Hg, and Pb) at several energies between 61 and 107 Mev. A discussion of the experimental techniques and a consideration of energy and angular resolution of the scintillation counter telescope employed will be given.

4. Preliminary Results with the Correlation of Meteorological Parameters with Cosmic Ray Neutron Intensities.* J. A. LOCKWOOD AND H. E. YINGST, *University of New Hampshire.*—A study of the effect of variations in such meteorological parameters as barometric pressure, specific humidity, cloud cover, and temperature upon the neutron component of cosmic rays (at ground surfaces) is now being made. Neutron intensity monitors have been established at sea level and at 6290 ft (Mt. Washington). The high energy neutron component is monitored by BF_3 proportional counters embedded in a lead-paraffin pile. Neutrons of energies <0.4 ev are detected by BF_3 tubes in a paraffin telescope which is covered alternately by Sn or Cd shields. The barometric coefficient for lead-paraffin pile is (-9.8 ± 0.3) percent cm Hg^{-1}. A 27-day variation for the high energy component has been found in agreement with results of Fonger and Simpson.[1] The results of barometric pressure, humidity, cloud cover, and temperature upon the low energy neutrons will be presented.

* Supported by the Geophysical Research Division, Air Force Cambirdge Research Center.
[1] W. H. Fonger, Phys. Rev. **91**, 351 (1954).

5. Diode Characteristics of Metal Point Contacts on Vacuum Heated Germanium.* RICHARD B. ALLEN AND H. E. FARNSWORTH, *Brown University.*—A germanium crystal was heated in vacuo in contact only with quartz and graphite. Magnetic controls allowed the catwhisker contact to be made without removing the sample from the vacuum system. Details of the experimental vacuum tube construction are discussed. Heating the sample to above 800°C followed by quick cooling (radiation quenched) to room temperatures nearly destroyed the rectification. Admission of dry air did not restore the rectification. Annealing at lower temperatures partially restored the rectification. The rectification ratio was cycled several times by thermal treatment while maintaining high vacuum conditions. These results differ from those of Esaki who reported a loss of rectification by vacuum heating germanium, but no recovery by vacuum annealing. The low level resistance of semiconductor point contacts is an exponential function of the reciprocal of the absolute temperature. From this function an activation potential may be calculated. Radiation quenching lowered the activation potential while annealing restored it to its previous value. The Schottky diode theory predicts that the activation potential of a metal-semiconductor point contact is dependent on the work function of the metal. Meyerhof reported no

dependence on the metallic work function for measurements made in air.

* This work is sponsored by the International Business Machines Corporation.

6. Imperfections in Germanium Single Crystals. A. SMAKULA, J. KALNAJS, AND V. SILS, *M. I. T.*—It is well-known that germanium shows anomalies in some of its physical properties, such as Hall effect, magnetoresistance, conductivity, and infrared absorption.[1] For an explanation of these anomalies, impurities (or imperfections) of the order of 10^{20} per cm^3 are assumed, which is in contradiction with spectrochemical analysis. In our study of crystal imperfections we determined the lattice constant precisely on four single crystals of highest purity (n-type). Simultaneously, we determined the density accurately by hydrostatic weighing. These densities compared with those computed from the lattice constants show a positive difference of 0.002 to 0.005 g/cm^3. It is assumed that germanium contains interstitial impurities of oxygen or germanium of the order of 10^{19}/cm^3.

[1] K. Lark-Horovitz, *The New Electronics in the Present State of Physics*, F. S. Brackett, Editor (American Association for the Advancement of Science, Washington, D. C., 1954), pp. 57 to 127.

7. Faraday Effect in a Polycrystalline Ferrite.* DAVID PARK, *Williams College.*—In a polycrystalline mass in which the crystallites are oriented completely at random, the permeability tensor μ is diagonal and no magneto-optical rotation will occur. But if there is a slight degree of alignment, so that the average magnetization $\bar{M}$ is not zero, then μ is no longer diagonal. The off-diagonal components, which are responsible for the Faraday effect,[1] can be shown to be proportional to $\bar{M}$ if $\bar{M}$ is small. In calculating the spectrum of μ it is assumed that the resonant frequencies of the individual crystallites are statistically distributed,[2] and then one can show that the interaction between crystallites does not greatly affect the form of the spectra. If the spectra of the diagonal parts of μ are known, those of the off-diagonal parts can be calculated. Sample curves will be shown and compared with available data.

* This work was supported by the Sprague Electric Company.
[1] C. L. Hogan, Bell System Tech. J. **31**, 1 (1952); Revs. Modern Phys. **25**, 253 (1953).
[2] D. Park, Phys. Rev. **95**, 652 (1954); Phys. Rev. (to be published).

8. A Vectorial Approach to the Principal Equation of Rigid-Body Kinematics. DAN E. CHRISTIE, *Bowdoin College.*—In textbooks on intermediate mechanics the kinematical principle that any instantaneous motion of a rigid body is screw motion is usually deduced quite directly and logically from a special case. This special case asserts that any motion of a rigid body with one point fixed is instantaneously rotation. The justification of this special proposition is not always so direct. Often, for instance, Euler's theorem on finite displacements is proved using spherical geometry, and then an argument about a limiting case is discussed.

It is here suggested that a derivation based on methods more germane to the subject might be preferable. A simple development using vectors is given. In this derivation repeated use is made of the following anticommutative relation: $\mathbf{V}_P \cdot \mathbf{R} = -\mathbf{V}_R \cdot \mathbf{P}$ (for position vectors $\mathbf{P}$ and $\mathbf{R}$ relative to the fixed point as origin, $\mathbf{V}_P$ denoting the velocity vector for the point whose position vector is $\mathbf{P}$, etc.). It is demonstrated that the only velocity pattern consistent with this relation is one of the type given by the formula $\mathbf{V}_R = \boldsymbol{\Omega} \times \mathbf{R}$, and hence that the motion is instantaneously a rotation.

9. Hertz's Abandonment of the Concept of Force in the Logical Clarification of Classical Mechanics. ROBERT S. COHEN, *Wesleyan University.*—In the sixty years since Heinrich Hertz died, philosophical explication of physical theories has been an expanding concern of logicians, philosophers, and physicists. In part, this has taken the form of analysis of terms and concepts, e.g., the debate over proposed requirements of operational definition. In part, this concern for clarity has led to axiomatic and other varieties of logical reconstruction of theories. That relativistic and quantum mechanical notions are not the only sources for such research is perhaps most convincingly shown by the great *Principles of Mechanics* in which Hertz set forth a basic scheme from which the general laws of classical mechanics might be deduced. The heart of his proposal consists in his acute critique of standard usage of the general laws (which, e.g., derives a universally applicable principle such as that of least action on the basis of the assumption of fixed conservative interparticle forces) together with his constructive use of the notions of time, position, and inertia to build a mechanics without forces. What results is a lucid and compact theory with a minimum of physical assumptions and a sparseness of anthropomorphic language; force and energy are purely auxiliary or short-hand concepts. Finally Hertz deliberately formulates certain criteria for those who reconstruct theoretical structures.

MINUTES OF THE 1954 AUTUMN MEETING OF THE NEW YORK STATE SECTION AT BROOKHAVEN NATIONAL LABORATORY, NOVEMBER 12–13, 1954

THE thirty-second meeting of the New York State Section was held at Brookhaven National Laboratory, Upton, Long Island, on November 12 and 13, 1954.

One paper, and the preceding address of welcome by R. A. Patterson, constituted the Friday morning session. Friday afternoon was devoted to three papers on neutron physics, followed by tours of the Brookhaven Reactor Building and the "Hot" Chemistry Laboratory. Friday sessions closed with cocktails and dinner and a lecture by D. H. Menzel on "The Physics of Flying Saucers."

Two papers on Saturday morning preceded a tour of the Cosmotron, which brought the meetings to a close. It is not possible to name all of the many staff members at Brookhaven whose efforts made this meeting a profitable and enjoyable one, but among them, deserving of special mention, are George B. Collins, Chairman of the Cosmotron Department, who took on the responsibility of arranging the program, and Mariette Kuper, Execu-