

PHYSICS

Chairman: J. F. MACKELL, Indiana State Teachers College

R. E. Martin, Hanover College, was elected chairman of the section for 1941.

ABSTRACTS

Theory of production of slow mesotrons. J. F. CARLSON, Purdue University.—Using the mesotron theory of nuclear forces as a basis, the effective cross section for the production of a mesotron in a collision between nuclear particles is calculated for the case that the excess kinetic energy of the nuclear particles above the threshold value is small. In this limit it is found that this cross section can be expressed as a constant times the ratio of the excess energy to the rest energy of the mesotron raised to an integral power. The power to which this ratio is raised depends on the type of interaction assumed between the heavy particle and the mesotron field. From the accepted numerical values of the quantities entering the expression, it is found that the constant has a value of about 10^{-31}cm^2 . It thus seems unlikely that any method for producing nuclear particles of high energies artificially will be efficient in producing slow mesotrons.

The structure of liquid nitromethane. G. C. DANIELSON and K. LARK-HOROVITZ, Purdue University.—From Fourier analyses of the X-ray diffraction pattern of liquid nitromethane, different distribution curves in the liquid have been determined. The electron and atomic distribution curves show that the first and second atomic neighbors are fixed by the distance of the atoms in the molecule as determined from the electron diffraction pattern of the gas. As indicated by the distribution curve, their distances are, therefore, not subject to statistical fluctuations. The number of first neighbors is 1.6 at $1.33\text{\AA}$ and the number of second neighbors is 1.6 at $2.40\text{\AA}$ which agree with electron diffraction determinations. Further concentrations of atoms are found at $3.48\text{\AA}$, $4.28\text{\AA}$, and at $5.26\text{\AA}$. The molecular distribution curve gives 1.9 first neighbors at $3.48\text{\AA}$, 2.7 second neighbors at $4.28\text{\AA}$, and 3.6 third neighbors at $5.26\text{\AA}$. The analyses of molecular distribution curves show that the flat shaped molecules have their first neighbors in parallel arrangement and not at random orientation.

A method for soil and fertilizer studies using radioactive elements. W. J. HENDERSON and U. S. JONES, Purdue University.—The fixation of phosphorus by Cecil clay, Bedford silt loam, Newton sandy loam and Crosby silt loam has been investigated by the use of the radioactive isotopes. When $\text{Ca}(\text{H}_2\text{PO}_4)_2$ containing radioactivated phosphorus was applied to the surface of the soil and washed down with water equivalent to a precipitation of 2.5 inches the penetration of the phosphorus ranged from one and one-fourth inches for the Cecil clay to about four inches for the Crosby silt loam. The addition of KCl caused the radioactive

phosphorus to move down into the soil more than where no KCl was used, while $(\text{NH}_4)_2\text{SO}_4$ had no immediate effect. The radioactive technique was used to study the movement of potassium in a Bedford silt loam. It was found that not more than five per cent of the KCl applied penetrated beyond one and five-eighths inches with a water treatment equivalent to 2.5 inches of rainfall.

A theoretical stress-strain curve for rubberlike materials. HUBERT M. JAMES, Purdue University, and EUGENE GUTH, University of Notre Dame.—A theoretical stress-strain curve has been derived for rubberlike materials built up from long-chain molecules connected into a network by cross bonds. The essential properties of rubber which our model is designed to reproduce are the approximate incompressibility of the bulk material and the flexibility of the rubber chain molecules. The stress-strain curve follows from the application of statistical mechanics. The stress-strain equation for the model was obtained. It may be used in rubber technology, for instance, to obtain the pressure-compression curve, given the stress-extension curve, and vice versa. The theoretical stress-strain curves show fair to good agreement with equilibrium stress-strain curves taken at Notre Dame and elsewhere.

A method of measuring the dielectric constant of poor dielectrics. R. R. RAMSEY and ARTHUR J. ROBERTSON, Indiana University.—A condenser filled with a poor dielectric can be represented as a good condenser with resistance either in series or in parallel. If the resistance is in series it can be measured by balancing a series bridge. The measured results are independent of the frequency of the hummer. If the resistance is in parallel with the condenser the results will vary with the frequency of the hummer. Robertson has proposed that the resistance is partly in series and partly in parallel and that a combination bridge should be used with a multivibrator in the battery position of the bridge. This involves three adjustments of the bridge; capacity, series resistance, and parallel resistance, which must be balanced at the same time. After much practice with made up unknowns containing a condenser with resistances in series and parallel a technic was developed so that a condenser containing water could be balanced at all frequencies of the multivibrator.

Temperature dependence of X-ray and electron scattering in zinc oxide. C. H. EHRHARDT and R. M. WHITMER, Purdue University.—Electron diffraction and X-ray diffraction patterns of zinc oxide powder obtained at different temperatures have been analyzed so as to measure the intensities of the different diffraction lines. It has been found that the intensity anomalies described before are not due to the temperature motion since they remained unchanged throughout the range of temperatures investigated.

New reactions yielding nuclei of type $Z = n + 1$. D. R. ELLIOTT and L. D. P. KING, Purdue University.—The existence of light nuclei of the type $Z = n + 1$ are of theoretical interest; one can predict the upper limit of the position spectrum or determine the nuclear radius. New reactions of this type have been observed. The half lines of nuclei

were observed by means of a multiple scale geiger countercircuit. The data were recorded by an electrically driven Sept camera tripped at intervals of from 0.4 sec to 1 sec.

The absorption spectrum of monobromobenzene. I. WALTERSTEIN, Purdue University.—An investigation of the absorption spectrum of monobromobenzene has been carried out using a hydrogen continuous spectrum source and an absorption cell of 50 cm length containing the vapor. Some 280 band heads have been measured in the region from 2750 Å to 2420 Å. A continuum sets in at about 2400 Å and extends to the lower wave length region. The classification of some of the bands and the resulting energy level diagrams of the vibrational levels were shown. Further classification is dependent on intensity measurements and variations of intensity with temperature.

A new camera for the study of molecular structure of gases by electron diffraction and the interatomic distance in nitrogen. H. J. YEARIAN, Purdue University. The determination of molecular structure by analysis of the electron diffraction patterns obtained from gases and vapors has had wide application. For molecules of low molecular weight, however, two fundamental difficulties have been encountered. A camera has been built to reduce these limitations as much as possible. Using this equipment a satisfactory agreement with the completely known structure of CCl_4 is obtained. Preliminary work on N_2 , as an example of one of the more difficult light molecules, gives an internuclear distance of 1.10 Å in comparison with the band spectrum value of 1.08 Å .

The motion of a particle in general relativity. C. LANCZOS, Purdue University.—Since the discovery of general relativity by Einstein (1916), it was realized that in this theory the motion law of a particle in an external field cannot be a superimposed principle as it is in the classical field theories, but has to be a natural consequence of the field equations. Nevertheless, the establishment of a rigorous law of motion is not obvious, due to the difficulty of defining kinematical quantities in a continuous field. Recently the author succeeded in bringing an earlier attempt of his to a satisfactory conclusion. Instead of the cumbersome power series developments attempted by Einstein and Infeld the motion law can be established rigorously and in finite form. The method is based on the application of the Gaussian integral transformation to the conservation law of momentum-energy. The analysis of the solution shows that the customarily assumed "law of the geodesics" holds under rather general conditions, but an interesting exceptional case arises if the so-called Laue scalar T vanishes. In this case the Newtonian law of motion still holds but with a proportionality factor which differs from the factor deduced from the geodesic principle. This throws new light on the problem of the anomalous value for the light deflection on the limb of the sun, observed by Freundlich.

X-ray determination of the particle size of electro-deposited coatings. E. P. MILLER and C. H. EHRHARDT, Purdue University.—The particle size of electro-plated metals is particularly important because the appearance and physical properties of the finished plates are largely

dependent upon it. Since such coatings cannot be removed from their base metal without changing their original nature and because of the smallness of the particle size, X-ray methods of determining their particle size have been used. Using experimental arrangements fulfilling the requirements of the theories as closely as possible, a detailed study of the Scherrer or Kochendorfer methods of X-ray particle size determination has been made. The arrangement was used to study the particle size of the nickel coatings on brass stampings plated under actual production methods. We have shown that under the condition of sharpest focusing of the diffracted line, the Kochendorfer equation reduces to the Scherrer equation without the term for line breadth. Since the value of the particle size of a particular sample should be independent of the method of determination, we have used the Kochendorfer method to determine the particle size of a particular sample. This size was then used to determine the breadth of the diffracted lines for a more complete pattern taken with the Scherrer arrangement. A further check is provided by comparing this natural breadth with the width of the diffraction lines from the brass base metal whose particles are so large that there is little particle size broadening.