

PHYSICS

Chairman: R. B. ABBOTT, Purdue University

The sectional meeting on physics was attended by about 50 members and guests. Good interest was shown in the papers and discussion. A special feature was the exhibit of the Cenco Company of apparatus and supplies.

James F. Mackell, Indiana State Teachers College, was elected chairman of the section for 1940.

ABSTRACTS

Accoustical properties of wood for musical instruments. R. B. ABBOTT and G. H. PURCELL, Purdue University.—Specimens of wood in the form of rectangular bars 24 in. x $\frac{3}{8}$ in. x $\frac{5}{8}$ in. were tested for their density, elasticity, and internal resistance to motion. The effects of boiling the rods in water, ethyl alcohol, and turpentine and of coating them with oils, varnishes, paints, *etc.*, were observed. A method for separating the internal damping resistance from the air resistance was developed.

The Indiana University cyclotron. FRANZ N. D. KURIE, Indiana University.—The cyclotron now being constructed here is the second largest in the United States. The magnet, weighing 77 tons, is constructed of 0.08 to 0.15% carbon open-hearth steel. With the exception of the poles, all the steel is in the form of slabs 2 in. thick, bolted and welded together. The diameter of the pole tip is 45 in., that of the core is 54 in., allowing a final radius for the ions of about 19.5 in. The over-all dimensions of the magnet frame are 11 ft. x 9 ft. x 4.5 ft. The proportions of the magnet were determined by tests on a small scale model. Energizing coils were wound of ten tons of copper strip ($1\frac{3}{8}$ in. x $\frac{1}{8}$ in.) in 24 pancakes. These coils were entirely homemade. They are to be cooled by water circulating through additional coils of $\frac{3}{8}$ -inch square copper tubing sandwiched between the conductor coils. At 50 KW the model tests indicate a field strength of about 17,000 oersteds for a gap of 6.25 in. This gap is composed of two shimming gaps of $\frac{5}{8}$ in. each and a 5-inch vacuum gap. Preliminary decisions have been reached to feed the radio-frequency power to the dees through a vacuum resonant line. Tests on a full-sized model indicate the vacuum chamber can be made to resonate at about 24 m. This gives a probable output voltage for deuterons of 16 MV. The cyclotron is housed in a room 75 ft. x 55 ft. which is semi-isolated from the new Physical Science Building now being constructed. It is planned to surround the instrument with a water wall in all directions as a protection from neutrons. The control room will be on a mezzanine about 40 ft. from the cyclotron.

Focusing and resonance requirements for the Indiana University cyclotron. ARNOLD F. CLARK and FRANZ N. D. KURIE.—The electric and magnetic fields through which the ions pass in being accelerated in a

cyclotron must satisfy two conditions. One of these is that the angular velocity of the ion must keep the ion in step with the oscillating electrical field, within certain limits. The second condition is that the ions be as well focused as possible in order that the maximum intensity be obtained. In order to facilitate design, these conditions were investigated with models. A two dimensional model of the dees in an electrolyte ray was used to find the best geometry for electric focusing. For dees 3 in. high a separation of 1.5 in. was found to be optimum. Using a twelfth scale model of the magnet, the radial gradient (focusing component) of the magnetic field was measured by two small sensitive search coils bucking each other. Various iron shims were used to determine, to a first approximation, the corrections to the large magnet which will have to be made in order to satisfy both the focusing and relativity resonance requirements for 16 MV deuterons.

The relation between the emission of beta and gamma rays in radioactive substances. A. C. G. MITCHELL, L. M. LANGER, and P. W. MCDANIEL, Indiana University.—The relation between the emission of beta and gamma rays has been studied by measuring coincidences between beta and gamma rays with the help of a coincidence amplifier. The apparatus has a time constant of 0.56×10^{-7} min. The radiations from In^{116} (54 min.), Mn^{56} (2.5 hr.) and Na^{24} (14.8 hr.) have been investigated. In all of the above cases, the method shows that the product nucleus has been left in an excited state by the previous beta ray emission. In the case of Mn, the beta ray spectrum was shown definitely to consist of two groups; that of the other elements was simple. In all cases, gamma-gamma coincidences were found, showing the presence of more than one gamma ray per disintegration. An estimate of the number of gamma ray quanta per disintegration has been made.

Estimates of yet unobserved half-lives of artificial radioactivities. GEORGE DICKSON and E. J. KONOPINSKI, Indiana University.—Advantage was taken of three types of regularities supposed to exist among the binding energies of the stable isotopes to make predictions concerning the half-lives of possible artificial radioactivities which have not yet been observed. First, the "shell structure" periodicity was used. On the basis of the two other types of regularity, nuclei, differing in constitution by a neutron and a proton or by an alpha particle unit, are to be regarded as analogous. The latter, more stringent condition was mainly used, especially because of its apparent confirmation by the incidence of stable isotopes on an isotopic chart. The half-lives of series of known radioactivities, analogous according to the alpha particle criterion, were compared and, wherever regularity was observed, the lives of missing radio elements were estimated in agreement with the regularity. Finally, for the heaviest elements whose stability is most influenced by the coulomb repulsion, series of isotopes symmetrically placed with respect to the most stable isotopes were treated as analogous. This also resulted in some regularities from which predictions of half-lives were made.

Effect of scattering in the source on measurements of beta spectra. E. J. KONOPINSKI, Indiana University.—The approximate evaluation of the effect on the energy distribution of beta particles of scattering in

the source as a linear energy loss is sufficient to show that even the thinnest feasible sources may alter a "Fermi" distribution into a type better represented by a "K. U." curve. The criteria for the use of the empirically found linear range energy relation are fulfilled by portions of the spectra with energy greater than about 200 kv. for source thicknesses, corresponding to losses much smaller than the mean energy of the beta particles. The effect of large angle scatterings of the electrons is to spread the solid angle actually admitted by the measuring devices and thus effectively to thicken the source. The application of these considerations to test the consistency of a given experimental spectrum with a "Fermi" distribution can be carried out analytically. However, the straightforward correction of the experimental data to reveal the true distribution is handicapped by the inapplicability of the method to the lower part of the spectrum.

X-ray diffraction in amorphous rubber. C. M. PARSHALL and K. LARK-HOROVITZ, Purdue University.—Using monochromatic copper or molybdenum x-rays, diffraction patterns of purest latex and smoke sheet have been obtained from samples without any stress. The positions of nearest neighbors and the distribution of atoms along the chain have been determined by Fourier analysis. The number of nearest neighbors is found to be two, in agreement with the prediction from the rubber structure and in agreement with the observations of previous investigators. There are, however, differences between the structure of latex and smoke sheet, which will be discussed in detail in connection with the possible precision of the method.

Test of the Schwarzschild equation for varying development temperatures. LILLIAN THELMA COLEMAN and MASON E. HUFFORD, Indiana University.—The object of this research was to study the effect on the Schwarzschild exponent due to a range of temperature of development, keeping other factors constant as nearly as possible. All the photographic plates were developed, hardened, fixed, and dried under identical conditions; exposure time and temperature of development were the only factors varied. The investigation led to the conclusion that deviation of the Schwarzschild exponent p shows no systematic variation with development temperature. There is, therefore, no one temperature for which the average value of p will more accurately apply than for any other temperature. Therefore, p is not more constant throughout a wide range of exposures for one development temperature as compared with another. In general, then, it may be said that at no one temperature as compared to another does the Schwarzschild equation $E = Itp$ hold.