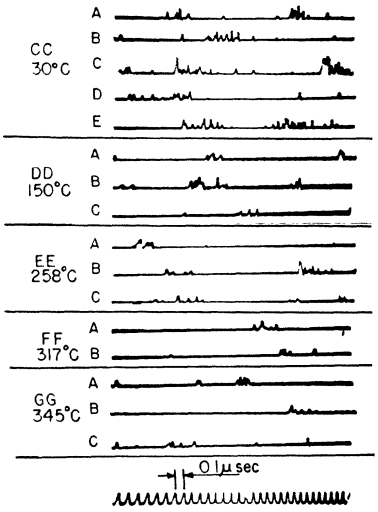

FIG. 2. "Irregular" pulses.

Figures 1 and 2 show typical pulses at the various temperatures. The pulses in these figures represent approximately the photomultiplier current (not integrated current). This is due to the low value of the anode load resistance at the photomultiplier.

* Research carried out at Brookhaven National Laboratory, Upton, Long Island, New York under the auspices of the Atomic Energy Commission.

[1] G. M. Lee, Proc. I.R.E. **34**, 121W (1946).
[2] W. C. Elmore, to be published.
[3] R. Hofstadter, Phys. Rev. **74**, 100 (1948).
[4] This technique has previously been used by G. B. Collins. We are indebted to Dr. Collins for loan of a quartz rod.

Energy of the Disintegration Product of a Light Mesotron*

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November 8, 1948

IN a series of cloud-chamber observations performed at sea level, a photograph was obtained which is interpreted as the disintegration of a negative mesotron which comes to rest in a graphite plate.

The experiments were performed with an Argon-filled cloud chamber 22 inches in diameter, with a lighted area 2-inches deep, illuminated from the sides by two Argon discharge tubes. The chamber was placed in a magnetic field of 4700 gauss, uniform to ±4 percent within the illuminated area. Three graphite plates, each 1.1 cm-thick (2.0 g/cm²) were inside the chamber; 33 cm of lead and two coincidence counters were placed above it. A schematic diagram of the apparatus, showing the arrangement of chamber, lights and cameras, is shown in Fig. 1.

On the photograph reproduced in Fig. 2, a particle is seen which enters the lower left-hand portion of the cloud chamber through the front glass and comes to rest in the bottom graphite plate. A lightly ionizing particle is seen to emerge from below the plate at an angle of about 90° with the entering particle. Its curvature and ionization indicate that it is a fast particle of negative charge. From comparison of the density of the track of the incoming particle with that of the outgoing particle it is quite apparent that the former is heavily ionizing. It should be pointed out that the difference in appearance of the tracks on the two photographs is characteristic for an arrangement of lights and cameras similar to that shown in Fig. 1, in which the light coming from the tracks must be scattered through widely different angles in order to reach the two cameras. The energy of the particle emerging below the plate is found to be 28.1±1.5 Mev by curvature measurement. This value is in very good agreement with the energy calculated from the energy loss in the several traversals of the graphite plates. The disintegration particle traverses the graphite plates five times and this affords a very good opportunity to obtain an upper limit for its mass. Extensive measurements of the energy loss of knock-on electrons of various energies in graphite plates were carried out.[1] It is well known that this energy loss is subject to statistical fluctuations; however, from statistics of the experimentally obtained values, the probability could be calculated that, in a specific case, the energy loss of an electron of a given energy in traversing 1 cm of graphite deviate from the mean (and theoretical) value by a given amount. Curvature measurements of the particle in the photograph before and after each traversal of a graphite plate together with the information obtained on the statistical fluctuation of the energy loss to be expected, allow then to place an upper limit on the mass of the particle: there is a probability larger than 0.95 that the mass of the particle is smaller than 7 electron masses. After careful measurement and reprojection of the two tracks it was concluded that they intersect 3 cm from the front glass, well within the illuminated region of the chamber. However the slight possibility that the two tracks pass within a small distance accidentally, cannot be excluded.

Interpretation of the event as the disintegration of a light mesotron and estimation of the point of intersection of the two tracks within the graphite leads to a value of

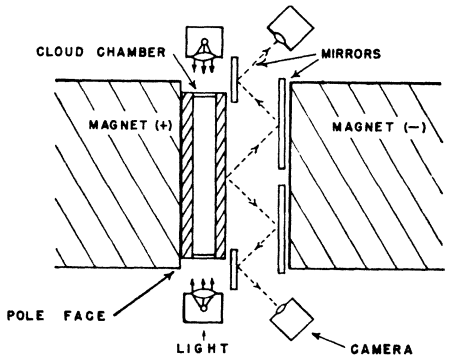

FIG. 1. Schematic diagram of apparatus.

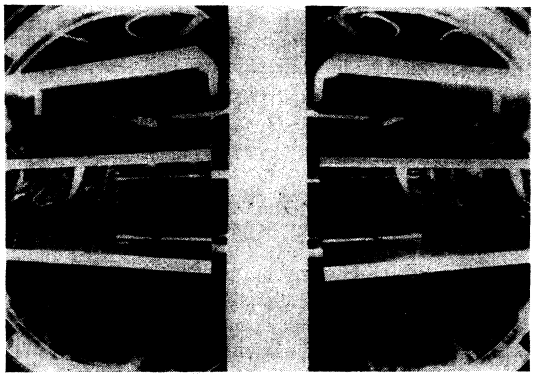

FIG. 2. Cloud-chamber photograph of a mesotron which stops in a graphite plate (lower left), and disintegrates with the emission of a lightly ionizing particle.

36 ± 3 Mev for the energy of the disintegration particle. This value for the energy is somewhat smaller than the average value of 45 Mev found by Thompson[2] and considerably larger than the value of 25 Mev found by Anderson *et al.*[3] The spread in disintegration energies indicates that more than 2 particles are created in the process of disintegration of the light mesotron.

The writers are indebted to Professor Carl D. Anderson who first suggested this problem and who rendered valuable aid during the progress of this work.

* Assisted by the Joint Program of the Office of Naval Research and the Atomic Energy Commission.
** Now at Hughes Aircraft Company, Culver City, California.
*** Now at the University of California, Los Angeles, California.
[1] J. C. Fletcher, thesis (Ph.D.), California Institute of Technology, June, 1948.
[2] R. W. Thompson, Phys. Rev. **74**, 490 (1948).
[3] Anderson, Adams, Lloyd, and Rau, Phys. Rev. **72**, 724 (1947).

Relative Sensitivities of Some Organic Compounds for Scintillation Counters*

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November 8, 1948

A SEARCH for organic materials which would serve as scintillation-type detectors similar to naphthalene[1] has resulted in establishing the sensitivities of nine compounds relative to naphthalene,[2,3] both for 1P21 and 1P28 photomultipliers. Recrystallized and sublimed samples of all compounds were used with the exception of one sample of commercial naphthalene for comparative purposes. 1.8 grams of each material were used, packed as nearly as possible at constant volume in quartz test tubes, the scintillations observed by four photo-multipliers in parallel surrounding the test tube. The pulses were amplified by a Los Alamos Model No. 500 pulse amplifier, voltage discriminated, and recorded on a scale of 4096 and register. The multipliers were not refrigerated. A 20 mc radium gamma-source placed at a standard distance of 71.5 cm was used for all tests.

Figures 1 and 2 show a series of integral, pulse height distributions for the compounds investigated as observed with 1P28s and 1P21s. In addition it is desired to call attention to the following features:

(1) Several compounds, in particular anthranilic acid, showed exceedingly strong fluorescence to ultraviolet excitation but were very poor as scintillating materials with radium gammas.

(2) The dynode power supply was arranged so that the supply voltage could be varied and also the voltages to the individual tubes could be separately adjusted. This made it possible to equalize the detection sensitivities of the parallel tubes and after adjustment to shift all the tubes together to any desired average dynode voltage. Dynode voltage on the 1P28s was so adjusted that for two bias values the purified naphthalene counts coincided with those using the 1P21s. Since this voltage was nearly identical with that used for the 1P21s, it appears from the RCA Handbook data that the 1P28 observes about ten times more luminous flux from the naphthalene radiation than the 1P21.

(3) The scintillation property appears to be connected with molecular structure since phenanthrene is a very poor material and its isomer anthracene a very good one.

(4) This property does not seem to be connected with condensed-ring systems in general, since 1,2-benzanthracene was exceedingly poor, but may possibly be more closely associated with the conjugate bonding observed in stilbene.

(5) The stilbene, at the high biases, is at least a factor of three better than anthracene which had been the best material found previously.[3]

(6) Although refrigeration was not used, the pulse height curves do not seem to extrapolate back to the same zero bias value for all the compounds. On the curves for naphthalene, anthracene and stilbene the zero bias values could possibly be the same, as shown in the figures, indicating that most of the betas arising from the gamma-radiation make enough photons to be counted. For most of the other materials, however, there seems to be some

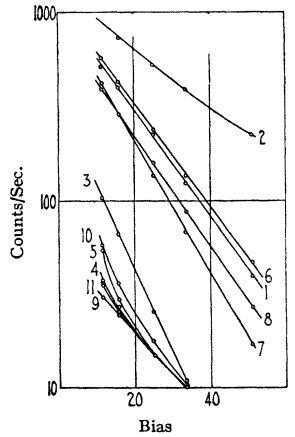

FIG. 1. Integral bias curves with 1P21s. 1—anthracene, 2—stilbene 3—phenanthrene, 4—phenyl benzal glyoxalidone, 5—triphenyl meth ane, 6—naphthalene, 7—naphthalene—stock, 8—fluorene, 9—anthranilic acid, 10—acenapthene, 11—benzanthracene, 12—diphenyl.

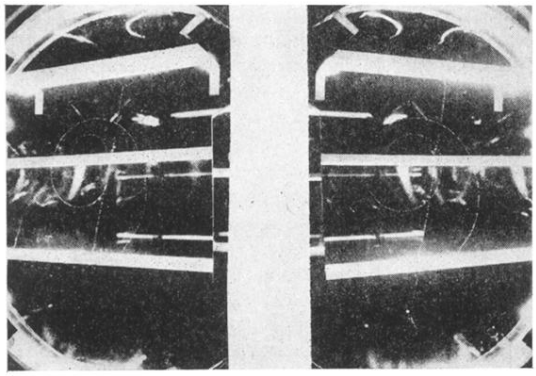

FIG. 2. Cloud-chamber photograph of a mesotron which stops in a graphite plate (lower left), and disintegrates with the emission of a lightly ionizing particle.