this measurement. The energy of shower A was estimated to be 1 Bev from the number of electrons observed at the maximum. If we consider that showers A and B originate from two gamma-rays which are the decay products of a neutral meson of 300 electron masses and having very short lifetime, the energy of shower B can be calculated from the energy of shower A and the angle between the showers; one finds this energy to be 300 ± 100 Mev. This value is not unreasonable with regard to the appearance of shower B.

* Assisted by the Joint Program of the ONR and the AEC.

Erratum: Quasi-Chemical Method in the Statistical Theory of Regular Mixtures

[Phys. Rev. 76, 977 (1949)]

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IN a private communication Dr. C. N. Yang (The Institute For Advance Study, Princeton) wrote:

"In my paper[1] (hereafter called I) it was shown that from the quasi-chemical method one derives the approximate combinatorial formulas (56) and (59) . . . That the converse is true (namely, that the non-interference of local configurations leads to the quasi-chemical method) is evident from the derivation in I of (56) and (59). It goes without saying that, assuming (56) and (59), the free energy of the crystal calculated therefrom is proportional[2] to the free energy of the imaginary gaseous mixture (see equation immediately preceeding (54) in I) and that therefore the equilibrium values of $[q]$ are given by the Eq. (31) of I . . ."

With apologies I withdraw the following comment which appears in the concerned paper at the end of the first paragraph in page 977.

"Yang implicity followed the exact line of the hypothesis of non-interference of local configurations. He also tried to deduce his quasi-chemical method by adopting the hypothesis although with little success (§6 of reference 1)."

[1] C. N. Yang, J. Chem. Phys. 13, 66 (1945).
[2] Except for a constant term which is independent of the $[q]$'s for given w.

Effect of Light on a Diamond Conduction Counter*

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December 5, 1949

ONE of the disadvantages of using a crystal conduction counter is the accumulation of space charge field resulting from the trapping of charge carriers. This space charge field opposes the applied field and may lower the pulse height below the noise level of the amplifier. Several methods of minimizing this difficulty have been suggested. Wouters and Christian[1] and McKay[2] used periodic reversals of the applied field; Hofstadter[3] suggested heat or light to release trapped charges; Chynoweth[4] increased the counting rate using light from a Nernst filament; and McKay[5] used the barrier layer in a semiconductor.

We have found in our counting of Co^{60} gamma-rays and Sr^{90}-Y^{90} beta-particles that the reduction of counting rate by the space charge field can be completely eliminated in some diamonds. This is accomplished by violet light irradiation of the diamond, which is normally in the dark. After this light treatment the diamond is in an activated condition and the counting rate is maintained indefinitely (as long as the external field is applied) at a value equal to or greater than the initial rate. This effect is quite different from the ordinary release of space charge by red light and to our knowledge has neither been predicted nor observed.[6]

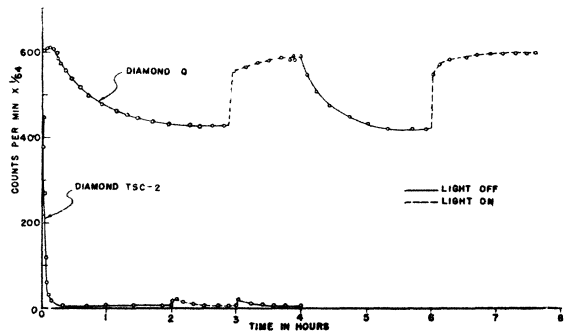

FIG. 1. Effect of red light on counting rate ($\lambda = 6500$A, $E_A = 10$ kv/cm, $Co^{60}\gamma$).

Figure 1 shows the effect of red light on two diamonds which count gamma-rays. Diamond Q is typical of several of our better counters. The counting rate increases slightly at first and then decreases finally approaching a relatively high equilibrium value. If a beam of monochromatic red light (6500A) is focused on the diamond, the counting rate increases very rapidly to a high value which seems to be maintained as long as the light is applied. Upon removal of the light source the counting rate again decreases.

Diamond TSC-2 is typical of our poor counters. In this case, the space charge effects are severe, and the counting rate decreases to a value approaching zero. Red light does not increase the counting rate appreciably.

Figure 2 shows the effect of violet light on the same two diamonds. If a beam of monochromatic violet light (4046A) is focused on diamond Q, the counting rate is observed to decrease rather than increase as it did for red light. Following the decrease there is an increase in counting rate to an equilibrium value. Upon removal of the light source the counting rate increases rapidly to a still higher value and then more slowly to a constant value. After several hours this final value equals or exceeds the initial counting rate. This rate appears to be maintained indefinitely with saturation fields. The source can be removed for several hours and then replaced without appreciable change in counting rate; but lower field strengths may result in a temporary lower counting rate. For fields less than 2 kv/cm it was not possible to put this diamond into the activated condition.

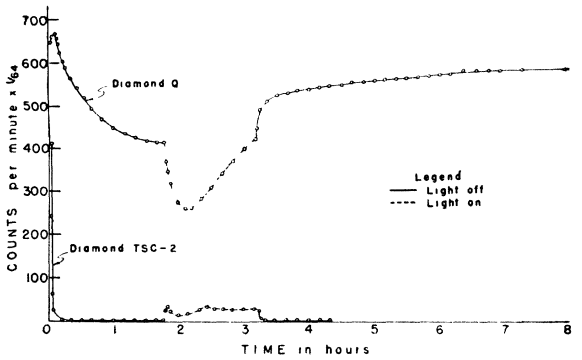

FIG. 2. Effect of violet light on counting rate ($\lambda = 4047$A, $E_A = 10$ kv/cm, $Co^{60}\gamma$).

Diamond TSC-2 does not show this response to violet light. The effect of violet light appears to be similar to the slight effect observed for red light on poor counting diamonds.

Using a Nernst filament as a strong light source, diamond Q may be put into the activated state more rapidly. A temporary initial rise in counting rate occurs and may be attributed to the longer wave-lengths. Unfiltered light from an ordinary projection lantern can also be used.

An explanation of these effects must involve a consideration of photo-conductivity as well as space charge. The decrease in counting rate when using violet light is probably caused by the trapping of photo-conducting carriers which adds to the space charge field. The following increase in counting rate may be caused by a smoothing out of the energy band boundaries[7] which will increase the average distance charges travel before being trapped.

In the activated condition the band boundaries may be nearly straight lines. The small rise at the beginning of the curves for diamond Q may have a similar origin; a slight smoothing out of the energy bands would temporarily predominate over the effect of space charge, especially when the applied field is one of saturation.

We wish to thank Mr. Louis Small, president of Service Diamond Tool Company for his cooperation in supplying these diamonds.

* Contribution No. 88 from the Institute for Atomic Research and Department of Physics, Iowa State College, Ames, Iowa. Work was performed at the Ames Laboratory of the AEC.

[1] L. F. Wouters and R. S. Christian, Phys. Rev. **72**, 1127 (1947).
[2] K. G. McKay, Phys. Rev. **74**, 1606 (1948).
[3] R. Hofstadter, Nucleonics **4**, 14 (1949).
[4] A. G. Chynoweth, Phys. Rev. **76**, 310 (1949).
[5] K. G. McKay, Phys. Rev. **76**, 1537 (1949).
[6] However, this effect is probably related to the unusual photo-conductivity properties of diamond; see the classical papers by Gudden and Pohl or by R. Robertson, J. J. Fox, and A. E. Martin, Phil. Trans. **232**, 465 (1934).
[7] Irregular band boundaries in an insulating crystal containing lattice defects have been suggested by G. H. Wannier, Phys. Rev. **76**, 438 (1949) and by H. M. James, Science **110**, 254 (1949).

Beta-Spectrum of Be^{10}*

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November 25, 1949

THE scintillation spectrometer[1,2] has been used to determine the beta-spectrum of Be^{10}. The sample was made by activating Be in the pile and then enriching the sample in Be^{10} by magnetic separation at *Y*-12. The results obtained confirm the earlier result reported at the 1949 Washington meeting of the Physical Society.

Approximately 1.5 milligrams of BeO were mounted on 100 microgram per cm² Formvar film; the area was about 3 cm². An anthracene crystal was used with an RCA-5819 photo-multiplier. The pulse height distribution is shown in Fig. 1. The sample activity was so large that the background was negligible. Our first sample separated from a cyclotron target had a specific activity of 18 disintegrations per second per milligram of Be. The pile sample after electromagnetic enrichment had a specific activity of 855 disintegrations per second per milligram of Be.

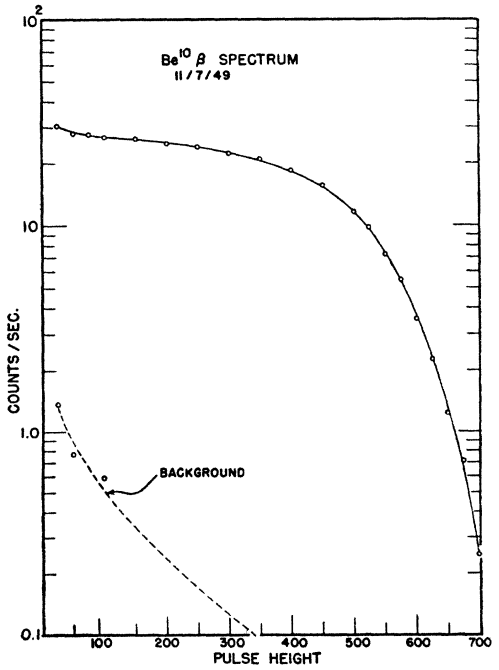

FIG. 1. Pulse height distribution of Be^{10} beta-ray pulses. Pulse height interval was 33 pulse height divisions.

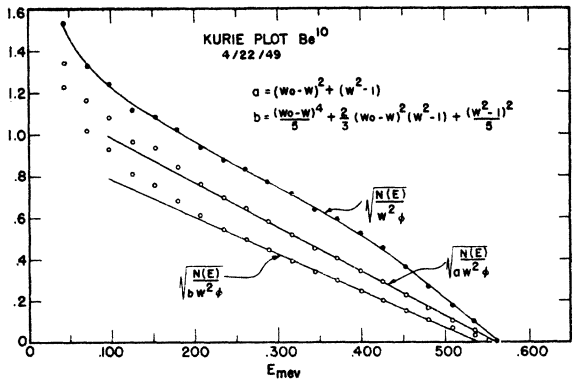

FIG. 2. Kurie plot of cyclotron Be^{10}. Sample thickness about 2 mg/cm² on 0.5 mg/cm² polyethylene.

Figure 2 shows the Fermi-Kurie plots reported previously. It was not possible to decide whether the first or second forbidden axial vector or tensor correction gave the best approach to a straight line near the end point. Figure 3 shows the results obtained with the present sample. It is now possible to see that the second forbidden correction gives the best fit, as is expected theoretically. The strong turn-up at low energies is found generally with the scintillation spectrometer and is probably due to scattering out from the crystal. The maximum energy of the beta-ray as given by the corrected Kurie plot is 0.535±0.02 Mev for the original sample and 0.545±0.010 Mev for the more active sample. The more precise value agrees with other recent measurements.[3,4]

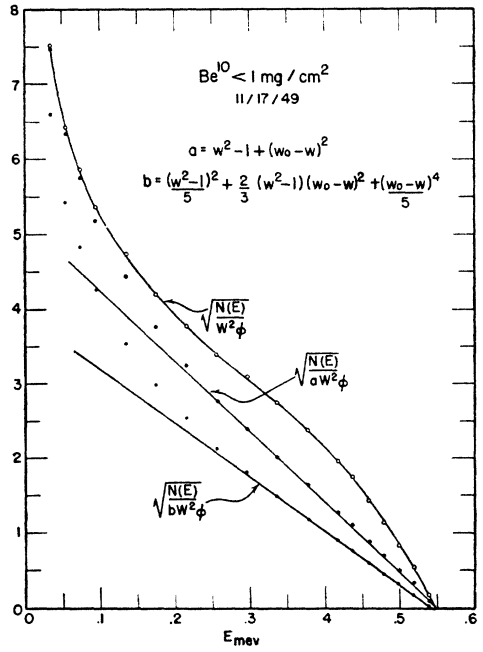

FIG. 3. Kurie plot of pile activated and electromagnetically separated Be.

* This document is based on work performed under Contract No. W-7405, eng. 26 for the Atomic Energy Project at Oak Ridge National Laboratory.
[1] W. H. Jordan and P. R. Bell, Nucleonics **5**, 30 (1949).
[2] Bell, Ketelle, and Cassidy, Phys. Rev. **76**, 574 (1949).
[3] C. S. Wu and L. Feldman, Phys. Rev. **76**, 698 (1949).
[4] H. W. Fulbright and J. C. D. Milton, Phys. Rev. **76**, 1271 (1949).