Letters to the Editor

PUBLICATION of brief reports of important discoveries in physics may be secured by addressing them to this department. The closing date for this department is, for the issue of the 1st of the month, the 8th of the preceding month and for the issue of the 15th, the 23rd of the preceding month. No proof will be sent to the authors. The Board of Editors does not hold itself responsible for the opinions expressed by the correspondents. Communications should not exceed 600 words in length.

The Gamma-Rays of Po^{210} *

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IN connection with Chang's studies[1] on the fine structure of the α-particles of Po and with Feather's discussion[2] on this subject it might be useful to report some recent absorption experiments on the γ-rays of this element. Since the sources at our disposal were larger than those used by previous investigators we could easily obtain more accurate results. A thin-walled glass G-M counter was used to detect the radiation.

Figure 1 shows the absorption in lead of the γ-rays of Po and a similar curve for Ra in equilibrium with its products. The ordinates are expressed in counts per minute and per Curie for Po, and in counts per minute and per 10^{-5} Curie for Ra. Within the accuracy of the absorption method it appears that the γ-radiation of Po consists of a single component of half-thickness equal to 8.5 g/cm³ Po. The energy of the radiation can be evaluated to be 0.8 Mev. The intensity per Curie of Po is equivalent to that of the γ-rays from 7.10^{-6} Curie of Ra, when both curves are extrapolated to zero absorption.

The absorption experiments were repeated with many samples, always giving consistent results. The data are in general agreement with those in the literature, both for the absorption curve and for the intensity. However, no evidence of a softer γ-component, as reported by Webster[3] and by Bothe and Becker,[4] was observed.

A search for softer radiations showed no other components until, with absorbers thinner than 0.5 g/cm² Al, one finds a radiation whose mass absorption coefficient in Al is 18 cm²/g and which is probably the same component observed by Curie and Joliot[5] and attributed by them to the L line of polonium.

If one assumed, as these results seem to indicate, that only one γ-component of 0.8 Mev is present, a theoretical difficulty mentioned by Feather[2] would be removed. However, Chang's results on the fine structure of α-particles would be still more difficult to explain.

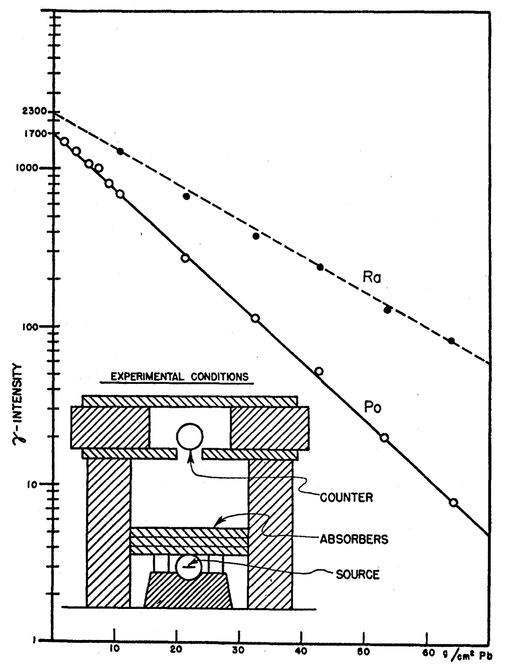

FIG. 1. Absorption in lead of the gamma-rays of polonium and of radium in equilibrium with its products. The ordinates are in counts per minute per Curie for polonium and in counts per minute per 10^{-5} Curie for radium.

* This document is based on work performed under Contract No. W-35-058-eng-71 for the Manhattan Project at Clinton Laboratories.

[1] W. Y. Chang, Phys. Rev. **69**, 60 (1946).
[2] N. Feather, Phys. Rev. **70**, 88 (1946).
[3] H. C. Webster, Proc. Roy. Soc. **A136**, 428 (1932).
[4] W. Bothe, Zeits. f. Physik **96**, 607 (1935).
[5] I. Curie and F. Joliot, J. de phys. et rad. [7] **2**, 20 (1931).

Gamma-Rays from Tungsten and Molybdenum

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THE harder gamma-rays of tungsten have been investigated to date only by means of absorption techniques.[1-4] We have studied the gamma-rays from the 24-hour tungsten isotope, using a spectrometer of the usual 180-degree deflection type, measuring photoelectrons emitted from a thorium or a uranium radiator. The spectrometer had a 5-cm radius of curvature, which is small enough to provide a rather large solid angle, but at the same time provides relatively little shielding between the source and the detector. Background counts were high, and the observed peaks amounted to small differences in the counting rates recorded. The instrument was calibrated with photoelectrons produced from the annihilation radiation of copper positrons.

The peaks which were observed have been confirmed on successive runs on different samples. Observation of the decay of the peaks indicates that each of the peaks noted has the 24-hour half-life. It is not likely that any of these peaks are L peaks since the intensity was believed to be too low to show an L peak. The gamma-ray energies corresponding to the observed peaks are 480, 570, 690,

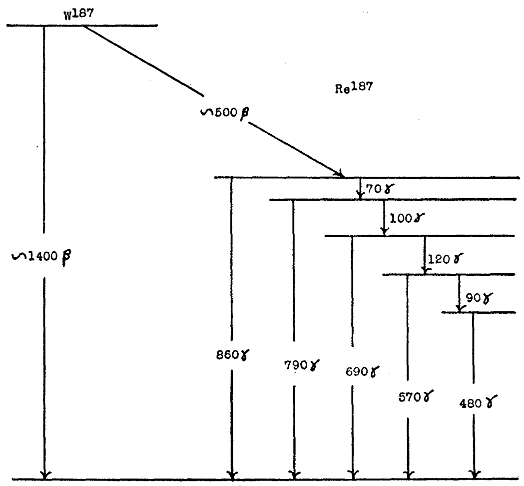

FIG. 1. Proposed energy level diagram of Re^{187}.

790, and 860 kev. An attempt was made to find a peak corresponding to a gamma-ray energy of 940 kev as previously reported,[3] but without success.

Figure 1 is a suggested energy level diagram for the resulting Re^{187} isotope. Valley[5] has reported internal conversion electrons corresponding to gamma-rays of 85, 101, and 135 kev. It is suggested that the 90, 100, and 120 kev transitions indicated in the diagram may be associated with the gamma-rays which Valley observed. Uncertainties due to width of lines can easily account for the differences in the values. The 70-kev jump has not been observed as yet, and this scheme suggests that the region roughly between 150 and 450 kev should be examined for evidence of other possible transitions between these levels.

The gamma-rays of the 67-hour molybdenum were also studied. A typical run is shown in Fig. 2. Here again the intensity of the peaks above the Compton background was not great. Three, however, seem to be confirmed—660, 705, and 730 kev—which correspond to gamma-rays of 770, 815, and 840 kev. Since Mo^{99} is in equilibrium with Ma^{99}, some or all of these gamma-rays may be associated with the masurium decay instead of with molybdenum, but work of Seaborg and Segrè[6] suggests that this is not likely.

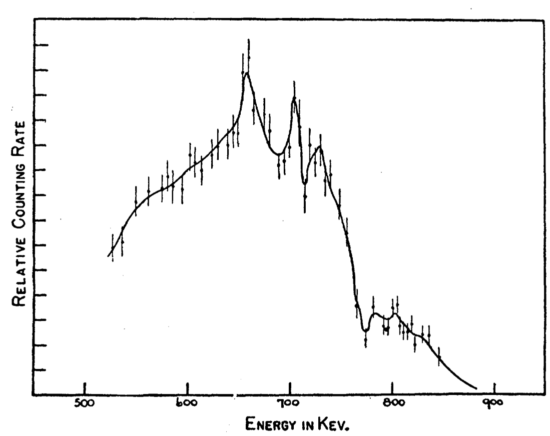

FIG. 2. Gamma-rays from 67-hour molybdenum.

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[2] A. F. Clark, Phys. Rev. **61**, 242 (1942).
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[5] G. E. Valley, Phys. Rev. **59**, 686A (1941).
[6] G. T. Seaborg and E. Segrè, Phys. Rev. **55**, 808 (1939).

A Proposed Detector for High Energy Electrons and Mesons*

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USE can be made of the visual radiation emitted by a charged particle moving at constant speed in a medium where the phase velocity of the light is smaller than the velocity of the charged particle to detect such particles. This visual radiation was first observed by Čerenkov.[1] A theoretical investigation was made by Frank and Tamm[2]; and an independent experimental quantitative verification using monoenergetic electrons was made by Collins and Reiling.[3]

If a particle of speed β impinges on a non-absorbing dielectric, then since the speed of the particle is maintained except for collision and radiative losses, the speed of the particle will remain equal to β. On the other hand the phase velocity of electromagnetic radiation is reduced to $1/n$ where n is the index of refraction of the dielectric. Frank and Tamm have shown that under these conditions the vector potential does not cancel and that coherent radiation exists directed at an angle θ with the direction of motion of the particle such that $\cos\theta = 1/\beta n$. The radiation has an energy spectrum per unit length of dielectric

$$f(\gamma)dr - 4\pi^2 \frac{e^2}{C^2}\left(1 - \frac{1}{\beta^2 n^2}\right)\gamma d\gamma;$$

that is, provided the radiation is not absorbed, light will be given off in that spectral region where n is substantially larger than one. For glasses and plastics like Lucite these conditions are met in the visual region; and since n is practically constant there, the number of photons per unit frequency interval emitted is independent of the frequency. It is to be noted that the Čerenkov effect depends only upon the charge and speed of the particle and not on its momentum or energy. Hence since high energy electrons

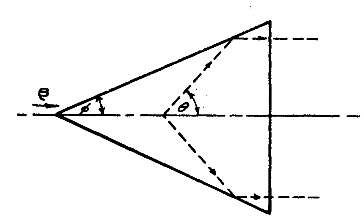

FIG. 1. Simple electron-type radiator ($n = 1.5$).