In order to study the activity of Cs^{135} a mass spectrographic separation of the cesium isotopes was made with the mass spectrograph which has been described by Lewis and Hayden.[5] Photographic transfers were obtained using different intervals of exposure. With the deposit obtained, a transfer was obtained due to the 33 year Cs^{137} after 10 minutes. However, after 4 months transfer, the activity of Cs^{135} was still undetected, although the darkening due to the small amount of 1.7 y Cs^{134} present was quite pronounced. This proves that the half-life of Cs^{135} is at least 1.8×10^4 times longer than Cs^{137}, i.e., is greater than 6×10^5 years. This result is not in disagreement with the results of Sugarman in which he has detected the activity due to Cs^{135} and assigned a half-life of 2.1×10^6 years.

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[3] M. G. Inghram, R. J. Hayden, and D. C. Hess, Jr., Phys. Rev. **72**, 967 (1947).
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Internal Conversion Coefficient and Mass Assignment of the 57-Min. Se Isomer

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THE internal conversion lines of the 57-min. Se isomer have been measured by A. C. Helmholz.[1] It was not possible, however, to calculate the internal conversion coefficient because of the contamination of other Se activities produced in the Se+d reaction. According to Seaborg's tables[2] the mass number 81 of this activity is still somewhat uncertain (class B).

The electromagnetic isotope separator of this institute has been used to separate deuteron bombarded Se. In this way it is possible to obtain carrier free activities deposited on very thin foils. As Fig. 1 shows, the ordinary isotope lines can also be focused as circular spots of a size convenient for β-spectrometer measurements. After the separation, the collector plate (Fig. 1) was cut into strips corresponding to the different mass numbers between 77 and 83. We found the complex activity of the chain $Se^{83}\rightarrow Br^{83}\rightarrow Kr^{83}$ at mass number 83. The 57-min. activity of mass number 81 (no activity at 79) was sufficient for β-spectrometer investigation. Figure 2 shows the β-spectrum of this isotope recorded 60 minutes after the separation, when transient equilibrium is practically reached. The β-spectrometer data are summarized in Table I.

TABLE I. Summary of the β-spectrometer data.

Isotope	Upper limit Fermi plot Mev	β-lines	$H\rho$	Energy kev	$h\gamma$ kev	K/L	Half-life min.
Se^{*81}		K	1060	90.5	104 ± 2	≈3.9	57 ± 1
		L	1131	102.4	104 ± 2		
Se^{81}	1.38 ± 0.05						

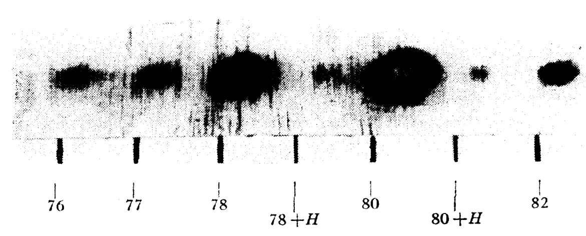

FIG. 1. Circular focused mass spectrum of Se deposited on a thin Al-plate. Spot distance 11 mm.

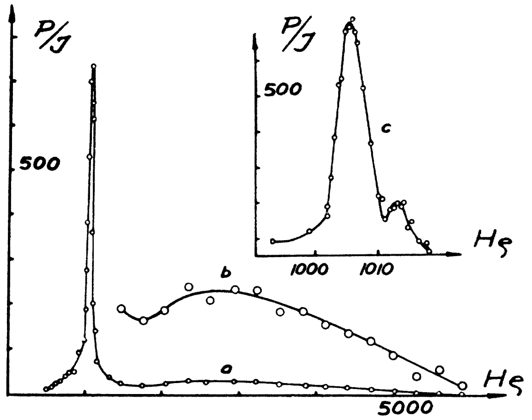

FIG. 2. a. β-spectrum of the separated activity on mass number 81. b. The continuum drawn to a five times larger P/I scale than a. c. The lines drawn to an eight times larger $H\rho$-scale than a.

To get the total internal conversion coefficient $[(Ne/(Ne+N\gamma)\cdot100)]$ the ratio of the surfaces under the lines and the continuum have to be multiplied by the factor $[\lambda Se^{81}/(\lambda Se^{81}-\lambda Se^{*81})]$, because of radioactive equilibrium requirements. If we use the values 57 and 19 min. of A. Langsdorff, Jr., and E. Segrè[3] for the half-lives, we arrive to a total impossible internal conversion coefficient of 120 percent. The half-lives 56.5 and 13.6 min. determined by H. Wäffler and O. Hirzel[4] seem, however, to fit our measurements much better and give the value 104 percent for the coefficient. We estimate the error in our measurements to be less than 10 percent. Thus the γ-ray corresponding to the isomeric transmission of Se^{81} seems to be almost completely converted.

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Interpretation of Underground Cosmic-Ray Data

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October 13, 1949

THIS letter is intended to put on record some remarks made verbally by the writer and others within the last year, regarding the interpretation of underground experiments.

It is well known that the vertical cosmic-ray intensity follows the depth as a power law with exponent ≈1.9 down to a depth of about 300 meters water equivalent (when correction is made at the smaller depths for the decay of mu-mesons in the atmosphere), and with exponent ≈2.9 at depths beyond about 400 meters. On the other hand, the extensive air showers have a power-law energy spectrum with exponent ≈1.8 continuing to energies 10^5 times greater than the energy which a meson must have to penetrate to the greatest depth at which they have been detected (3000 m). The explanation of this anomaly in terms of increased energy loss of high energy mesons has been rejected.[1-3] Barnothy and Forro[3,4] have explained it on the hypothesis that the rays that penetrate great depths are not mesons but their neutral decay products, which occasionally produce short-range charged secondaries in or near the detecting apparatus. The writer[1] and Hayakawa[2] have offered the suggestion that mu-mesons are the penetrating particles, but are themselves decay products of pi-mesons produced high in the atmosphere. The original estimate of the lifetime of the pi-meson necessary to fit this picture was rather crude, but more refined calculations by Hayakawa and Tomonaga[5] and by Eyges

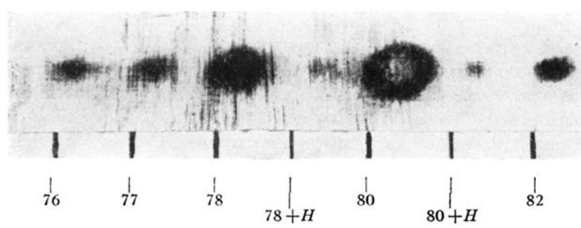

FIG. 1. Circular focused mass spectrum of Se deposited on a thin Al-plate. Spot distance 11 mm.