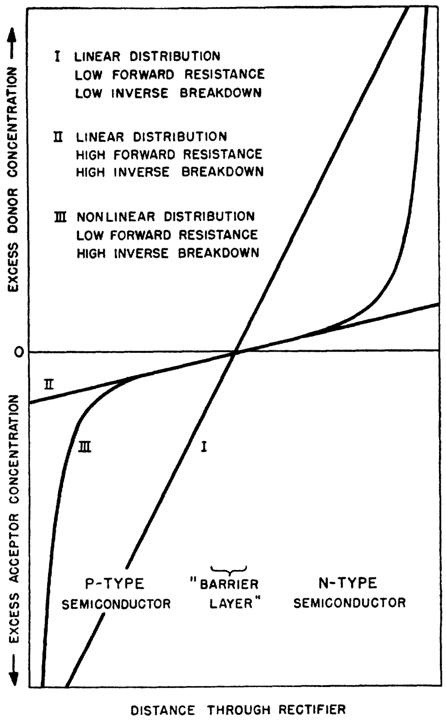

FIG. 1. Impurity distributions in semiconductor rectifiers.

teristics of these rectifiers are similar to those of selenium or copper oxide units except that the current densities are approximately 1000 times greater in the germanium units. Satisfactory rectifiers may be made from N- or P-type germanium having a resistivity of 5 ohm-cm or more.

When a rectifier is prepared by the diffusion of donor and acceptor impurities into the opposite sides of a wafer of extrinsic semiconductor, the barrier is located near one surface where the concentrations of donors and acceptors are equal. Accurate location of the barrier by means of a potential probe is possible and affords a sensitive method for the measurement of the diffusion of donor and acceptor impurities into semiconductors.

The Beta-Disintegration of Th^{233}

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THE 23.3-minute activity of Th^{233} has been studied in a magnetic lens spectrometer.[1] Sources were prepared by irradiating ThO_2 with neutrons in the thermal column of a nuclear reactor. The above decay rate was obtained by direct measurement for over eight half-lives and was also checked in the spectrometer. Sources were about 0.5 inch in diameter. The spectrometer was adjusted at a resolution of six percent during the investigation. Detection was by means of a 3.6-mg/cm^2 mica end-window counter.

The momentum distribution of the beta-particles is shown in Fig. 1 and the corresponding Fermi plot is shown in Fig. 2. There is clearly only one group of beta-rays. The extrapolated end point is 1.23±0.01 Mev. At high energies the Fermi plot is a straight line as might be expected, since the comparative half-life is only $ft\sim 10^6$. From the nuclear shell model one might expect this transition to involve a change of parity. The transition, therefore, appears to be of the once-forbidden type with a spin change of 0 or 1.

The downward deviation of the Fermi plot at low energy cannot be ascribed to source thickness or to counter window cut-off and is not fully understood. The data represented by circles were obtained using a source with 16 mg/cm^2 surface density mounted on 0.0002-inch aluminum backing. In order to examine the possibility that the apparent deficiency of low energy particles was due to source thickness, another source, with surface density of 0.6 mg/cm^2 mounted on a thin Zapon film, was studied in the spectrometer. These data are represented by triangles in Figs. 1 and 2. It is apparent that the use of a much thinner source

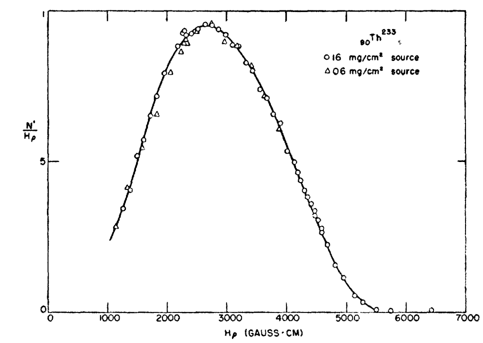

FIG. 1. Beta-spectrum of Th^{233}.

merely served to accentuate the downward deviation at low energy. This fall-off could possibly be due to a low energy defocusing effect in the spectrometer, although no other beta-ray spectrum analyzed with this instrument has exhibited any such deviation until below 200 kev. For example, the RaE spectrum, which has about the same end point and is located in the same part of the periodic table, was found to yield its characteristic shape, with no evidence of a deficiency of low energy electrons as reported above.

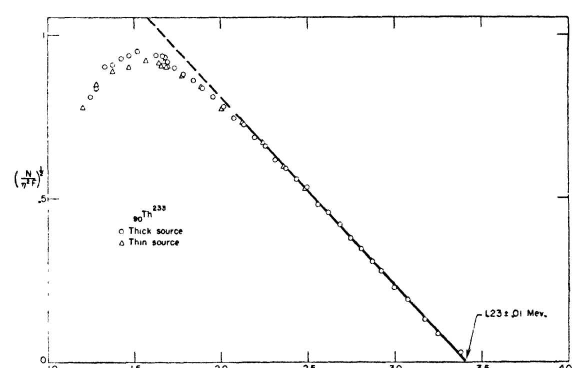

FIG. 2. Fermi plot of the data. The values for F were determined from the curves prepared by Moszkowski.

A search for gamma-rays was made by placing irradiated ThO_2 powder in a cylindrical copper capsule fitted with a uranium radiator. A very weak secondary electron distribution was observed which was interpreted as resulting from bremsstrahlung.[2] There was no evidence of photo-electron peaks. It is concluded that the beta-transition is directly to the ground state of Pa^{233}, as suggested by previous absorption measurements.[2]

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1 L. M. Langer, Phys. Rev. **77**, 50 (1950).
2 Seaborg, Gofman, and Stoughton, Plutonium Project Report CN-126 (June, 1942), unpublished.