Some results of these calculations (for $r=A=14$) are given in Table I. The high energy mesons must also be produced in groups. If $E_P \sim 10^{17}$ ev, we find multiplicities $\sim 10^5$ mesons, and meson energies $\sim 10^{12}$ ev sufficient to explain the penetration of mesons at great depths.[11]

[1] Symposium on Cosmic Rays, Acad. Bras. Ciencias 129 (1941); G. Wataghin, Phys. Rev. **70**, 787 (1946); Comptes Rendus **207**, 358 (1938).
[2] In accord with Heisenberg's general idea of explosion showers.
[3] G. Wataghin, Phys. Rev. **71**, 453 (1947); E. P. George and A. C. Jason, Nature **161**, 248 (1948); J. Tinlot, Phys. Rev. **73**, 1476 (1948).
[4] L. Janossy, Proc. Roy. Soc. **A179**, 361 (1941); L. Janossy and Rochester, Proc. Roy. Soc. **A183**, 181 (1944); V. H. Regener, Phys. Rev. **64**, 252 (1943).
[5] More data about these showers can be found in our paper (see reference 1).
[6] G. F. Chew, Phys. Rev. **73**, 1128 (1948).
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[11] See Professor A. H. Compton's remarks at the Symposium (reference 1).

Non-Rectifying Germanium

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RECENTLY germanium of rather unique properties has been prepared in this laboratory. Most unique of the properties observed is an almost complete absence of surface rectification at the germanium-metal contact. Several ingots of this type were prepared by melting germanium powder at a pressure of less than 10^{-4} mm Hg. The powder was prepared by reduction of germanium dioxide in a hydrogen furnace. Ten-point, plane-welded contact rectifiers were made from one ingot. Their average rectification ratio for 20 volts and at room temperature was 3.54. At −196°C the average ratio was 1.22. These units were weakly *N*-type at room temperature, *P*-type at −196°C. Hall effect measurements on larger samples showed that the material was *P*-type at low temperatures, reversing to *N*-type at 70°C. Potential distribution studies indicated a uniform resistivity of 17.8 ohm cm. The mobility averaged 2890 cm²/volt sec. and the Hall coefficient 514,000 e.m.u.

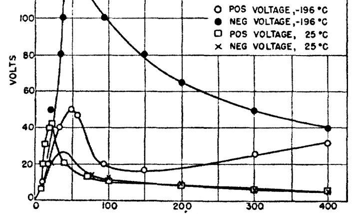

FIG. 1. Residual rectification characteristics for a welded contact rectifier made from "non-rectifying" germanium. At voltages below 10 the rectification ratio is less than 1.5, both at 25°C and −196°C, but at voltages of the order 50 there is a slight rectification with ratio ~2 at both temperatures. "Breakdown" occurs at 25 volts for 25°C, at 125 for −196°C. It is the result of heating at the point of contact.

The room temperature resistivity was increased by 22 percent by application of a magnetic field of 13,750 gauss. The Hall coefficient decreased by 29 percent on changing the magnetic field from 3600 to 13,750 gauss. Resistance of the point-contact rectifiers increased by about 18 percent in a field of 13,750 gauss, for both directions of current. Since this result is almost as large as the magnetoresistance of the bulk, one is compelled to conclude that practically all the resistance at the contact was "spreading resistance," with little contribution from contact barriers. The contact resistance averaged 2900 ohms. This is roughly ten times the forward resistance of *N*-type units made from material of comparable resistivity. Thus the "electric field-sensitive" conductivity studied by Bray, Lark-Horovitz, and Smith,[1] and by Brattain and Bardeen[2] may not appear in *P*-type germanium.

Figure 1 illustrates the residual rectification of a typical non-rectifying unit, No. H775. For small voltages the rectification was negligible, at both 25°C and −196°C, but the rectification factor increased to a value of the order 2 at 20–100 volts. It seems probable that the observed rectification was due to heating and consequent inhomogeneity in the germanium rather than to a true rectification between the germanium and the Pt-10 percent Ru whisker. Pressure contacts utilizing brass, stainless steel, and dural were found to yield negligible rectification. A study is now being made of the relation of the above results to the theory of the contact properties of a *P*-type semi-conductor.

A second point of interest is that, in spite of the apparently high degree of homogeneity in this *P*-type germanium, the magnetoresistance was large, as was the variation of Hall coefficient with magnetic field. Since the magnetoresistance of the ten test units was determined largely by a very small region of germanium around the point of contact, it seems that either the magnetoresistance (and probably also the variation of Hall coefficient with field) is intrinsic (not a result of inhomogeneity) or else the inhomogeneity is on a scale small compared to the dimensions of the point contact (~0.0002 in.). Although we cannot decide definitely as yet between these possibilities, a plausible picture retaining the second hypothesis is that the inhomogeneity consists of a rather uniform distribution of sub-microscopic lattice defects, which may also be responsible for the *P*-type conduction. Work is continuing to test these ideas.

[1] R. Bray, K. Lark-Horovitz, and R. N. Smith, Phys. Rev. **72**, 530 (1947).
[2] W. H. Brattain and J. Bardeen, Phys. Rev. **74**, 231 (1948).

γ-Radiation from Be^8

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THE cross section for the capture of a proton by the Li^7 nucleus, resulting in a state of Be^8 having an excitation energy of 17 Mev, shows a strong resonance