conserved in fast interactions. In the Pais and Gell-Mann formulation, for example, this quantum number has the value -1 for K^--mesons and hyperons, while for K^+-mesons its value is $+1$. Consequently, a K^--meson can be absorbed by a nucleon to produce a hyperon and a π meson, in a fast interaction, conserving strangeness, while a K^+-meson can undergo only scattering or charge exchange.

While K^--mesons can also undergo scattering and charge exchange, the present results indicate that absorption predominates strongly. The difference between K^- and K^+ interactions[5] with respect to both the size of the cross section[8] and the types of interaction are in excellent agreement with the requirement of conservation of strangeness in fast interactions.

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[2] Eighteen scattering events, at angles $>5°$, were observed. With account taken of the K^--meson energy at the point of scatter, most of these events are consistent with Coulomb scattering; only one is classified as a nuclear scattering.
[3] A value of the K^--meson lifetime will be reported separately.
[4] J. Hornbostel and E. O. Salant, Phys. Rev. **102**, 502 (1956) also give a value for the mean free path for K^--interaction, based on eight events.
[5] Lannutti, Chupp, Goldhaber, Goldhaber, Helmy, Iloff, Pevsner, and Ritson, Phys. Rev. **101**, 1617 (1956).
[6] In plotting the prong distributions, recoil tracks shorter than $\sim 5\mu$ were not included. Such recoil tracks were associated with about half of the "zero-prong" stars.
[7] Fry, Schneps, Snow, and Swami, Phys. Rev. **100**, 950 (1955) and Phys. Rev. **100**, 1448 (1955); J. Hornbostel and E. O. Salant, reference 4. Reports in Proceedings of the International Conference on Elementary Particles, Pisa, June, 1955, Nuovo cimento (to be published) by Chupp, Goldhaber, and Webb; Pevsner, Ritson, and Widgoff; Bacchella, di Corato, Ladu, Levi Setti, and Scarsi; Bristol-Padua group.
[8] K. A. Brueckner and A. Pais have independently pointed out that, if K^-- and K^+-interactions proceed in such a way as to conserve strangeness, the difference in size of their cross sections can be understood in terms of a simple perturbation theory.

Further Analysis of the Massachusetts Institute of Technology Antiproton Event*

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Some time ago, the M.I.T. group published[1] a picture showing a heavy particle that came to rest in a $\frac{1}{2}$-inch thick brass plate of a multiplate cloud chamber, and gave rise to at least three photons with a total energy in excess of 1 Bev. The event could not be explained in terms of any experimentally known particle, but could be interpreted easily as the annihilation of an antiproton, or an antihyperon, whose existence was predicted by Dirac's theory. At that time, a unique identification was not possible because the primary mass and the secondary energy had not been determined with sufficient accuracy to rule out the possibility that the event represented the decay of a hitherto-unknown boson of mass considerably greater than that of the various heavy mesons.

Subsequently, however, Hazen[2] made a careful cloud-chamber study of showers produced in copper plates by electrons of known momentum. His results show that the total number of secondary electrons gives a good measurement of the primary energy in the region from 0.1 to 1 Bev, and that the fluctuations are not unduly large. Using the M.I.T. results, Hazen found that the total energy of the showers in the M.I.T. event was more than[3] 1630 Mev ($\pm 20\%$), which is in agreement with the original energy determination by DeStaebler. Hazen's results remove any doubt as to the evaluation of the secondary energy, and they provide a good estimate of the error.[4]

In addition, since our original measurements, photometric techniques for the determination of ionization in cloud-chamber tracks have been studied in detail.[5–7] In particular, a method has been developed for making ionization measurements in multiplate chambers.[7] Using ionization *vs* residual range, we have applied this method to determine the mass of the primary particle in the M.I.T. event. The application is particularly favorable in this case because five track segments of 13 cm total length were available in the central, uniformly illuminated region of the chamber. Furthermore, three proton tracks, two K-meson tracks, one π-meson track (all of known range), and several tracks of minimum ionizing particles were available for comparison in nearby pictures in the same chamber region. The ratio of the photometrically determined transmission of the unknown track to that of a comparison track is related to the ratio of their ionizations by a calibration curve obtained from measurements on a number of known particles of known residual range. This method, which will be described in detail elsewhere, gave for the rest energy of the primary particle a value of 823 ± 155 Mev, which is to be compared with the rest energy of the proton, 938 Mev. As a check, similar measurements were made on a statistically equivalent length of tracks made by stopping K-mesons, and the resulting rest energy, 488 ± 80 Mev, was in excellent agreement with the accepted value of 493 Mev (all errors are standard deviations).

The new measurements of the primary mass and the secondary energy make it appear very unlikely that

the mass of the primary particle could have been sufficiently large to account for the total energy of the secondary particles arising from its disappearance. It is thus virtually certain that the M.I.T. event was actually the annihilation of an antiproton, or less probably an antihyperon, with an ordinary nucleon. This interpretation, of course, is strengthened by the fact that no bosons heavier than nucleons have been discovered in the meantime, whereas the existence of antiprotons has been established by experiments[8] with the Berkeley bevatron.

It may be added that an energy and momentum analysis of the photons associated with the M.I.T. event indicates that at least three neutral mesons must have been produced in the annihilation process. This result is in accord with the selection rules for the annihilation of an antiproton at rest.

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[2] W. E. Hazen, Phys. Rev. **99**, 911 (1955).

[3] Two showers were not fully developed before they left the chamber. Furthermore, since the momenta of the three showers do not balance, some additional energy escaped detection.

[4] Recently, P. A. Bender [Nuovo cimento **2**, 980 (1955)] has made a further study of shower energies by DeStaebler's method, and his results are in excellent agreement with Hazen's.

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