the parameter curve that passes through the corresponding point on the parameter curve. An inspection of the curves of constant m in the range, curvature coordinates shows that the linear measure orthogonal to the parameter curves is closely proportional to log m. The change of the variable from m to log m with appropriate change in weight makes an appreciable change in the mean value of the mass. When each value of log m is weighted inversely as a square of $\Delta m/m$ the value of m corresponding to the mean is found to be 212 in agreement with the more accurate method.

* Assisted by the joint program of the ONR and AEC.
[1] W. B. Fretter, Phys. Rev. 70, 625 (1946).
[2] A detailed discussion of the adjustment of a parameter curve to two Gaussian variables is given by Demming, *Statistical Adjustment of Data* (John Wiley and Sons, Inc., 1943), pp. 141–144.

Interaction of Mesons with Nucleons and Light Particles

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WE have been making a phenomenological study of the various experiments which have been done in recent years on the interaction between the various types of particles. In the course of this investigation two interesting points have come to light.

First, we found that if the decay of the μ-mesons and the capture of the μ^--mesons by nuclei are described by the reactions[1]

$$\mu \rightarrow e + \nu + \nu \qquad (e = \text{electron}, \ \nu = \text{neutrino})$$
$$\mu^- + P \rightarrow N + \nu \qquad (P = \text{proton}, \ N = \text{neutron}),$$

and that the Fermi type interactions are assumed to be responsible for these processes, the coupling constants would have the values

$$g_{\mu e} \sim 3 \times 10^{-48} \text{ erg cm}^3$$

and

$$g_{\mu P} \sim 2 \times 10^{-49} \text{ erg cm}^3,$$

respectively. These values are so determined as to fit the experimental lifetime[2] of the μ-mesons and the capture probability of the μ^--mesons by nuclei.[3] It is remarkable that the three independent experiments: the β-decay of the nucleons and the μ-mesons and the interaction of the nucleons with the μ-mesons lead to coupling constants of the same order of magnitude.

One can perhaps attempt to explain the equality of these interactions in a manner analogous to that used for the Coulomb interactions, i.e. by assuming these interactions to be transmitted through an intermediate field with respect to which all particles have the same "charge." The "quanta" of such a field would have a very short lifetime and would have escaped detection.

Second, if we assume the π-mesons to have integral spin and assume direct couplings for the processes

$$\pi \rightarrow \mu + \text{anti } \nu$$
$$N \rightarrow P + \pi^-$$

with coupling constants determined from the lifetime of the

π-mesons[4] and the strength of nuclear forces,[5] the interaction between the μ-mesons and the nucleons can be *quantitatively* explained as a second-order interaction through the virtual creation and annihilation of π-mesons.

After the completion of our work Mr. A. Ore has kindly informed us that similar considerations have been carried out by J. A. Wheeler and J. Tiomno.

[1] The masses of the π- and μ-mesons are taken to be

$$m_\pi = 286 m_e, \qquad m_\mu = 212 m_e.$$

[2] B. Rossi, Rev. Mod. Phys. 20, 537 (1948).
[3] B. Rossi, Rev. Mod. Phys. 20, 537 (1948). In the calculation for the capture process the Fermi model for the nucleus is assumed and only single particle excitations are considered. See M. Rosenbluth, Phys. Rev. 75, 532 (1949).
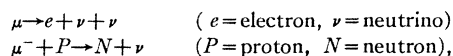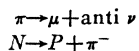[4] J. R. Richardson, Phys. Rev. 74, 1720 (1948).
[5] H. Bethe, Phys. Rev. 57, 390 (1940).

Some Preliminary Cloud-Chamber Photographs of Artificial Mesons

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THE 184-inch cyclotron has recently been converted so that it accelerates protons up to an energy of 350 Mev. A cloud chamber has been operated in the neutron beam which is produced when the 350-Mev protons are allowed to strike a two-inch copper target. The first run has yielded several tracks that may be definitely classified as meson tracks though we are not able to distinguish between light and heavy mesons.

The cloud chamber was operated in a magnetic field of 21,700 gauss and contained $1\frac{1}{2}$ atmospheres of argon with water vapor. The neutron beam was six inches in diameter and was allowed to strike the chamber so that it traversed

FIG. 1. Meson track produced in a cloud chamber, operated in a beam of neutrons from a copper target bombarded by 350-Mev protons. Its radius of curvature corresponds to a π-meson of 2.3 Mev or a μ-meson of 3.0 Mev.