TECHNICAL PAPERS

Creation of a "σ" Meson by a Highly Ionizing Nucleus in the Cosmic Radiations[1]

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A 100-μ-thick boron-loaded Ilford C2 plate was exposed to the cosmic radiation through the use of free balloons which remained at altitudes corresponding to pressures between 4 and 6 cm of Hg for 11 hrs.

sion and into the glass backing at (b). At a point on this column 26 μ from the upper surface, a "σ" meson originates and travels 158 μ, where it stops and is captured, producing a nuclear disintegration in which the visibly ionizing particles (e), (d), and (c) are emitted. Fig. 2 is a drawing in which the tracks in this event have been projected on the plane defined by the tangent to the meson track at the point of creation and the silver column from (a) to (b). The grain densities of sections (a) and (b) are considerably greater than those corresponding to protons or alpha particles capable of cre-

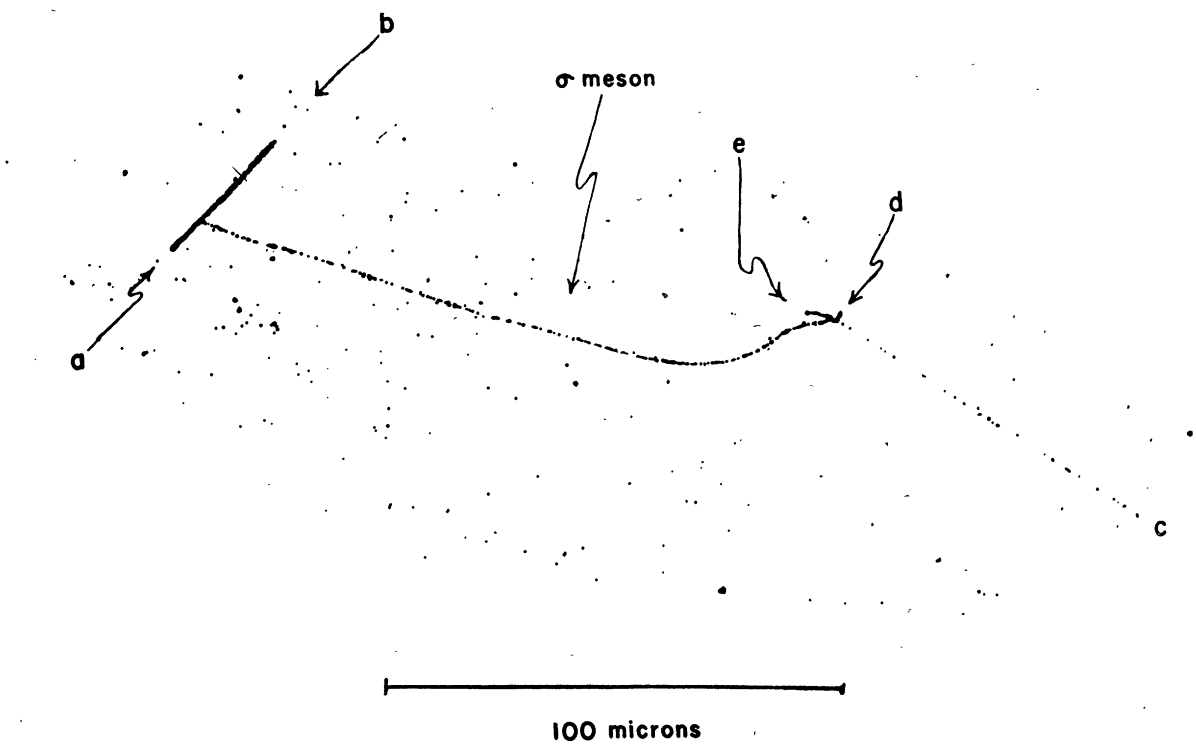

FIG. 1.

The mosaic of microphotographs in Fig. 1 shows an example of an unusual case of the production of a "σ" meson in the emulsion of this plate. The elementary act in which this meson was produced differs from those found by Powell and his collaborators (*2*).

A column of silver grains passes steeply (64°) from the top of the emulsion (a) completely through the emul-

ating a meson of mass energy which is known from measurements with the synchrocyclotron in Berkeley, California, to be 143 mev. Section (b) of the column appears to be slightly more dense than (a). This small difference, however, may be due to a loss in resolving power of the microscopic system when viewing grains at greater depths beneath the surface of the emulsion. An upper limit to the difference in the grain densities above and below the point at which the meson is created is certainly less than 10%. The measured deviation of the

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column from (a) to (b) is less than 1°, which is about the deviation expected for a straight track of 110 μ due to emulsion distortions in the central regions of a plate.

It seems impossible that this meson is produced in a nuclear disintegration of the ordinary type in which the only other visible tracks, (a) and (b), of nearly the same grain densities travel in opposite directions along a straight line. This strongly suggests that the track from (a) to (b) is due to a single particle passing through the emulsion which interacts with one of the

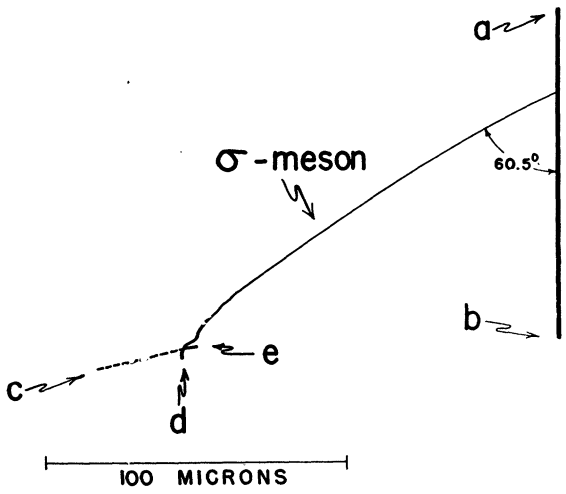

FIG. 2.

nuclei in this emulsion to create a meson. This is further augmented by the existence in this emulsion of several other heavy nuclei tracks of the same character as reported previously (*1*). This was shown by tracing the passage of 8 of these particles down through a 0.325-cm-thick lead plate and into a similar photographic emulsion. Two of these were followed on through an additional 3.9 cm of lead into another photographic emulsion.

The track from (a) to (b) in Fig. 1 could not be traced through the 0.325-cm lead plate, and this places an upper limit on the range of the particle producing the meson. This, coupled with the small change of less than 10% in the ionization after the creation of the meson, shows that the particle had a maximum energy of several bev at the point where the meson was created and a nuclear charge between 7 and 20 unit electronic charges.

The absence of a large nuclear disintegration demonstrates that the meson was created in a pure nucleon-nucleon interaction. This seems to indicate that nuclei can be greatly transparent to the bombardment of stripped nuclei of energies capable of producing a meson.

References

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2. OCCHIALINI, G. P. S., and POWELL, C. F. *Nature, Lond.*, 1948, **162**, 168.

Analysis of Insect Food Habits by Crop Examination

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It has been common practice for many years to determine the food habits of birds and mammals by examination of crop or stomach contents, but there appears to have been no effort to apply the same technique systematically to the study of the food habits of insects. Recent studies, however, demonstrate clearly both the feasibility of the technique and its value in determining food habits under natural conditions.

The technique is probably applicable to all insects with chewing mouth parts, but in the studies here reported has been limited to various types of Orthoptera. In the Orthoptera, even those with graminivorous- rather than carnivorous-type mandibles (*2*), the food is not so finely divided when it reaches the crop but that much can be learned of its character from examining the fragments. Whether leaf fragments are from forbs or narrow-leafed plants can readily be determined by the character of the epidermal cells of the plant fragments found in the crop. Even those grasshoppers that feed exclusively on grasses and have graminivorous mandibles swallow relatively large bits of grass. Some plant fragments may be quite accurately identified—pollen grains, for example. Fragments of insects permit various degrees of identification: scales of Lepidoptera may be intact; wing fragments of smaller insects may show characteristic patterns of venation; or mouth parts and leg parts may be distinguishable. In other words, the natural diet of an insect species may be determined, at least qualitatively, from the examination of collected specimens. This means that one need not have recourse to laborious methods of experimental testing, at least for preliminary studies of food selection, and in some cases this technique may prove entirely adequate for both quantitative and qualitative determinations of food habits. Since field observation has not proved a successful means of judging food choice and since such observation has led to many errors, it appears probable that the method of crop analysis may prove a valuable guide to food habits of many species. It has already yielded significant results for certain orthopterans.

The feasibility of this technique is due to the fact that the food eaten by an orthopteran accumulates in the thin-walled expansible crop, where it undergoes little digestion before passing into the next division of the digestive tract. The esophagus in the Orthoptera merges directly into the crop, which may or may not be rather definitely

[1] Prof. Isely died December 30, 1947. This report was prepared by the junior author from his notes and supplementary observations.