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

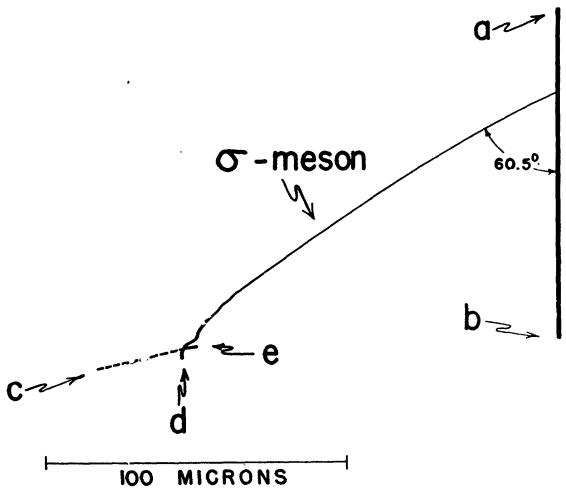

FIG. 2.

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.

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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.

separated by a constriction from the next section, the proventriculus. In the Gryllidae and Tettigoniidae (e.g., *Conocephalus*, see Fig. 1) the constriction is quite evident; in the Acridiidae it is less noticeable. In either case, however, food accumulates in the crop in a state of incomplete mastication. Examination of the crop contents may be most simply carried out by pulling off the head of the freshly killed insect. The digestive tract, at least the anterior part, will remain attached to the head. In crickets, katydids, and meadow grasshoppers the tract usually breaks at the constriction forming the posterior boundary of the proventriculus. In the short-horned grasshoppers practically the entire tract may be pulled out with the head. In either case, the crop may be opened at the anterior or posterior end and its contents pushed out. Teased apart in a drop of water on a microscope slide, the contents are ready for examination. The crop contents of specimens collected years before can be examined successfully if a little more care is observed. The contents of the crop, either from fresh or dried material, if placed under a sealed cover glass in 40 parts of 10% formalin and 60 parts of glycerine, can be studied at leisure.

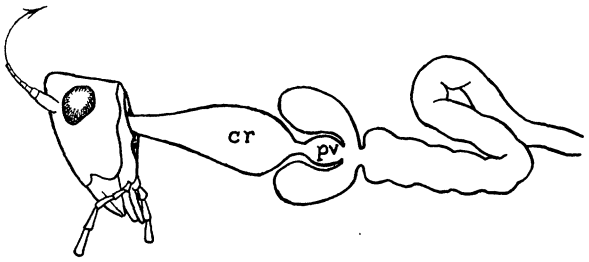

FIG. 1. Head and digestive tract of *Conocephalus fasciatus*, approximately 3 times natural size. The crop (cr) is distended as it is when filled. When the tract is pulled out with the head, it usually breaks at the indentation just posterior to the proventriculus (pv).

The value of crop analysis is well illustrated by the fact that studies recently carried out on several species of meadow grasshoppers (Conocephalinae) show conclusively that insects constitute a part of their normal diet. Certain other members of the Tettigoniidae, particularly decticids, are known to be carnivorous (*3*). The carnivorous habits of the meadow grasshoppers, on the other hand, while known, have been considered aberrant modifications of the normal feeding behavior (*1*). These first studies, which are to be reported in extended form elsewhere, show further that the vegetative parts of plants are rarely, if at all, eaten by these Conocephalinae. These insects subsist on flowers, pollen, and seeds of grasses, in addition to insects, normally deriving little if any food from the leaves of either the grasses or the broad-leafed plants among which they live. Inasmuch as it has been assumed, largely on the basis of analogy, that meadow grasshoppers exert significant pressure on meadow vegetation (*4*), the method of crop analysis has in this case demonstrated that the biotic role of this group of insects is quite different from that which has been assumed for it for many years. These species, which we have believed harmful, may, on the basis of these studies, be considered beneficial, or at least neutral, in their ecological role. An expansion of this technique to the study of the food habits of other species may yield equally interesting and significant results.

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Evidence That Two Different Plant Viruses Can Multiply Simultaneously in the Same Cell[1]

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It is well known that a plant may harbor two or more viruses at the same time. Indeed, infection of a plant with two nonrelated viruses, which alone cause only mild symptoms, sometimes results in a severe disease. Thus, mild tobacco mosaic and potato mottle viruses together produce a serious disease of tomato known as streak (*7*). It has been presumed, but not proved, that two such nonrelated viruses may occupy the same cell. Experiments reported here demonstrate the presence of inclusions of both tobacco mosaic and tobacco etch viruses in a large number of cells of doubly infected tobacco plants. Since these inclusions are closely associated with the respective viruses, their presence together indicates that the viruses increased simultaneously in the same cell.

The type strain of tobacco mosaic virus, which we used, forms abundant hexagonal crystals in the cytoplasm of its host. The mild strain of tobacco etch virus likewise produces crystals, often plate-like, but easily differentiated from those of tobacco mosaic virus, being different in size, form, and location. They occur characteristically in the nuclei but can sometimes be seen in the cytoplasm. Such inclusions were first described for the severe strain of tobacco etch by Kassanis (*4*).

The crystalline inclusions are usable for identifying tobacco mosaic and tobacco etch viruses within cells. Each of these viruses forms, in the cytoplasm, amorphous bodies which McWhorter (*6*) has designated as *viroplasts*. The viroplasts vary in structure; those of tobacco mosaic cannot always be distinguished from those of tobacco etch. They are not, therefore, readily usable for identifying the respective viruses within cells.

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