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Nonmarine Miocene Arthropods from California*

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An excellently preserved fauna consisting mostly of fossil insects, arachnids, and branchiopods has been discovered in lacustrine deposits of middle Miocene or older age in the Calico Mountains, Mojave Desert, California. The composition of the fauna secured to date is shown in Table 1. Most of the specimens except the dragonfly nymphs, which are 18 mm long, have a maximum dimension of less than 3 mm.

The insects are preserved in petroliferous limestone nodules associated with bedded borates. At least three modes of preservation have been observed.

The dragonfly nymphs are preserved in calcite, the remainder of the specimens are preserved either in silica or in apparently only slightly altered organic material. Most of the specimens are uncrushed, and the quality of the preservation is such that hairs on the body and appendages are preserved. Figure 1 illustrates some of the detailed characteristics that are preserved.

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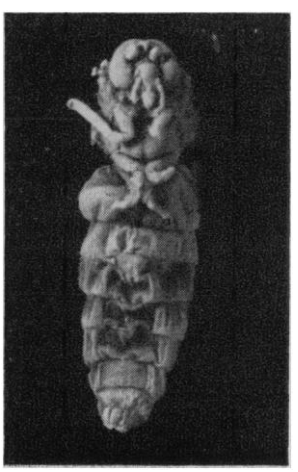

Fig. 1. Ventral view of a silicified adult midge. (×20)

The dragonfly nymphs were almost completely enclosed within limestone nodules when found. They have been excavated with a fine chisel-edged needle. The remainder of the specimens have been obtained from insoluble residues of limestone nodules digested in formic acid. Neither the organic nor the siliceous material appears to be affected by this acid. Most of the specimens are completely free of enclosing sediment and may be treated for study in much the same way as modern specimens.

Calcareous nodules in other fresh-water lake deposits of the Tertiary period should be examined for insect material. If additional specimens found at other localities are comparable in quality to those already discovered, the relatively unexploited field of stratigraphic paleoentomology may become a valuable tool in the study of the Tertiary lake deposits of western United States. In cooperation with entomologists of the U.S. Department of Agriculture and some universities, we are presently engaged in the study and description of the geologic and biologic implications of the insect fauna outlined in this paper.

The locality from which the insects have been collected is in the southeastern Calico Mountains about 5 mi north of Yermo and 1500 ft east of the Mule Canyon road, in the NE¼ NW¼ sec. 25, T. 10 N., R. 1 E., San Bernardino Meridian, Mojave Desert, California.

The geology of the Calico Mountains has been mapped recently by Thane H. McCulloh of the U.S. Geological Survey. He has divided the Tertiary section in the vicinity of the insect beds into four major lithic units:

4) Fluviatile and lacustrine sandstone, siltstone, mudstone, limestone, and conglomerate (1000+ ft).

3) Massive resistant hornblende andesite flow breccia (0 to 500 ft).

2) Thin- to medium-bedded lacustrine sandstone, siltstone, and shale containing numerous limestone beds in the lower half and gypsum, howlite, and colemanite beds locally near the top (900 to 1100 ft); the fossil insects are found near the top of this unit.

Table 1. Composition of the fauna.

Kind of fossil	Aquatic	Non-aquatic	Approx. No. of specimens	Approx. % of fauna
May-fly nymph	x		1	< 1
Dragonfly nymph	x		4	1
Thrips		x	17	5
True bug (3 species)		x	4	1
Beetle larva	x		130	30
Midge (2 species)			100	25
Larva	x		(23)	(6)
Pupa	x		(55)	(15)
Adults		x	(14)	(4)
Mite (2 species)		x	6	> 1
Spider		x	2	< 1
Fairy shrimp	x		150+	35

1) Tuffaceous sandstone, tuff, tuff breccia and volcanic mudflow deposits (5000 to 10,000 ft), resting on varied pre-Tertiary rocks.

These four units are conformable in this area, although there is an unconformity at the top of the lowest unit, 1, a few miles to the west.

The only diagnostic fossils so far found in the aforedescribed Tertiary section are in unit 4. Mammals of early late Miocene age have been identified by G. Edward Lewis from the upper part of the unit, and late middle (?) Miocene mammals occur near the base. Since the insect-bearing beds lie in unit 2, conformably under these Miocene beds, they also are believed to be of Miocene age.

The limestone nodules are associated with the borate beds and occur in brown paper-thin shales, laminated siltstones, and thin limestone beds that weather to gray and buff colors and form badlands beneath the cliff-forming andesite flow breccia. The nodules range from a fraction of an inch to several inches in diameter and are generally spheroidal, but some are flatter parallel to the stratification, and some have a small central depression on the top surface. Microscopic examination of crushed nodules indicates that they are composed of finely crystalline calcium carbonate with a minor amount of dark oily material.

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Inhibition of Virus Infections of Certain Plants by Extracts from *Capsicum frutescens* L.*

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The transmission and ready identification of viruses from certain plant genera and species are rendered difficult or impossible because of the presence of substances in extracts of these plants that inhibit the infection of indicator and other hosts. Extracts from *Phytolacca* (*1–3*), Dianthus (*4*), cucumber (*5*), and a number of chenopodiaceous plants (*6*, 7) contain such inhibitive substances. The paucity and sometimes the complete absence of characteristic symptoms following the mechanical inoculation of certain indicator hosts with juice expressed from sweet pepper plants (*Capsicum frutescens* L.) infected with cucumber mosaic and tobacco etch viruses indicated the existence of an inhibitor in pepper.

When juice expressed from the leaves of pepper plants infected with cucumber mosaic virus (CMV) was rubbed on the primary leaves of cowpea that had been lightly dusted with carborundum, one or two discrete, reddish, local lesions developed occasionally, and frequently no lesions appeared. The same results were obtained when the inoculum was obtained from recently infected pepper plants and from those showing long-standing infections. In contrast, however, inoculum obtained from infected burley tobacco plants yielded large numbers of local lesions on every inoculated leaf of cowpea. The results of five separate tests in which the extract from infected pepper was compared with an extract from infected tobacco gave an average of 0.4 lesions from the former and 150.6 from the latter. Three different isolates of CMV yielded essentially similar results. Furthermore, inoculations on *Chenopodium hybridum* L., another local lesion host for this virus, yielded correspondingly similar results.

Other infectivity tests were conducted in which CMV juice expressed from tobacco was adulterated with a few drops of healthy pepper extract. Assays of the adulterated and unadulterated juices were made on cowpea and *C. hybridum*. In six tests the average number of lesions per cowpea leaf was 7.9 for the former and 220.7 for the latter, and on *C. hybridum* the average number of lesions recorded was 10.2 following inoculation with the adulterated juice and 133.0 with the unadulterated juice.

As demonstrated by the local lesion response on cowpea, pepper extract was shown to be capable of reducing the infectivity of CMV, regardless of whether the virus was multiplied in *Nicotiana tabacum* L., *N. glutinosa* L., or in cucumber.

Other similar inoculations involving two different strains of ringspot virus isolated from tobacco and from cucumber showed that pepper extract almost completely inhibited the development of local lesions on cowpea and on *C. hybridum*. Moreover, the adulteration of infective juice of tobacco ringspot virus with a few drops of healthy pepper extract reduced local lesion production on tobacco.

In addition, other mechanical inoculations disclosed that the percentage of successful transmissions with tobacco etch virus by rubbing the leaves of cape gooseberry (*Physalis peruviana* L.) with juice expressed from infected pepper, as compared with that from tobacco, was relatively low. Furthermore, the adulteration of infective juice of the etch virus obtained from tobacco with a few drops of pepper extract decreased primary lesions on the inoculated leaves of burley tobacco by as much as 7 or 8 times.

Although assay tests indicated that the concentration of both cucumber mosaic and tobacco etch viruses in pepper was extremely low, nevertheless, in view of the afore-described evidence this may not be the true picture. The presence of virus inhibitors makes it necessary to exercise caution when estimating, by means of local lesion assays, the concentration of a virus in several different hosts.

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