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FOSSIL ARTHROPODS OF CALIFORNIA
NO 23. SILICIFIED INSECTS IN MIOCENE NODULES
FROM THE CALICO MOUNTAINS.

By W. DWIGHT PIERCE

In No. 22 of this series (Bull. So. Calif. Acad. Sci. 58:72-78, 1959), the writer presented a general report on studies of fossils found in calcareous petroliferous nodules of Miocene age in Southern California. Recovery of the fossils has continued, with particular concentration on the nodules from the Calico Mountains. The vast amount of material accumulating, both in the Los Angeles County Museum laboratory, and in that of Mrs. Ruth Kirkby, at her home in Riverside, California, necessitates breaking down the results in short papers as rapidly as accurate reports can be prepared. The present paper includes some of the rarer finds in several orders: Collembola, Ephemera, Plecoptera, Corrodentia, and Coleoptera.

Order COLLEMBOLA Lubbock 1873.

Although the oldest known fossil insect remains recorded are Collembola from the Devonian of England, fossils in this order are very rare. Handlirsch (1906. Die Fossilien Insekten. V Lief.: 678, 679) lists seven of the Suborder Arthropleona, and three of the Suborder Symphypleona from the Lower Oligocene Baltic amber. It is with pleasure that a three-dimensional crystalline springtail from the Miocene is added to the Arthropleona.

Suborder ARTHROPLEONA Börner 1901.

Superfamily ENTOMOBRYOIDEA Womersley 1933.

Family ENTOMOBRYIDAE (Tömösvary 1883) Gisin 1944.

Tribe ENTOMOBRYINI Börner 1906.

Genus ENTOMOBRYA Rondani 1861.

Entomobrya (Entomobrya) Kirkbyae

New Species

(Figures 1, 2)

HOLOTYPE. No. 5-303. Ruth Kirkby collection, Kirkby private Museum, Riverside, California. From Kirkby site 2 (float), in Upper Switchback Cañon, NW ¼ Section 19, R.2.E., T.10.N., Calico Mts., Yermo Quadrangle, San Bernardino County, California. The photograph (Figure 1) slightly retouched by the author, while studying the specimen under the microscope, gives a good representation of the specimen, which is complete except for parts of the legs and antennae.

DESCRIPTION. Length of body 1.00 mm; length of body with extended manubrium 1.50 mm.

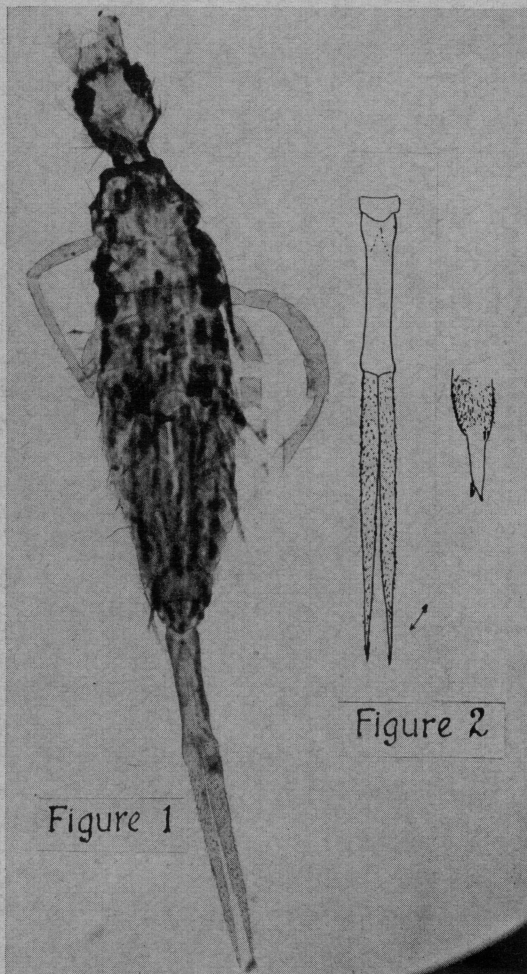


PLATE 14

Figure 1. *Entomobrya kirkbyae*, new species, type, actual length 1.5 mm. Photomicrograph by Edwin Horne.

Figure 2. *Entomobrya kirkbyae*, drawing by author of manubrium and dentes, with enlargement of mucro at tip of dentes. Size 0.5 mm.

Head elongate, in the proportions of: total length 28, frons and clypeus 8.5, eyes 7.5, behind eyes 9.5; width: clypeus 4, frons at base 10.5, head at eyes 17.5, vertex between eyes 7, occiput before narrowing 16, at apex 8.2. Prothorax length 4; width 8.5. Mesothorax length 17; width anterior portion 15, posterior portion 24. Metathorax length 11.5; width 28.5. First abdominal length 5.2; width 29. Second abdominal length 10; width 30. Third abdominal, length on median line 8.5; width 30. Fourth abdominal, length 39.5; width diminishing from 30 to 16.5. Fifth abdominal, length 7.5; width 14.5. Sixth abdominal length 7; width 10. Manubrium, length 25; width at base 7, narrowing at middle to 6. Dentes with mucro, length 52; width of single dens at base 3.5. All of these measurements are proportionate and obtained from photograph by centimeter calipers.

The head and body are sparsely clothed with long hairs. A great cluster of strong bristles on prothorax reaches forward over back of head. The dentes are minutely clothed with a short, fine pubescence. Frons and labrum show indistinctly between the bases of the antennae. Only basal joints of antennae are present. The eye patches are large and black, but the separate ocelli are not decipherable. The occipital area behind the eyes is longer than the eyes, and is abruptly angularly narrowed to the necklike prothorax.

Side margins of prothorax, also anterior margin and side margins of anterior half of mesothorax (scutum) sharply impregnated with black pigment. The scutal or anterior portion is almost twice as wide as prothorax at base, then curving abruptly widens to the wider posterior or scutellar portion. There is indication that the metathorax is evenly divided into scutum and scutellum.

Abdominal segments I, II, and III are short; while segment IV is much longer dorsally than the three combined, and four times as long as III. (From this we derive that the antennae are 4-segmented.)

The manubrium and dentes are together very long and slender, in the proportion to the rest of the body, as 4:7. The dentes are about twice as long as the manubrium, and taper to the tip. With difficulty, due to the transparency of the specimen, the mucro was seen at tip, and it seems to have a tooth as shown in sketch (Fig. 2).

The ventral lobe is short; the hamulus is indistinct.

This fossil species belongs to the group of cosmopolitan species of springtails, including *E. (E.) marginata* Tullberg (1871), and *E. (E.) atrocincta* Schött 1897. The latter is recorded as a present-day inhabitant of stagnant water pools in California.

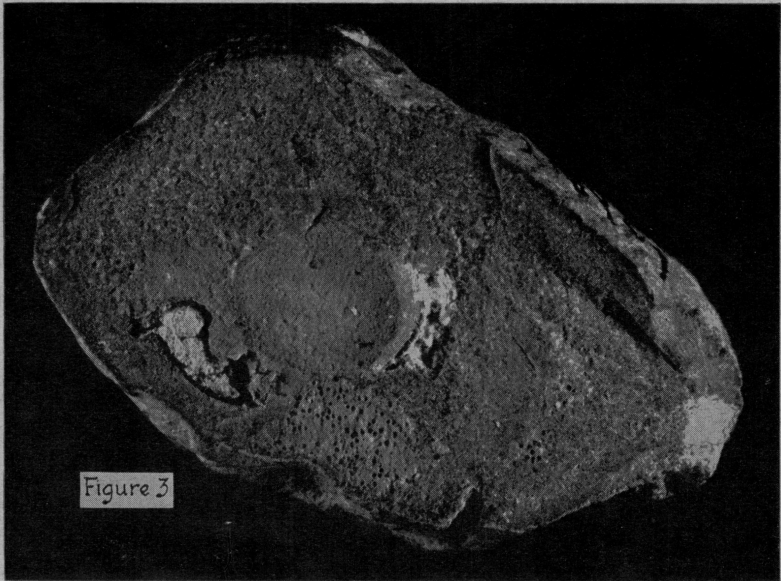


PLATE 15

Figure 3. Nodule 3686 containing mayfly and eggs. Size of nodule, $44 \times 34 \times 22$ mm. Photograph by George Brauer.

Order EPHEMERIDA Leach 1817.

Superfamily BAETIDOIDEA n.nom.
(BAETOIDEA Ulmer 1920)

Family BAETIDIDAE n.nom.
(BAETIDAE Ulmer 1920)

Subfamily BAETIDINAE Handlirsch 1929, or
BAETISCINAE Handlirsch 1929.

(Figures 3, 4, 5)

An interesting find, specimen 3686, was made in a very irregular, unpromising brown and gray-colored nodule, No. 28957, collected by Mrs. Laura Rouse, in Section 19, R.2.E., T.10.N., Yermo Quadrangle, when she broke the nodule in two. Here were disclosed in the two pieces, a female mayfly and her cluster of eggs, loosely placed in a mass which probably was originally foamy or gelatinous. The nodule weighs 34.7 gram, and measures $44 \times 34 \times 22$ mm.

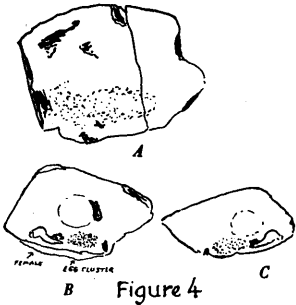


Figure 4

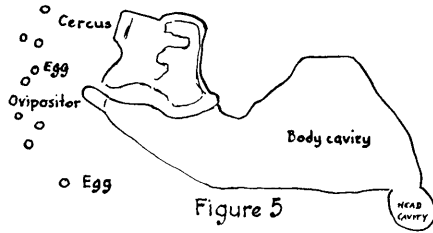


Figure 5

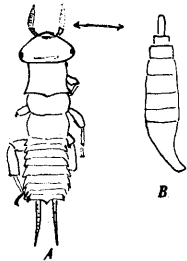


Figure 6

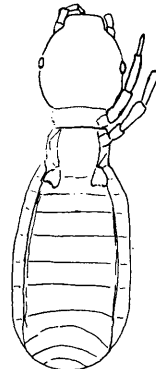


Figure 7

PLATE 16

Figure 4. Drawings of nodule 3686. a. Outside of nodule. b. Face of larger piece showing female mayfly and cluster of eggs. c. Face of smaller piece showing eggs and cavity occupied by female.

Figure 5. Mayfly from nodule 3686: sketch of female cavity, and proximity of eggs.

Figure 6. Stone fly, specimen 2597: a. First larva, length 1.8 mm.; b. Enlargement of antenna.

Figure 7. *Miotroctes rousei*, new species, type. Size 0.9 mm.

Robert W. Pennak (1953, *Fresh Water Invertebrates of the United States. Ephemeroptera (Mayflies)*, pp. 509-521) states:

"In some species the female actually crawls below the surface and deposits on submerged objects. . . . The eggs are produced in great numbers . . . exceedingly small . . . sometimes imbedded in a gelatinous material." He further says that mayfly nymphs browse in the substrate, feeding with a grinding action of the mandibles, on algae, or the tissues of higher aquatic plants.

Mayflies, after emergence as adults, seldom live over a day (in which they mate and oviposit). The finding of the female and her egg cluster presents the event of one day perpetuated by the catastrophe that involved the lake.

The female is chalky, cream color, not crystallized, and contains many orange brown spherical bodies, but her cavity proves her identity as mayfly. The body measures 7.44 mm., height 2.80 mm. Her egg cluster is 14 x 6 mm. in cross section. The individual eggs measure 0.19 to 0.23 mm. in diameter. They are spherical, unornamented, without filaments. James G. Needham, Jay R. Traver, and Yin-Chi-Hsu (1935, *The Biology of Mayflies*) limit the known spherical eggs with smooth chorion to the genera *Baetisca* and *Callibaetis*.

The *Callibaetis* species are pond dwellers, and the eggs measure about 0.12 mm. in diameter. The *Baetisca* species are stream dwellers and the eggs measure about 0.18 mm. in diameter. The fossil eggs measure 0.19 to 0.23 mm. in diameter.

The size of the adult fossil (7.44 mm.) ranks her with the smallest of *Baetisca* and *Callibaetis*. The sketch of the cavity (Figure 5) shows the lowered head, the high thorax, the ovipositor tube extending to a point opposite the base of the cerci. The eggs lie just beyond the ovipositor. But their distribution in the nodule shows that she moved quite a distance during the oviposition.

Order PLECOPTERA Burmeister 1839.
(Figure 6).

While stone flies can be expected in the lake fauna, the only specimen so far found is a crystallized first larva, extracted by formic acid from Nodule 17212, and numbered specimen 2597; found by Ruth Kirkby at her site 10, which is not far from our site 10, the Rouse anticline, at the switchback in NE $\frac{1}{4}$ Section 19, R.2.E., T.10.N., Yermo Quadrangle.

This tiny larva is crystal clear, measuring 1.8 mm. in length; antennae 0.4 mm., cerci 0.5 mm. Figure 6a shows the general form, and Figure 6b an enlargement of the left antenna. The antenna has a large curved basal segment; segments 2 to 7 transverse, segment 8 elongate, slender.

So little is known of the early stages of this order that further placement is not yet possible.

Superorder CORRODENTIA Burmeister 1839.
Order COPEOGNATHA Enderlein 1903.

It is with great pleasure that a fossil bark louse is now added to the nodule series of fossils.

A total of 18 species in 10 genera of Copeognatha are known from amber (Handlirsch, 1906. *Die Fossilen Insekten* Lief. 5:702-704). One fossil of this order is known from North America,—*Parapsocus disjunctus* Scudder, from the Oligocene of Fossil Cañon, White River, Utah (Scudder, 1890. *Tertiary Insects of North America*. p. 119; pl. 5, fig. 51).

Suborder TROCTOMORPHA Borror and Delong 1954.
Family LIPOSCOLIDAE (Troctidae)

Until 1907 only one species of fossil Liposcolidae (Troctidae) had been recorded. The specimen here described resembles our common household pest *Liposcolis divinatorius* (Müller 1776) (*Troctes*).

Genus MIOTROCTES, new genus.

The genus is separated from *Liposcolis* by the fact that the anterior and middle femora are not enlarged. The posterior femora are missing in the specimen.

Miotroctes rousei, new species.
(Figure 7).

Named in honor of the late John H. Rouse, who with Mrs. Rouse independently discovered this interesting field of fossil insects.

HOLOTYPE. A beautiful, clear crystalline specimen, No. 3633 (L.A.Co.Mus.Invert.Paleontology No.S 9103), separated by the author by use of formic acid from Nodule 26624, collected at Site 10 (Rouse anticline) (LACMIP 357), in Lot 313, from NE ¼ Section 19, R.2.E., T.10.N., Yermo Quadrangle, by Mrs. Laura Rouse.

DESCRIPTION. Length 0.903 mm. Head broadly rounded, with single eyes slightly in front of the middle of the head. Clypeus quadrate, one-half as wide as head, and about one-seventh as long as head. (In this it differs strongly from the common *Liposcolis divinatorius*.) Maxillary palpi 4-jointed.

Prothorax short, transverse; mesothorax and metathorax with common sternal plate. Anterior and middle legs with femur and tibia of equal length, not swollen. Posterior legs missing in specimen.

Abdomen 10-segmented, with pleural folds ventral.

Order COLEOPTERA Linnaeus 1758.
Family DERMESTIDAE Leach 1817.
Subfamily ANTHRENINAE.
Tribe MEGATOMINI.
Subtribe CRYPTORHOPALINA.
Genus MIOCRYPTORHOPALUM, new genus.

Characters based on larva only; ocelli probably 6; antennae short and stout; mandibles toothed, but without retinaculum; hastisetal hairs on meso- and methathorax, and seventh abdominal segment. The following table shows the position of this genus with respect to others in the family.

TABLE OF CHARACTERS OF DERMESTID LARVAE

DERMESTIDAE	Ocelli on each side	Hastisetal hairs on segments	Antennae	MANDIBLES		Caudal brush	Distribution
				with tooth	with retinaculum		
Thylo driinae Thylo drius	3	none	short	absent	absent	absent	Europe America
Attageninae Novelsis	4	none	long	absent	present	present	America
Attagenus	5	none	long	absent	present	present	America
Dermestinae Dermestes	6	none	long	tridentate	present	absent	America
Trinodinae Aspectus	6	none	short	present	absent	sparse long hairs	America
Anthreninae Anthrenini Anthrenus	6	5-7	long	absent	with or without	dense brushes	America
Megatomini Megatomina Perimegatoma	6	5-8	long	absent	present		America
Thaumaglossa	6	5-8	short	absent	absent		America
Trogoderma	6	5-8	short	absent	present	present	cosmopolitan
Cryptorhopalina Labrocerus	6	7, 8	short	present	present	hastisetal	
Globicornis	6	7, 8	short	present	present	hastisetal	
Miocryptorhopalum	prob. 6	mesothorax metathorax 7	short	present	absent	absent	fossil
Cryptorhopalum	6	7 only	short	present	present	hastisetal	arid America
Ctesiini Ctesias	6	4-7	long	present	absent	present	Europe

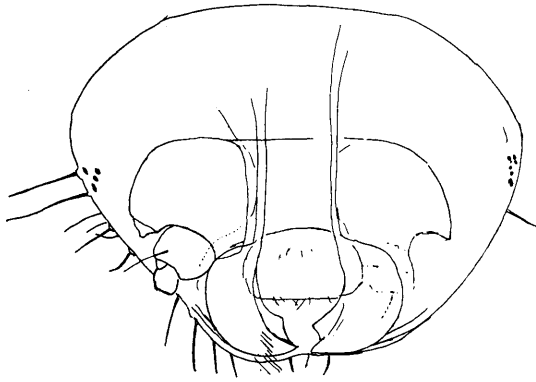


Figure 8

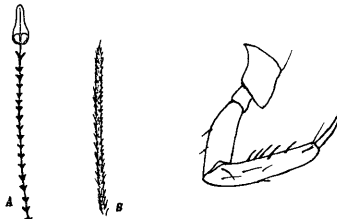


Figure 9



Figure 10

PLATE 17

Figure 8. *Miocryptorhopalum kirkbyae*, new species, type, larval head, Instar I.

Figure 9. *Miocryptorhopalum kirkbyae*, a. Hastiseta; b. Barbed seta.

Figure 10. *Miocryptorhopalum kirkbyae*. Hind leg of larva I.

There is a desert species *Cryptorhopalum aridum* Casey, from the Inyo Mts., of which the larva is undescribed. All of the species of *Cryptorhopalum* in the United States are from arid regions.

***Miocryptorhopalum kirkbyae*, new species.**

(Figures 8, 9, 10).

Named in honor of my friend and co-worker, Mrs. Ruth Kirkby.

HOLOTYPE No. S-776, in Kirkby Private Museum, Riverside, Calif. Crystallized larva extracted by formic acid from a Calico Mountain nodule, collected by Ruth Kirkby at her site 10, NE ¼ Section 19, Upper Switchback Cañon, R.2.E., T.10.N., Yermo Quadrangle.

DESCRIPTION. Instar I larva: length 1.44 mm.; width of head 0.203 mm.

Head (Figure 8) transverse, ovoid, with mandibles ventral. The mandibles are outwardly rounded, medianly about in contact, with abductor muscles just within the margin of the head; and the adductor muscles parallel, directed posteriorly. The armature of the mandibles consists only of the incisor and a molar tooth. The three-jointed robust antennae are postero-lateral to the mandibles, and the third segment barely surpasses the anterior margin of the head. A tiny lobe on second segment beside the third segment is characteristic of Dermestid larvae. The specimen is so clear that the maxillae and epipharynx are barely discernible. There are probably 6 pigmented ocelli in clumps at each side of head.

Body simply segmented, with 8 abdominal segments. The surface is armed with many barbed setae (Figure 9b), and a few hastisetae (Figure 9a) on mesothorax, metathorax, and seventh segment. The hastisetae are close in form to those of *Trogoderma ornatum* Say. There is no terminal brush.

Legs alike, four-jointed, with broad coxa, short trochanter, more robust femur, longer tibia, and a long acute tarsungulus (Figure 10).

The finding of this larva, usually associated with dry, dead material is unexpected. It was probably blown into the water with the dry material in which it was feeding.

This species has been studied by checking the following publications:

BÖVING, Adam G., and F. L. CRAIGHEAD.

1931. An illustrated synopsis of the principal larval forms of the Order Coleoptera. Brooklyn Ent. Soc. p. 55, plates 89, 90.

PETERSON, Alvah

1951. Larvae of Insects. An Introduction to nearctic species. Part II. pp. 42, 80, 174, plates 89, 90.

REES, Bryant E.

1943. Classification of the Dermestidae (larder, hide, and carpet beetles) based on larval characters, with a key to the North American genera. U.S. Dept. Agr., Misc. Publ. 511, pp. 1-18, 5 figs.

