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CALILEUCTRA, A NEW GENUS, AND TWO NEW SPECIES OF STONEFLIES FROM CALIFORNIA (PLECOPTERA: LEUCTRIDAE)

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ABSTRACT.—*Calileuctra* is proposed as a new genus in the family Leuctridae, with *Calileuctra ephemera* designated as the type species. All stages of *Calileuctra ephemera* are described. *Calileuctra dobryi* is described in the male and female stages. Both species inhabit the Mediterranean climatic region of California. A phylogenetic analysis of the genera in the family Leuctridae is given, which places *Calileuctra* near the genus *Perlomyia*.

Key words.—Insecta, Plecoptera, Leuctridae, Calileuctra, *description, distribution, phylogeny.*

Both of us have been collecting stoneflies from streams all across California. Several years ago one of us (WDS) collected a small and poorly sclerotized stonefly nymph from an intermittent Napa Valley stream. The male adult that was reared from the nymph could not be determined using existing keys by WDS. The specimen was then given to RWB for identification. His identification kept us collecting at the same site for nine years. The single male specimen was first thought to be a new species in the Asian genus *Rhopalopsole*. However, recent work indicates that the male represents a new genus in the family Leuctridae. Despite extensive searching in surrounding areas, only the Napa Valley population has been found.

A few years after discovery of the first new species, RWB found, in the Natural History Museum of Los Angeles County, a small series of an interesting new leuctrid from the San Gabriel Mountains. Later, two additional females of this species were collected in the Santa Ana Mountains. However, we decided that fresh male specimens were needed before a description could be undertaken.

Keith Dobry, who was doing fieldwork in the Los Angeles area, was encouraged to look for additional specimens of this leuctrid species. He was successful in locating two additional populations, one in the San Gabriel Mountains, the other in the Santa Monica Mountains. This species is known from only four populations, all from mountains surrounding the Los Angeles basin.

Calileuctra, new genus

TYPE SPECIES.—*Calileuctra ephemera*, new species

ADULTS.—Body brownish, weakly sclerotized; setation sparse, except for abundant tiny setae, "clothing hairs" (Figs. 1, 10). Wings macropterous or brachypterous; venation as illustrated (Fig. 3). Prosternum with prestermum separate, furcasternum fused to base of triangular basisternum; meso- and metasternum similar except basisternum rectangular (Fig. 2).

MALE.—Tergum IX with posterior border heavily sclerotized and irregularly serrate or dentate; tergum X with posterolateral corners, each with one or two elongate horns projecting posteriorly (Figs. 4, 11); sternum IX projecting posteriorly to cover base of paraprocts, with vesicle broadening posteriorly (Figs. 6, 13); paraprocts fused into a complex, T-shaped, subanal probe, with two ventromedial projections off subanal probe (Figs. 8, 9, 13).

FEMALE.—With weak abdominal sclerotization; sternum VII completely sclerotized; sternum VIII largely membranous; sternum IX completely sclerotized; subgenital plate poorly produced; sternum X incompletely sclerotized (Figs. 7, 14). Cerci one-segmented; elongate in male, poorly sclerotized on sides,

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apically flat and membranous (Figs. 4, 11); simple in female (Figs. 7, 14).

Nymph.—Mature nymph weakly sclerotized; body elongate; setation scarce. Abdominal segments I–VII with membranous pleural fold. Mesosternal Y-ridge with double stem; arms meeting furcal pits at posterior ends. Paraprocts fused basally with no visible suture; sparse setation. Cercal segments each with apical fringe of 10–15 setae; setae approximately one-half length of cercal segments.

Distribution.—Napa Valley and Los Angeles basin, CA.

Diagnosis.—Males are best characterized by their unique elongate, flat-topped cerci. Females are characterized by sternum VIII being incomplete, and the lack of a posteriorly projecting subgenital plate. Nymphs are characterized by abdominal segments I–VII having a membranous pleural fold, the subanal lobes having basal fusion but no distinct fusion line, and the cercal segment setae being one-half length of the cercal segment.

Etymology.—The prefix *Cali-* was selected to denote California, the origin of the specimens. The suffix *-leuctra* was selected to indicate placement of the genus in the family Leuctridae. Gender of the name is neuter.

Key modification.—Modifications are given for the following identification keys for Nearctic leuctrid genera: Harper and Stewart (1984)—nymphal and adult keys; Stewart and Stark (1988)—nymphal key. Wording, style, and figure citations are as presented in the original keys.

Harper and Stewart (1984)—Nymphal Key

38 (37) Body robust, length less than 8 times width; body conspicuously clothed with hairs about one-fifth the length of middle Ab segment; subanal lobes of mature male a fused, strongly keeled plate, much produced with no posterior notch (fig. 13.44) . . . . . *Megaleuctra*

38′ Body more elongate, fine hair pile inconspicuous, appearing naked; subanal lobes of mature male fused one-half to two-thirds length, leaving a notch at tip 38A

38A (38) Subanal lobes fused but with complete suture; apical setae on cercal segments usually less than one-half length of cercal segments . . . . . *Perlomyia*

38A′ Subanal lobes basally fused, no suture in basal half; apical setae on cercal segments one-half length of cercal segments . . . . . *Calileuctra*

Harper and Stewart (1984)—Adult Key

58 (56) In hind wing, Cu_1 not forked . . . *Calileuctra*
58′ In hind wing, Cu_1 forked 58A

58A (58′) In hindwing, m-cu joining Cu_1 beyond fork of Cu_1 59
58A′ In hindwing, m-cu joining Cu_1 before fork of Cu_1 60

Stewart and Stark (1988)—Nymphal Key

5. Pronotum with no long, marginal setae (Fig. 8.14A); paraprocts of both sexes fused basally, with no distinct medial line of separation 5A

Pronotum with 2–4 long hairs on anterior and posterior margins (Fig. 8.2A, 8.12A); paraprocts of both sexes fused with distinct medial line of separation or slightly separated medially (Fig. 8.2H,I; 8.12H,I) 6

5A. Abdominal segments 1–6 divided by ventrolateral membrane; ENA and SW . . . . . *Zealeuctra*

5A′ Abdominal segments 1–7 divided by ventrolateral membrane; WNA . . . . . *Calileuctra*

Key to Adults of *Calileuctra*

1a Wings macropterous; male with epiproct bifurcate dorsally, tergite IX posteriorly emarginate with two large heavily sclerotized teeth, cerci with apical tooth, tergite X with one tooth on each posterolateral corner, sternite IX with posterior projection broadly rounded; female sternite VII broad with a posteriorly projecting rectangular lobe, sternite VIII membranous . . . . . *C. dobryi*

1b Wings brachypterous; male with epiproct with one dorsal hook, tergite IX with single sclerotized posterior plate bearing numerous teeth, cerci without apical tooth, tergite X with two teeth on each posterolateral corner, sternite IX with posterior projection broadly angulate; female sternite VII elongate with lateral constrictions, sternite VIII with two arcuate sclerotized plates. . . . . *C. ephemera*

Calileuctra ephemera, new species

Figs. 1–9

Male.— General color brown; dark brown pattern as illustrated (Fig. 1). Length of body 4.5 mm. Brachypterous, length of forewing 2.5–3.0 mm; wings light brown, venation similar to the genus *Perlomyia* (Fig. 3). Prothoracic basisternum triangular in shape (Fig. 2). Abdominal tergum IX with posterior border complete, projecting and serrate; tergum X

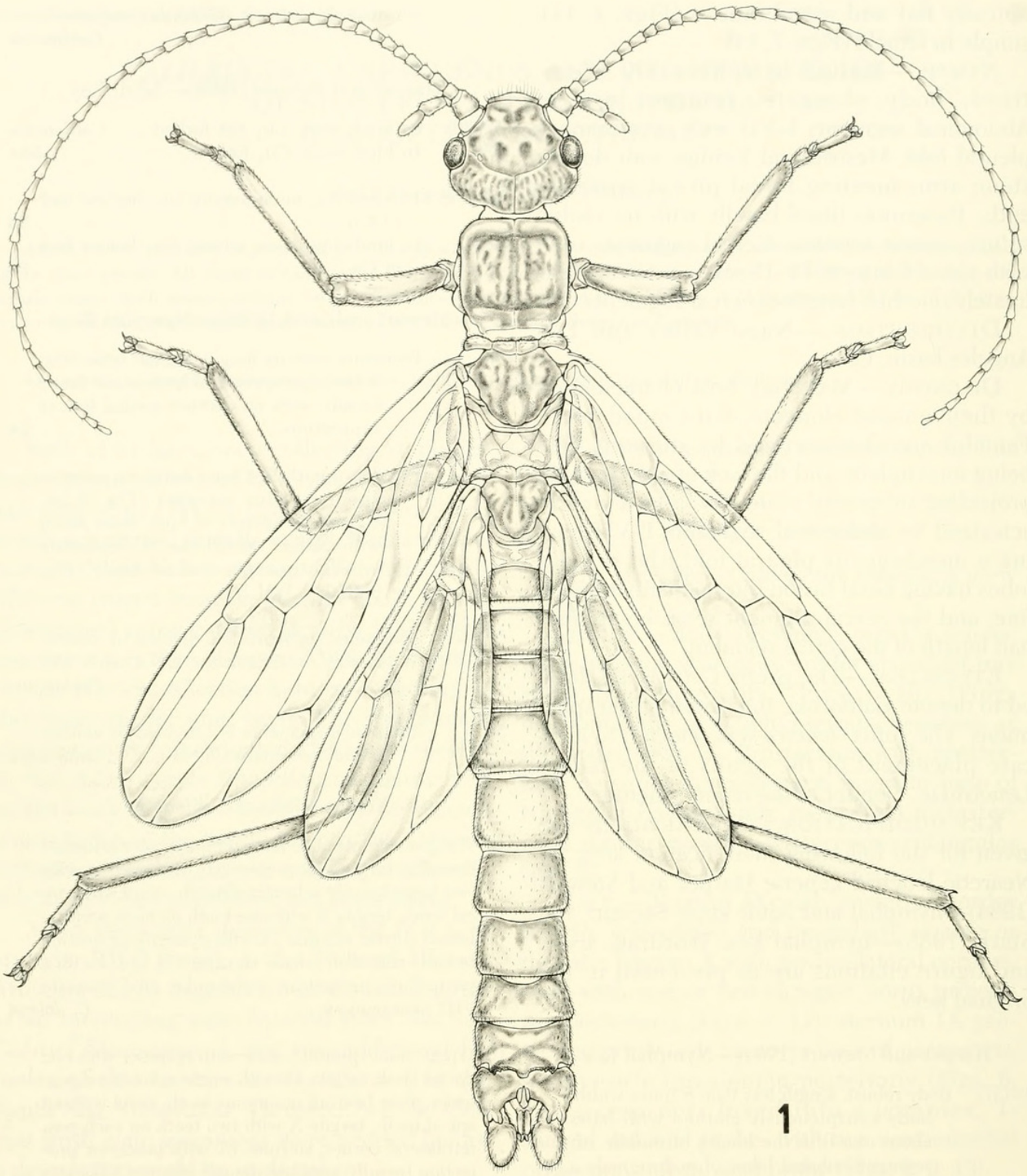
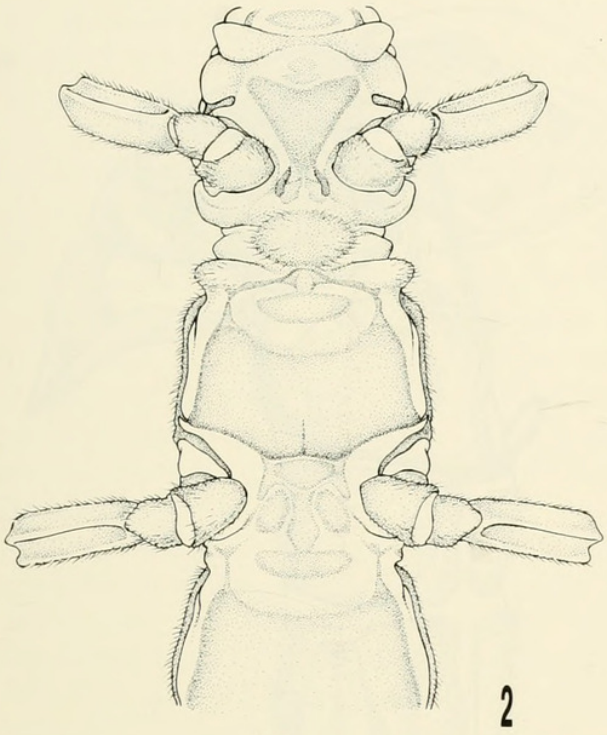
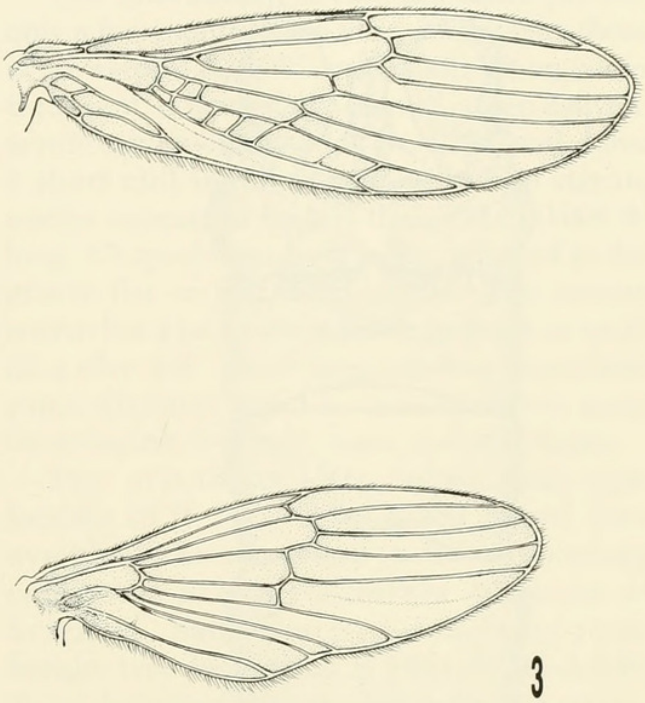


Fig. 1. *Calileuctra ephemera.* Habitus.

incomplete medially, posterolaterally with two elongate projections (Figs. 4, 5). Sternum IX with basal pear-shaped vesicle; posterior border extending to base of subanal probe (Fig. 6). Cerci extending beyond genitalia, with apical membranous area expanded and flattened (Figs. 4, 5, 6). Epiproct small and hook-shaped (Fig. 5). Subanal probe large, elongate, both membranous and sclerotized, expanded near apex (Figs. 8, 9).

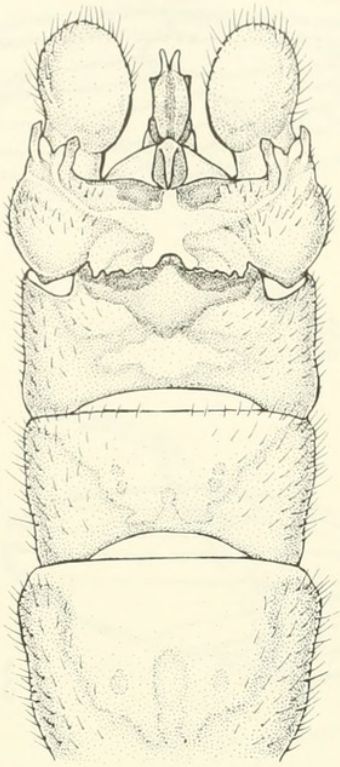
FEMALE.— General color and wing venation similar to male. Brachypterous, length of forewing 3.5–4.0 mm. Sternum VII constricted laterally, projecting slightly over sternum VIII; sternum VIII reduced to 2 small arcuate sclerotized plates (Fig. 7).





Figs. 2, 3. *Calileuctra ephemera*: 2, ventral view of thorax; 3, wings.

NYMPH.—Body lightly sclerotized; light in color; setation sparse except on labrum, legs, and cerci; size small—7.2 mm long. Head slightly broader than thorax; color pattern faint. Mouthparts of the herbivorous/detritivorous type [Type I (Stewart and Stark 1988)]. Labrum and clypeus with numerous long setae. Mandible typical for Leuctridae: 4 dorsal cusps (2 large, 2 small), and 1 small ventral cusp on side of first large dorsal cusp; bowl-shaped molar region, with transverse ridges in the "bowl," and with a pectinate scraping ridge on the ventromedial edge. Maxillary palpi 5-segmented. Labial palpi 3-segmented; glossae and paraglossae short and subequal in size (paraglossae slightly larger). Pronotum quadrangular; transverse anterior and posterior sclerotized bands; median longitudinal suture unsclerotized; color pattern weak. Mesonotum with two sclerites; anterior sclerite transverse and roughly trapezoidal; posterior sclerite roughly U-shaped. Metanotum like mesonotum. Wing pads three or more times as long as wide; posterior wing pads a little shorter than anterior wing pads; longitudinal axes of wing pads almost parallel to axis of body. Prosternum naked and membranous except for two small sclerites between the coxae; sclerites forming a posteriorly directed U-shape. Mesosternum narrowest anteriorly, widest by coxae; membranous except for weak sclerotization of the furcal pits and the Y-ridge; Y-ridge with faintly sclerotized double stem, arms connecting to posterior ends of furcal pits; transverse ridge connecting anterior ends of furcal pits. Metasternum similar to mesosternum; sclerotization only in a transversely rectangular area limited by the furcal pits, a transverse ridge connecting the anterior ends of the furcal pits, and the area between the pits and the ridge. All legs similar but increasing in size posteriorly; setation consists of abundant very small setae ("clothing hairs") and sparse longer setae; tibiae and femora with setal fringes; apex of tibiae with a pair of spines; tarsi 3-segmented, first segment short and conical, second very short, ringlike with apex cleft, third elongate and cylindrical, suture between first and second tarsomeres very narrow and hard to see; tarsomeres with ventral pad of numerous fine setae; tarsal claws slender. Abdominal terga very weakly sclerotized; setation sparse except on end of tenth segment. Abdominal fold present on segments I–VII. Subanal lobes incompletely fused. Cercal segments with apical fringe of 10–15 setae; setae about one-half length of the segments.



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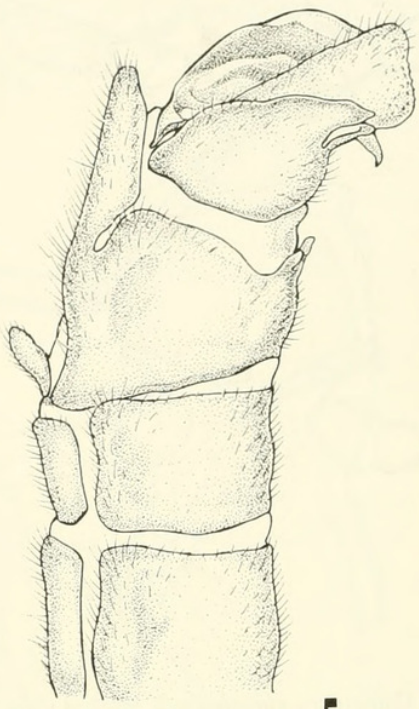

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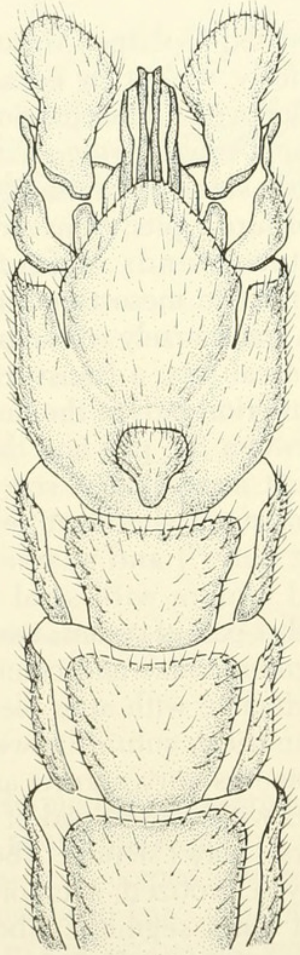

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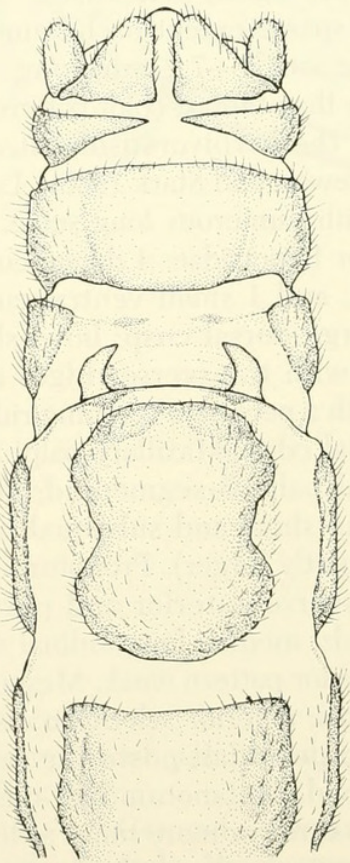

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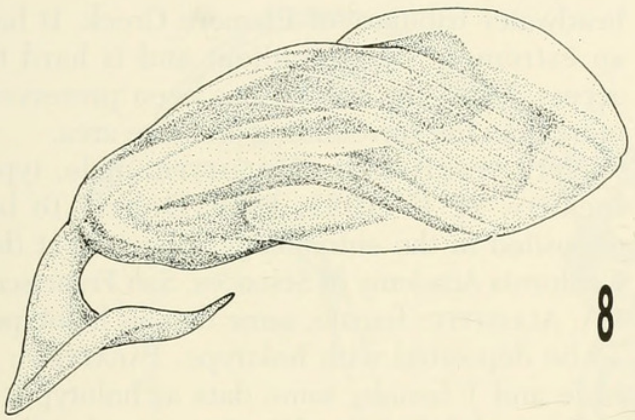
Figs. 4–7. *Calileuctra ephemera*: 4, male terminalia, dorsal view; 5, male terminalia, lateral view; 6, male terminalia, ventral view; 7, female terminalia, ventral view.



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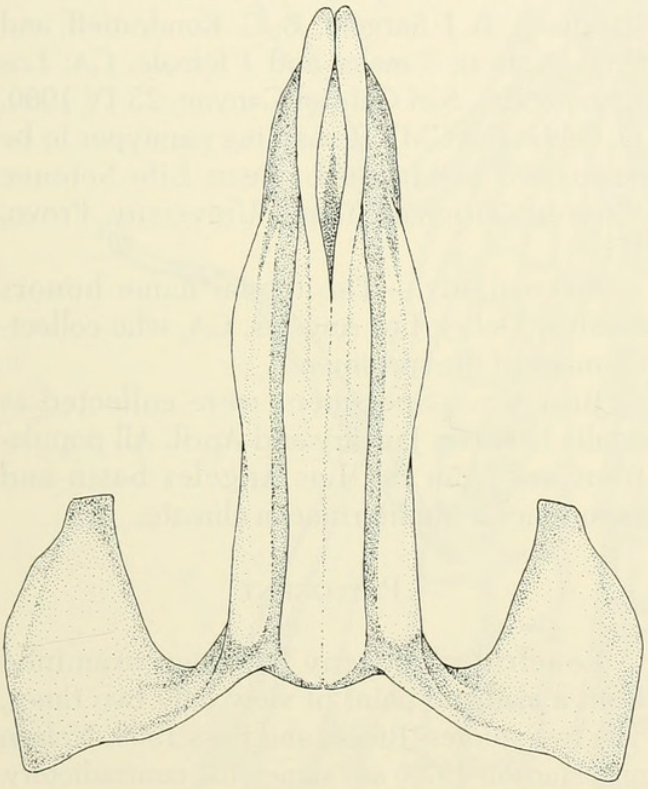

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Figs. 8, 9. *Calileuctra ephemera*: 8, male subanal probe, right lateral view; 9, male subanal probe, ventral view.

EGG.—Shape oval; size uniform, 0.133 mm in length, 0.095 mm in width. Surface coarsely rugose; large, coarse punctures present in an irregular distribution.

TYPE LOCALITY.—CALIFORNIA: Napa Co., 3.36 km (2.1 mi) N on Hwy 128 from the intersection of Hwy 128 and Hwy 121, unnamed tributary to Capell Creek (ca 300 m [275 ft] elevation).

This intermittent stream has water present only a few months each year; some years there is no water (i.e., 1987 and 1990). When water is present, it flows down a small, steep canyon, across a grassy flat, under Hwy 128, and down a short cliff into Capell Creek. The stream course appears to be less than 350 m (1000 ft) long. All specimens have been collected in the grassy flat or just downstream. The stream course has a substrate of either bedrock or rocks on a clay soil. There is no obvious hyporheic zone. Detrital input is usually leaves from trees (mainly live oak), grass, and star-thistle.

TYPE SPECIMENS.—HOLOTYPE: male, type locality, 19 II 1983, WDS-A-160, reared from nymph. To be deposited in the entomology collection at the California Academy of Sciences, San Francisco, CA. ALLOTYPE: female, type locality, 25 II 1984, WDS-A-240. To be deposited with the holotype. PARATYPES: 1 male, type locality, 18 II 1984, WDS-A-234, reared from nymph (deposited at Monte L. Bean Life Science Museum, Brigham Young University, Provo, UT); 3 females, type locality, 18 II 1984, WDS-A-234 (deposited with male paratype). Additional specimen: 1 nymph, type locality, 27 II 1988, WDS-A-527 (deposited with the holotype and allotype).

ETYMOLOGY.—The trivial name was selected to indicate the temporary nature of the stream at the type locality, and also to indicate the difficulty encountered when trying to collect specimens.

BIOLOGY.—All specimens were collected during the last two weeks of February, when the stream was flowing. Streams in this area of the coastal mountains experience a Mediterranean climate with a December-to-February rainy season. Local intermittent streams usually have surface flow only from January through March.

When first collected, all specimens were either late-instar nymphs (3) or adults (4). All field-collected adults (4 females) were swept from vegetation overhanging the stream. Two of the three nymphs collected were held in styrofoam containers until they molted to the adult stage. Both individuals were males.

The bowl-shaped molar region of the mandibles is similar to molar modifications found in beetle larvae that feed on fungal tissues, in general, and fungal spores, in particular (Lawrence 1977, Lawrence and Hlavac 1979, Lawrence and Newton 1980). Since fungal

tissues are high in protein (Martin 1987), use of them as a food would aid the fast growth and development of nymphs.

Present information suggests that *Calileuctra ephemera* has a facultatively long egg diapause, very fast nymphal development, and short stadium for both nymphs and adults. The high protein content of fungal tissues (Martin 1987) may aid in the fast growth and development of nymphs of this unique species. These characteristics are similar to those of *Zealeuctra* (Snellen and Stewart 1979), an eastern North American genus and another inhabitant of intermittent streams.

Calileuctra dobryi, new species

Figs. 10–14

MALE.—General color brown; dark pattern as illustrated (Fig. 10). Length of body 4.0–6.0 mm. Macropterous, length of forewing 4.5–5.5 mm, wings light brown, venation similar to the genus *Perlomyia*. Tergum IX with membranous median band dividing tergum into two sclerotized halves, each half bearing a small, nipplelike projection and a large, earlike posterior projection. Tergum X also divided into two halves, each half with a gently rounded, knoblike lobe and an enlarged, lateral posterior lobe which ends in a sclerotized prong that extends about one-third the way up the cercus (Figs. 11, 12). Sternum IX broadly rounded posteriorly, extending only to base of subanal probe, large vesicle present at median anterior margin, vesicle with truncate apex (Fig. 13). Cerci enlarged, elongate, extending beyond genitalia posteriorly, sclerotized on lateral margins, apex rounded, ending in a sclerotized lateral prong (Figs. 11, 12, 13). Epiproct with narrow bifurcate apex (Fig. 11). Subanal probe large, elongate, broadest medially, apex pointed (Fig. 13).

FEMALE.—General color and wing venation similar to male. Length of body 5.0–6.0 mm. Macropterous, length of forewing 5.0–6.0 mm. Abdominal sternum VII enlarged, expanded slightly over VIII; posteromedial area formed into a narrow, medially rounded lobe. Sternum VIII small and only lightly sclerotized (Fig. 14).

NYMPH.—Unknown.

EGG.—Unknown.

TYPE LOCALITY.—CALIFORNIA: Los Angeles Co., South Fork Elsmere Canyon, San Gabriel Mountains. The type locality is a very small headwater tributary of Elsmere Creek. It has an extremely steep gradient and is hard to access. Thus, the habitat has been preserved more than the surrounding drainage area.

TYPE SPECIMENS.—HOLOTYPE: male, type locality, 22 IV 1991, K. F. Dobry. To be deposited in the entomology collection at the California Academy of Sciences, San Francisco, CA. ALLOTYPE: female, same data as holotype. To be deposited with holotype. PARATYPES: 1 male and 1 female, same data as holotype; 2 males and 1 female, CA: Los Angeles Co., Santa Monica Mountains, East Fork Arroyo Sequit, 5 mi NW Pacific Coast Highway off Mulholland Highway, 28 II 1992, K. F. Dobry; 2 females, CA: Orange Co., Santa Ana Mountains, Trabuco Canyon, 1300′, 11 I 1988, R. W. Baumann, B. J. Sargent, B. C. Kondratieff, and C. R. Nelson; 3 males and 1 female, CA: Los Angeles Co., San Gabriel Canyon, 23 IV 1960, D. Gibbo (LACM). Remaining paratypes to be deposited at Monte L. Bean Life Science Museum, Brigham Young University, Provo, UT.

ETYMOLOGY.—The trivial name honors Keith F. Dobry, Los Angeles, CA, who collected many of the specimens.

BIOLOGY.—Specimens were collected as adults between January and April. All populations are from the Los Angeles basin and experience a Mediterranean climate.

PHYLOGENY

Leuctrid phylogeny has been examined from a cladistic point of view only two times. The two studies (Ricker and Ross 1969, Nelson and Hanson 1973) are somewhat contradictory. However, examination of the analysis given in both studies shows *Calileuctra* to possess many character states that are termed primitive or ancestral. Following Nelson and Hanson's more comprehensive analysis, the character states present in *Calileuctra* are as follows: 1-0, 2-0, 3-0, 4-0, 5-0, 6-0, 7-1, 8-0, 9-0, 10-2, 11-0, 12-0, 13-0, 14-2, 15-0, 16-0, 17-0, 18-0,19-0, 20-0, 21-1, 22-0, 23-0, 24-1, 25-1, 26-1, 27-1, 28-1, 29-0, 30-1, and 31-2 (first number = character; second number = character state). See Nelson and Hanson (1973) for a key to the characters and character states. Character states for *Calileuctra* and those cited in Nelson and Hanson (1973) for other leuctrid genera were run through the PAUP 3.1.1 program

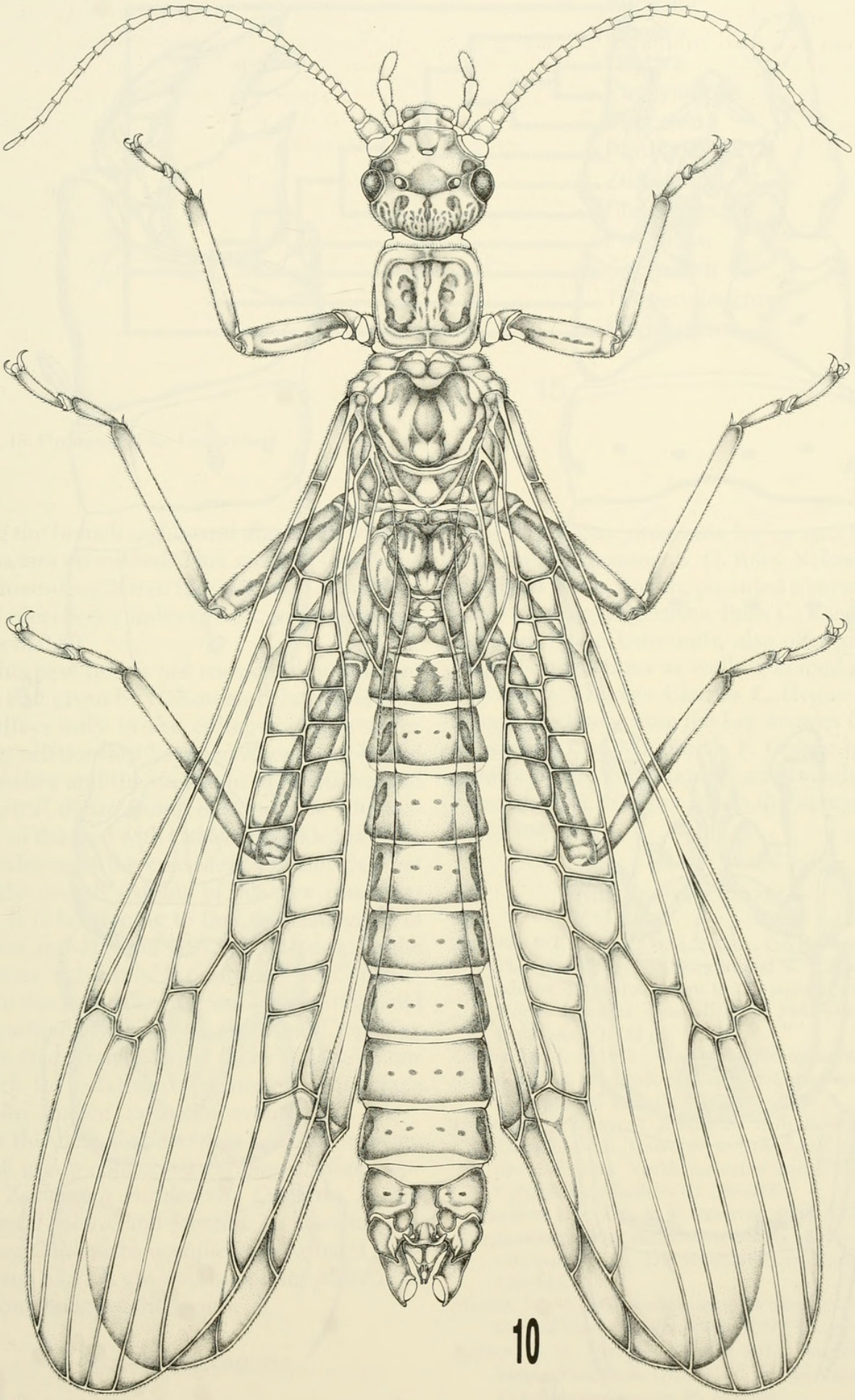
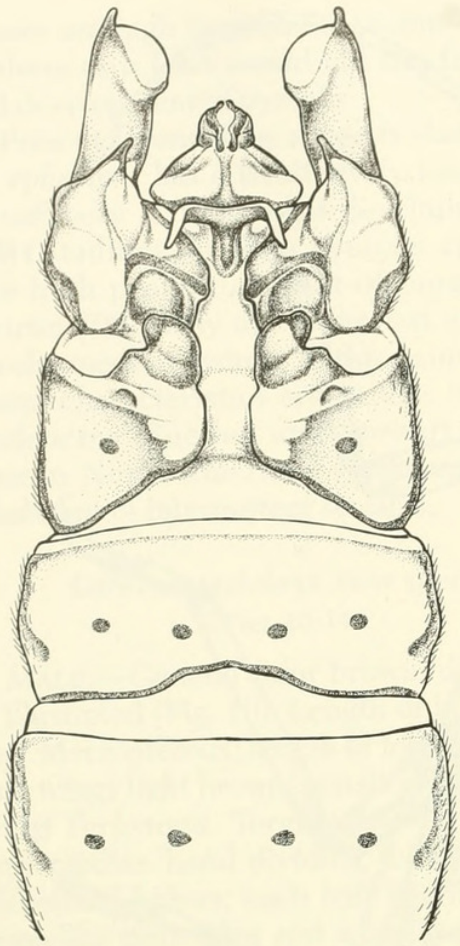


Fig. 10. *Calileuctra dobryi.* Habitus.



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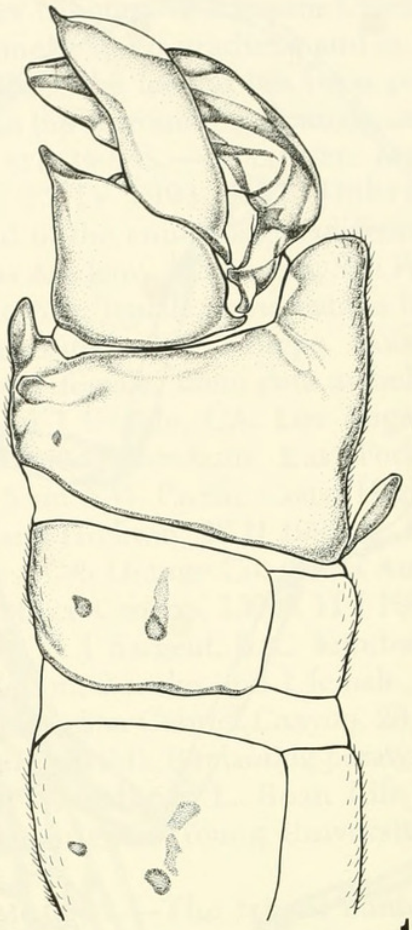

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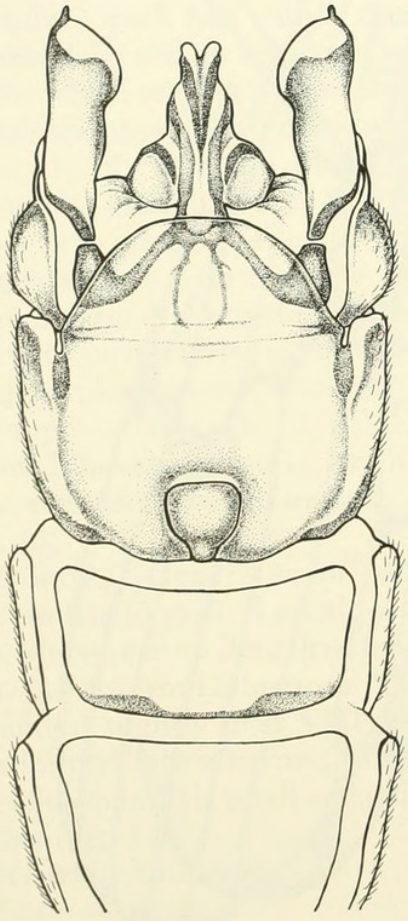

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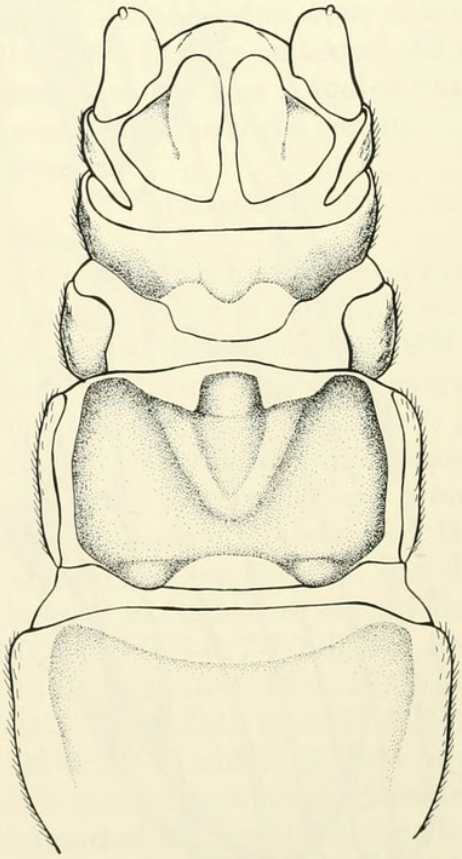

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Figs. 11–14. *Calileuctra dobryi*: 11, male terminalia, dorsal view; 12, male terminalia, lateral view; 13, male terminalia, ventral view; 15, female terminalia, ventral view.

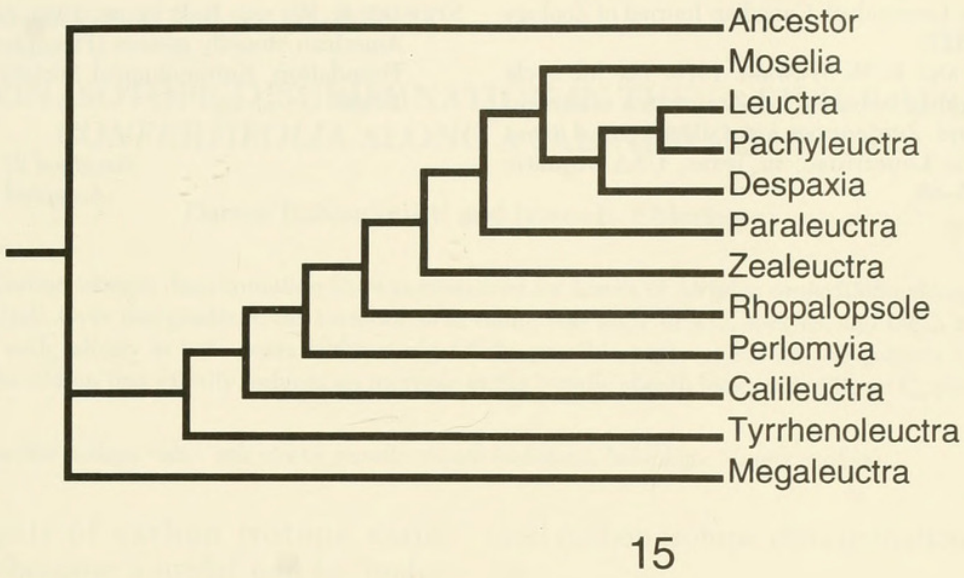

Fig. 15. Phylogeny of the Leuctridae.

using the branch and bound algorithm with all characters unordered. This analysis found one minimum-length tree (Fig. 15) with a length of 68, a consistency index of 0.82, and a retention index of 0.80.

This new tree is not considerably different from that given by Nelson and Hanson (1973). It differs only in the collapse of the sister group relationship between *Rhopalopsole* and *Zealeuctra* and the exclusion of *Euleuctra* and "*Leuctra*" *divisa* from consideration. The stability of this tree with *Calileuctra* added is taken as evidence of the consistency of this data set and the overall stability of this new classification. It is heartening to find the cladogram of Nelson and Hanson (1973) stable despite the previous "extinction" (i.e., absence) of *Calileuctra.* In this particular case, an "extinct" taxon did not particularly influence the overall topology of the cladogram. Hence, there is hope in our search for relationships among living taxa despite "known" extinction events.

In this tree, *Calileuctra* is a the sister-taxon of the group containing *Perlomyia, Rhopalopsole, Zealeuctra, Paraleuctra, Despaxia, Pachyleuctra, Leuctra,* and *Moselia.* In leuctrid phylogeny, *Calileuctra* occupies a near basal position and as such gives an important addition to our knowledge of the group.

Acknowledgments

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