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THE STONEFLIES (PLECOPTERA) OF CALIFORNIA

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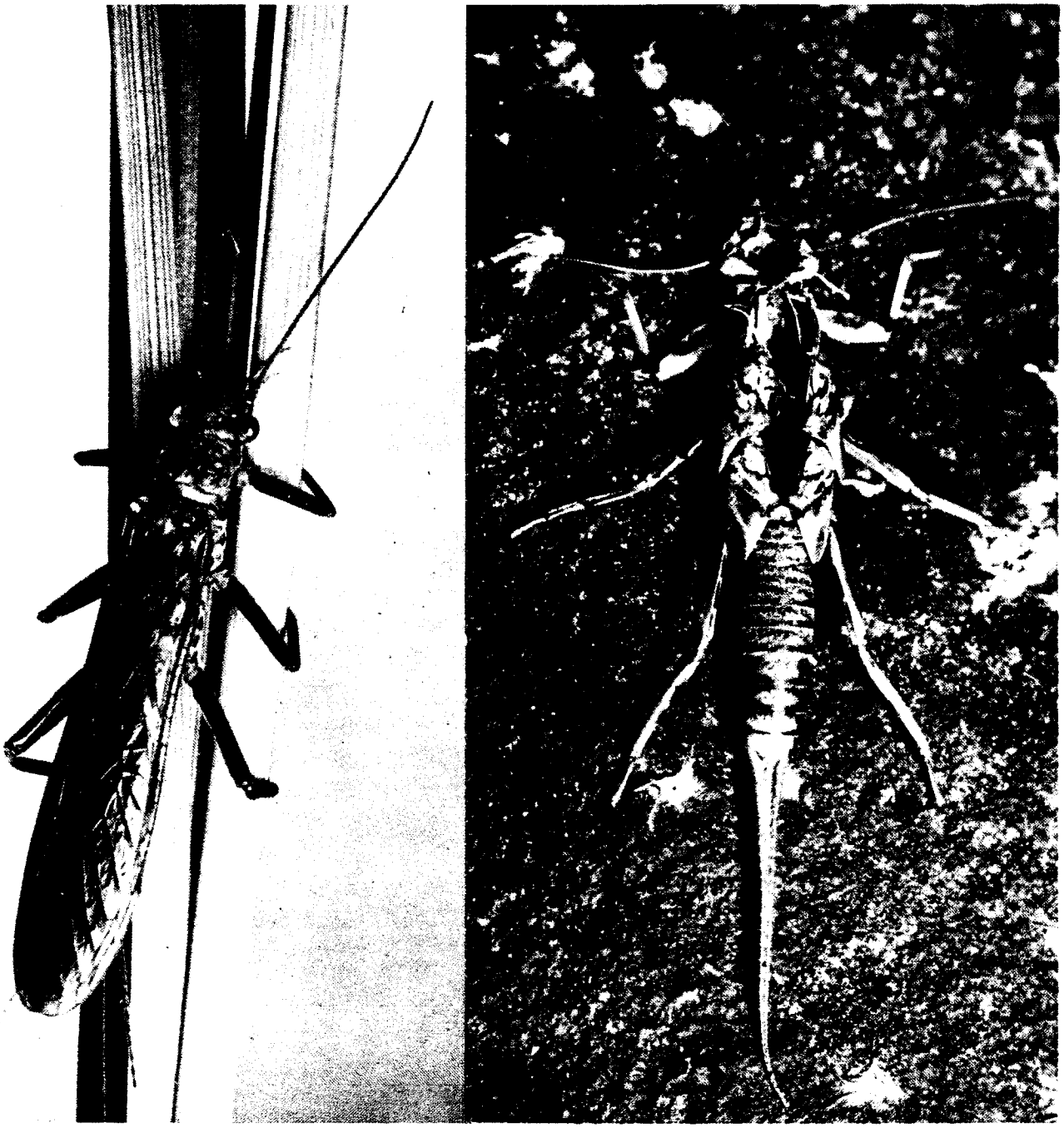

Typical Adult Stonefly and Cast Nymphal Skin
(Courtesy of Dr. E. S. Ross, California Academy of Sciences)

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(U. S. Bureau of Commercial Fisheries, Portland, Oregon)

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INTRODUCTION

Plecoptera is a relatively small order of aquatic insects with a world fauna of approximately 1,200 species. They require moving water for development of the nymphs, and for that reason the adults are usually found near streams. In some northern regions their early life is passed in cold lakes where the shore area is composed of gravel, but in most areas the immature stages are passed in creeks and rivers. There is a marked seasonal succession in the emergence of stoneflies, particularly in the northern hemisphere; adult stoneflies can be collected every month of the year in California if the proper locality is visited.

Adult members of the genus *Brachyptera* are occasionally an agricultural pest to soft fruit crops in the Pacific Northwest, where they are reported to feed on the tender buds of these plants (Newcomer, 1918). The principal economic importance of the majority of species, however, lies in their beneficial value as food for fish. Dimick and Mote (1934) rate stoneflies as the second most important order of insects in the diet of Oregon rainbow trout that are resident in streams.

Stoneflies require a habitat with cool, well-oxygenated water. The temperature of the water controls development and emergence; streams with marked temperature changes during the seasons usually display a distinctive sequence of emergence of various species. Springs and streams of constant or nearly constant temperature do not have a distinctive succession of forms; the species frequenting such habitats emerge during a period of many months. Some stoneflies occur only in large streams; some are found solely in small streams; still others frequent a wide range of stream sizes. Since they differ in their feeding habits – the suborder Filipalpia being principally vegetarian and the Setipalpia mostly carnivorous – both the physical character of the aquatic environment and its biota govern the kinds of stoneflies which occur in a habitat. Much valuable work could be done in determining the ecological distribution of stoneflies in California, and the results could have application in fishery management and pollution studies.

In general, the stonefly fauna of the western cordilleran region is of similar aspect. Of the 101 species recorded herein for California, 73 occur in Oregon, and 60 are recorded for British Columbia. As further collecting is done in western North America, indications of an even greater homogeneity in the Plecopteran fauna can be expected than these records indicate. Nevertheless, existing records show that many species have a limited range and that distinctive differences occur in the stonefly fauna of different regions within western North America. For example, the coastal area of central California has at least three unique species that probably occur only in that area. Several northern species are holarctic, but none of these reaches California. Several stoneflies are widespread in North America among which are *Taeniopteryx maura* (Pictet) and *Leuctra sara* Claassen, both of which occur in eastern North America and in California. Table 1 indicates present records of California stoneflies by counties.

The world stonefly fauna includes nine families (Ricker, 1951), three of which are primarily Notogaean. Six occur in North America, and all of these are represented in California. There are approximately 350 described North American stoneflies. As the fauna of this state becomes better known, the present list of 101 species will probably be increased.

In addition to my material (S.G.J.), the col-

lections of the California Academy of Sciences (C.A.S.), the California Insect Survey (C.I.S.), the University of California at Los Angeles (U.C.L.A.), D. L. Abell (D.L.A.), the late Harry P. Chandler (H.P.C.), Stephen W. Hitchcock (S.H.), and Wm. E. Ricker (W.E.R.), have provided the majority of the records for California stoneflies. A few specimens which I have collected have been deposited in the United States National Museum (U.S.N.M.). Permission to examine the material and record specimens in these collections is gratefully acknowledged.

Adult. – The adult stonefly is readily distinguished from other insects with which it might be confused, such as male Embioptera and certain Neuroptera, by its relatively primitive venation and mouth parts and by the fact that stoneflies always have three tarsal segments and two or three ocelli. Stoneflies vary in body length from 4-5 mm. (small *Capnia* and *Nemoura*) to 40-50 mm. (large *Pteronarcys*). Most stoneflies are normally winged, but a number are known to be brachypterous. One little-known western species, recorded only from New Mexico, is apparently wingless in the male (*Capnia fibula* Claassen); this is also true of another Capniid found in the Midwest, *Allocapnia vivipara* (Claassen). Filipalpia are primarily diurnal, but many Setipalpia are crepuscular or nocturnal and are attracted at night to artificial lights.

Egg. – Eggs are most frequently deposited in flight over water, but some species, notably among the Filipalpia, crawl to the water's edge for egg deposition. A stonefly may lay eggs only once or several times. In some species the total number of eggs deposited by one stonefly is known to exceed a thousand. Egg shape usually differs in the two suborders: those of the Filipalpia are spherical in general shape and have a sticky coating when moistened, an adaptation which enables them to adhere to the substrate; those of the Setipalpia are usually longer than wide but variously shaped and sculptured, without an adhesive coating but with an anchor plate.

Nymphs. – The nymphs of European stoneflies and those found in the midwestern United States are rather well known, but those of a great many North American species have not yet been described; this is particularly true of our western species. Many stonefly nymphs occur in waters with a gravel bottom, but some species are found where the substrate is chiefly detritus. Generally, the Filipalpia are found most abundantly in cooler waters, and the Setipalpia, most commonly in

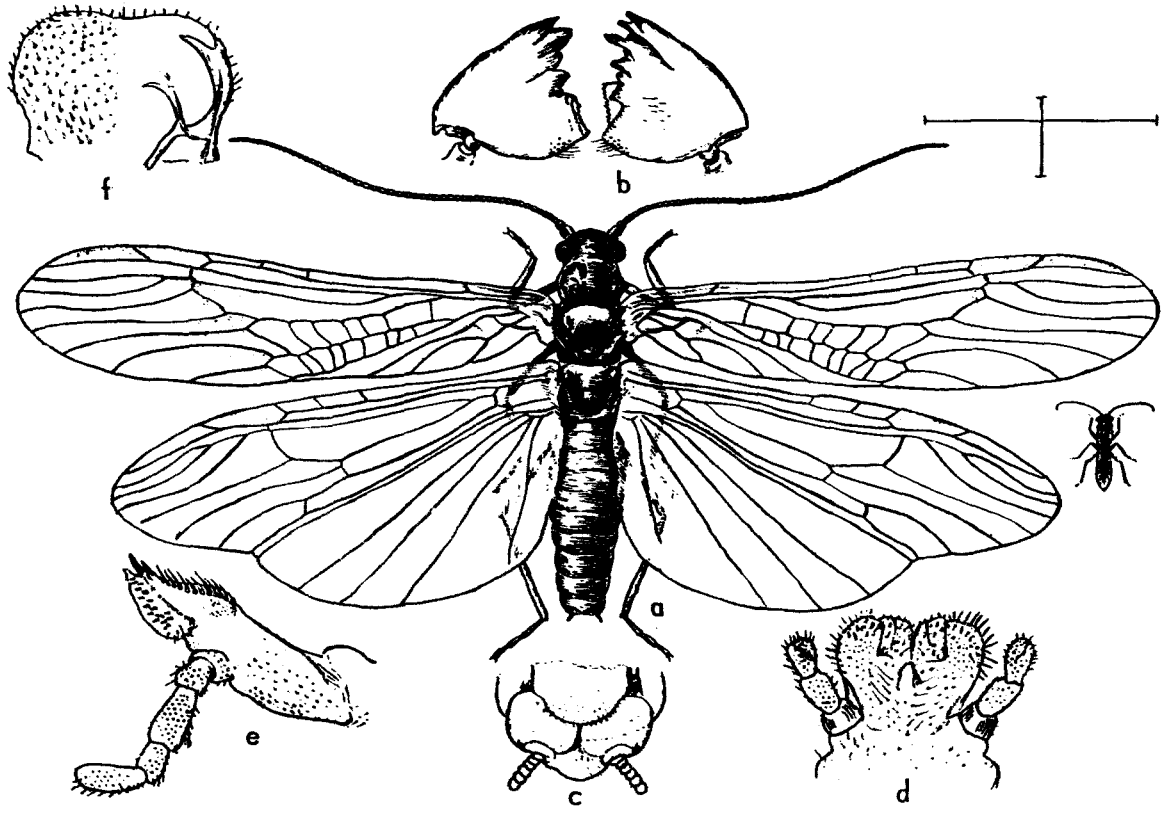

Fig. 1. *Brachyptera pacifica*. *a*, adult female; *b*, mandibles in ventral view; *c*, female terminal abdominal segments; *d*, labium; *e*, maxilla; *f*, labrum, dorsally at left and ventrally at right (Newcomer, 1918).

warmer waters. Many exceptions occur, and in some tropical regions only Setipalpia are found. For the stoneflies which have been reared from eggs, the number of instars has varied from twenty-two to thirty-three (Claassen, 1931, pp. 7-8). Development of the nymph may occur gradually, but in the majority of species there is apparently a period shortly after hatching when growth virtually ceases (Brinck, 1949, pp. 131-140). The nymphal stage lasts about a year in most species, but two or three years are required in some. Nymphs may or may not have external gills on the mentum, submentum, neck, thoracic segments, or on the first few abdominal segments, or gills may be extruded from the anus. Remnants of nymphal gills are present on some adults and are important in classifying the order.

The keys presented here have been modified from those prepared for my chapter on Plecoptera in Usinger *et al.* (1956). As indicated in that study, most of the keys have been adapted from those devised by Claassen (1931), Frison (1935, 1942), Needham and Claassen (1925), and Ricker (1943, 1952). Illustrations have been reproduced from published figures. Literature citations for each species include the original description, the reference in Needham and Claassen's 1925 monograph if included in that work, and synonyms and systematic references occurring subsequent to 1925. Literature references before 1925 may be found in the Needham and Claassen monograph. The systematic arrangement of Ricker (1950, 1952) has been followed closely.

PRESERVING AND COLLECTING

Stonefly nymphs and adults should be preserved in 70 to 75 per cent ethyl or isopropyl alcohol and preferably placed in it as they are collected or very soon after. Stoneflies are soft-bodied insects and particularly during warm weather will soon dry and shrivel if left exposed to the air after death. A convenient sized vial for temporary preservation is one of three-dram capacity measuring 65 by 17 mm. Cork or rubber stoppers may be used but the latter give better protection from evaporation. Care should be exercised not to crowd too many specimens into a vial. Specimens in vials of smaller diameter with cotton plugs are best stored permanently in large jars filled with 70 per cent alcohol.

Adult stoneflies may be collected in several ways. From late autumn to early spring, when most Capniids and many Nemourids emerge, concrete bridges over streams are excellent sources of specimens which can be easily collected with a pair of forceps. During the rest of the year the most productive method of collecting is by sweeping vegetation along streams with an insect net. The foliage of conifers is a favorite resting place for stoneflies wherever those trees border streams. Nocturnal species may be taken at artificial lights, from under large stones bordering streams, and particularly from under loose bark of logs which extend into the water. Cast nymphal skins found on rocks or tree trunks near the water should be preserved.

Nymphs are easily collected by overturning rocks and stirring gravel in stream beds upstream from the opening of an aquatic net of fine-meshed sieve. An excellent source of nymphs is among the debris which collects at grills at water diversion structures. Nymphs may be reared by placing them in small wire cages fixed to a floating raft in streams in such a manner that the upper part of each cage is above the water level (Frison, 1935*a*, pp. 305-307).

TAXONOMIC CHARACTERS

Wing venation, gills, number of ocelli, and male genitalia are the principal morphological features

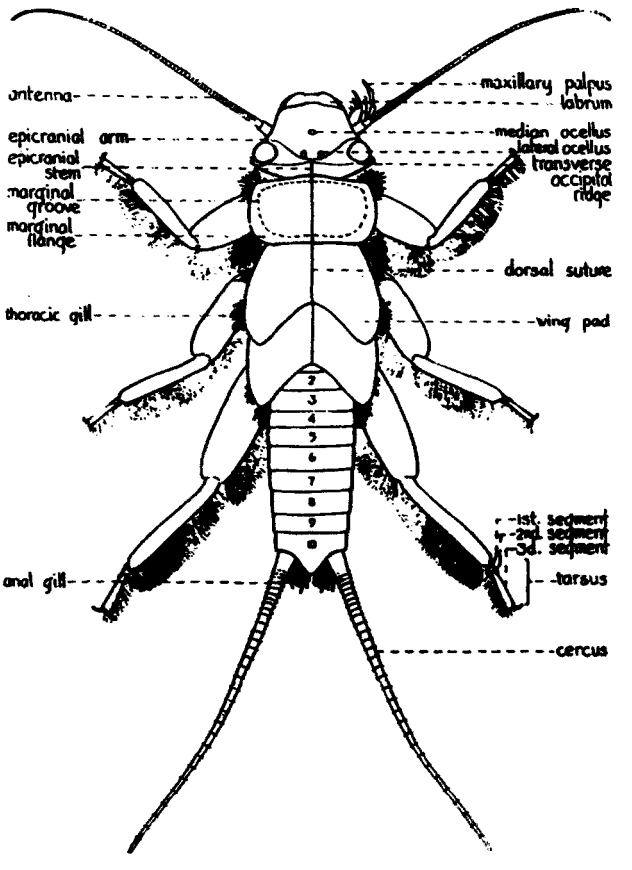

Fig. 2. Dorsal view of a constructed stonefly nymph (Frison, 1935).

used in classifying stoneflies above the species level. The genitalia of both sexes, but particularly those of the male, are used primarily for differentiating species. The dorsal color patterns of the head, thorax, and abdomen are very useful in classifying the Setipalpia and are specifically distinct for many species. The mouth parts and chaetotaxy of nymphs seem to be distinctive for most species, but the association of nymphs with adults is best accomplished through rearing. Where external gills occur, nymphs may sometimes be associated with adults of the same species, since remnants of nymphal gills persist in the adult stage.

Usually clearing of genitalia in adults is unnecessary in studying stoneflies if the specimens have been preserved correctly in alcohol. Exceptions occur with some of the smaller species, with dry or poorly preserved alcoholic specimens, and with genera where the aedeagus is useful or necessary for specific identification. The mouth parts of nymphs should be cleared. Clearing is easily accomplished by placing the mouth parts or the terminal third of the abdomen in 10 to 15 per cent KOH. Softening of the nonsclerotized parts is usually accomplished within twenty-four hours, and these can be removed; heating the KOH will greatly speed the process. After several baths in distilled water, the structure may be kept in the larger vial containing the rest of the specimen.

Notes and records on distribution of the species have been gleaned from the literature, from my notes based on material which I have identified, and from correspondence with other workers. Specimens recorded were identified by Dr. Wm. E. Ricker or by me; specific data are omitted for a few widespread, common species.

Key to the Families and Genera of California Plecoptera Nymphs and Adults (Figs. 1-5, 28, 30)

1. Paraglossae and glossae of about equal length, fig. 3, *a* . . . . . Suborder FILIPALPIA 2
   Paraglossae much longer than the glossae, fig. 3, *b* . . . . . Suborder SETIPALPIA 12

2(1). Abdomen without branched gills on the ventral side; anal area of the fore wing without cross veins or with only 1 row of them 3
   Branched gills on the ventral side of the abdominal segments 1 and 2; anal area of the fore wing with 2 or more full rows of cross veins . . PTERONARCIDAE 11

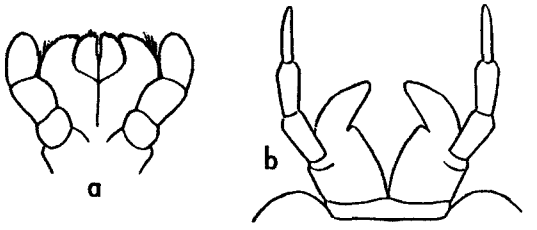

Fig. 3. Ventral view of nymphal labium. *a, Taeniopteryx maura; b, Isoperla patricia* (*a*, Frison, 1935; *b*, Frison, 1942*b*).

3(2). Form cockroachlike; ocelli 2; nymphal thoracic sterna produced posteriorly into thin plates overlapping the segment behind; at least 10 costal cross veins in fore wing . . . . . PELTOPERLIDAE: *Peltoperla*
   Form typical; ocelli 3; less than 10 costal cross veins in the fore wing except in *Isocapnia* which may have 10 or more . . . . . NEMOURIDAE 4

4(3). Second tarsal segment much shorter than the first, fig. 4, *a* 5
   Second tarsal segment at least as long as the first, fig. 4, *b* . . . . . TAENIOPTERYGINAE 10

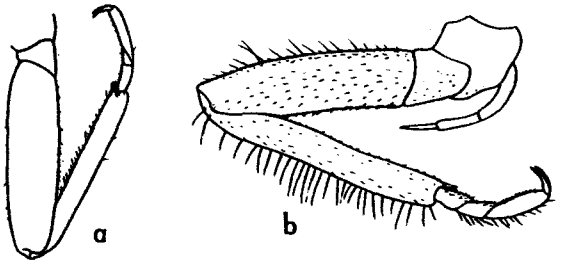

Fig. 4. Hind leg: *a, Leuctra claasseni; b, Taeniopteryx maura* (Frison, 1935).

5(4). Stout nymphs with hind wing pads strongly diverging from the axis of the body; wings lying nearly flat when at rest; 2d anal vein of fore wing forked, fig. 5, *b*; cerci of adult 1-segmented . . . . . NEMOURINAE: *Nemoura*
   Cylindrical elongate nymphs with hind wing pads nearly parallel with the axis of the body; wings either rolled around the body at rest or wings flat when at rest and with 2d anal vein of the fore wing simple, fig. 5, *a, c-f;* cerci of adult either 1-segmented or with more than 4 segments 6

6(5). Nymphal abdominal segments 1 to 9 divided by a membranous fold laterally; wings flat with 1 or rarely 2 intercubital cross veins in the fore wing, fig. 5, *c, e, f;* 2d anal vein of the fore wing simple; cerci of adult with at least 4 segments . . . . . CAPNIINAE 8

At most only the first 7 abdominal segments of the nymph divided by a membranous fold; wings rolled around the body; intercubital cross veins of the fore wing usually more than 5, fig. 5, *a, d:* 2d anal vein of the fore wing forked; cerci of adult 1-segmented. . . . . LEUCTRINAE 7

7(6). Segments 1 to 7 of the nymphal abdomen divided laterally by a membranous fold; veins Rs and M in the fore wing with a common origin on R, fig. 5, *d* . . . . . *Perlomyia*

Only the first 5 or 6 nymphal abdominal segments divided laterally; veins Rs and M in the fore wing arising from R beyond the origin of M, fig. 5, *a* . . . . . *Leuctra*

8(6). Nymphal cerci without mesal and lateral fringes of long silky hairs and abdominal segments without bristles; inner margin of the hind wing pad of nymph with a notch about half way from base to tip; R_1 of fore wing bent upward at its origin; 1st anal vein of fore wing bent abruptly caudad at its junction with cu-a and then curved outwardly again, fig. 5, *e* . . . . . *Capnia*

Nymphal cerci with fringes of long silky hairs or abdominal segments with bristles; R_1 of fore wing not bent upward at its origin; 1st anal vein of fore wing without abrupt bend at its junction with cu-a, fig. 5, *c, f* 9

9(8). Nymphal abdominal segments with a few

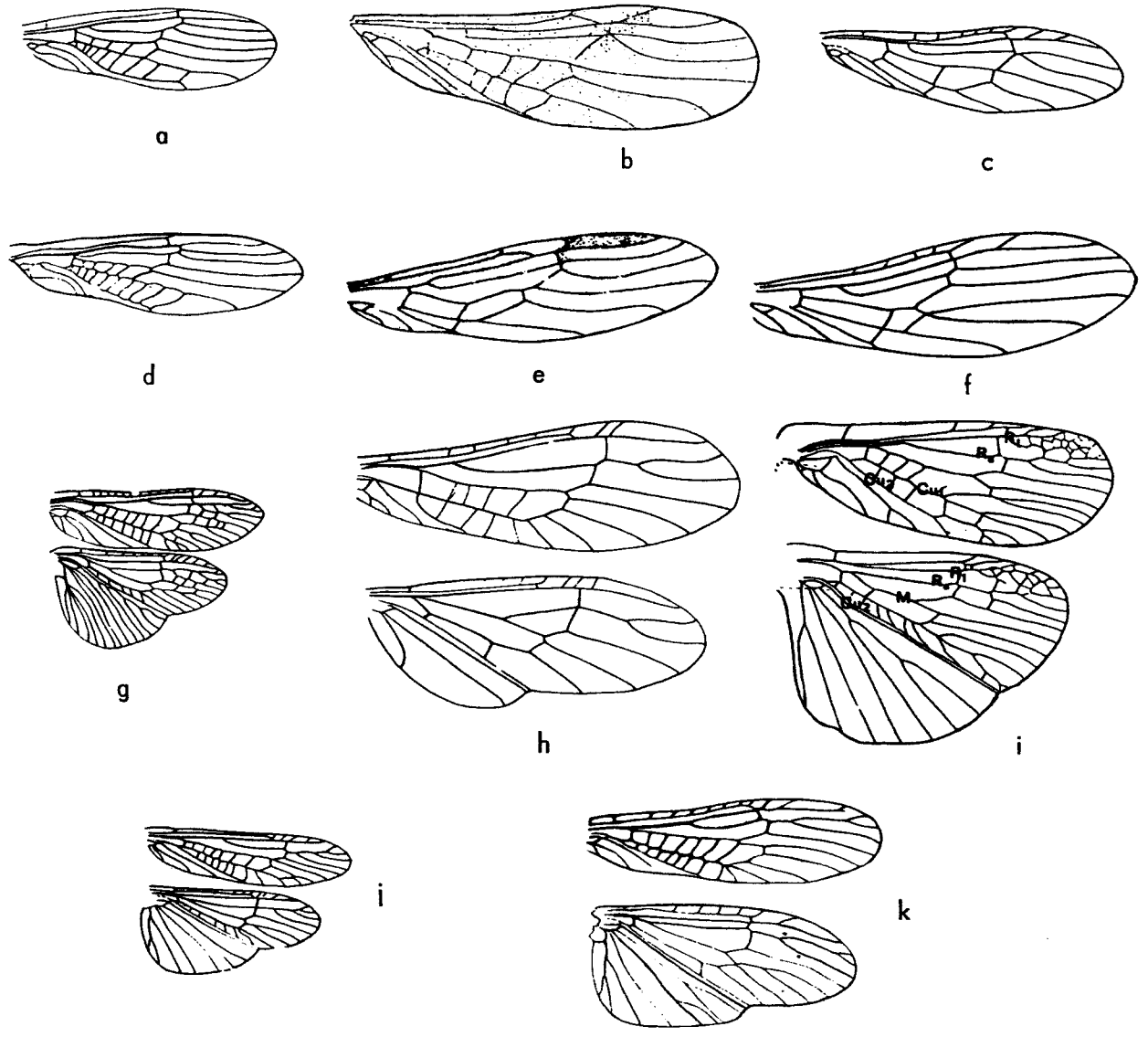

Fig. 5. Wings of stoneflies. *a-f*, fore wing: *a, Leuctra claasseni; b, Nemoura besametsa; c, Isocapnia* sp.; *d, Perlomyia utahensis; e, Capnia projecta; f, Eucapnopsis brevicauda; g-k*, fore and hind wings: *g, Acroneuria pacifica; h, Alloperla borealis; i, Arcynopteryx aurea; j, Isogenus alameda; k, Kathroperla perdita* (*a*, Frison, 1935; *b, c*, Ricker, 1943; *d, g, h, i, j, k*, Needham and Claassen, 1925; *e, f*, Frison, 1937).

slender bristles; cerci without long silky hairs; cerci of adult with fewer than 10 segments; 1 cross vein in costal area beyond the cord, fig. 5, *f*. . *Eucapnopsis*

Nymphal cerci with mesal and lateral fringes of long silky swimming hairs; cerci of adult with more than 11 segments; 2 or more cross veins in costal area beyond the cord, fig. 5, *c* . . . . . *Isocapnia*

10(4). Nymph with a single gill on each coxa; coxal scars on adult; adult male cerci 1-segmented; adult female 9th sternite without a long projection .. *Taeniopteryx*

Nymph without coxal gills; adult male cerci with at least 3 segments; adult female 9th sternite with a long projection . . . . . *Brachyptera*

11(2). Ventral abdominal gills on segment 3 . . . . . *Pteronarcella*

No ventral abdominal gills on segment 3 . . . . . *Pteronarcys*

12(1). Profusely branched gills at the lower angles of the thorax; cubito-anal cross vein of fore wing usually either in the anal cell or distant from it by no more than its own length, fig. 5, *g* . . . PERLIDAE, ACRONEURINAE: *Acroneuria*

Branched gills absent from the thorax; cubito-anal cross vein, if present, usually distant from the anal cell by more than its own length, fig. 5, *h-k* . . . 13

13(12). Nymphal body usually pigmented in a distinct pattern; nymphal cerci usually at least as long as the abdomen; pads of the hind wings in nearly mature nymphs set at an angle so that their central axis diverges considerably from the axis of the body; gills absent or simple gills present on submentum, thorax, or abdomen; fork of 2d anal vein of the fore wing included in the anal cell so that its 2 branches leave the cell separately, fig. 5, *i, j* . . . . . PERLODIDAE 14

Body of nymph almost concolorous without a pattern; cerci of nymph not more than 3/4 as long as the abdomen; pads of hind wings nearly parallel to the axis of the body except in mature *Kathroperla* which has the head elongated behind the eyes; external gills entirely lacking; 2d anal vein of the fore wing not forked or forked beyond the anal cell except in *Kathroperla* which has the fork at the margin of the cell or included in it, fig. 5, *h, k* . . . . . CHLOROPERLIDAE 17

14(13). Nymphs without a striped pattern on the abdomen; wings with or without a distal network of cross veins; adult male 10th tergite completely cleft . . . . . ISOGENINAE 15

Nymphal abdominal segments usually with a longitudinal striped pattern; wings never with a distal network of cross veins; adult 10th tergite of male entire or at most slightly notched . . . . . ISOPERLINAE 16

15(14). Gills present on the thorax, or if absent, the submental gills at least twice as long as their greatest width; wings with 4 to many cross veins beyond the cord, and these usually arranged in an irregular network, fig. 5, *i;* 7th abdominal sternite of male without a lobe . . . . . *Arcynopteryx*

Gills absent from the thorax; submental gills less than twice as long as their greatest width; wings with no more than 2 cross veins beyond the cord, fig. 5, *j;* 7th abdominal sternite of male with a lobe behind . . . . . *Isogenus*

16(14). Subanal lobes of male not formed into hooks; male 10th tergite slightly notched dorsally, fig. 18, *a* (nymph unknown) . . . . . *Calliperla*

Subanal lobes of male formed into hooks; male 10th tergite entire, fig. 30, *c-e* . . . . . *Isoperla*

17(13). Eyes small and set far forward; nymphal body narrow and elongate; anal veins with 5 to 7 branches reaching to the margin of the wing, fig. 5, *k* . . . . . PARAPERLINAE 18

Eyes large and normally situated; body less elongate; anal veins with 4 branches at most . . . . . CHLOROPERLINAE 19

18(17). Head longer than wide . . . . *Kathroperla*

Head about as wide as long . . *Paraperla*

19(17). Length of mature nymphs, excluding cerci, 5-7 mm.; inner margins of the hind wing pads of nymph almost straight; anal area of hind wing absent . . . . . *Hastaperla*

Length of mature nymphs usually more than 6 mm.; the inner margin of the hind wing pads of nymph curved or notched; anal area of hind wing present . . . . . *Alloperla*

Family PELTOPERLIDAE
Suborder FILIPALPIA

The peculiar, roachlike nymphs of *Peltoperla* are common in the streams of California, and the group is well represented by at least four species which are placed in three subgenera.

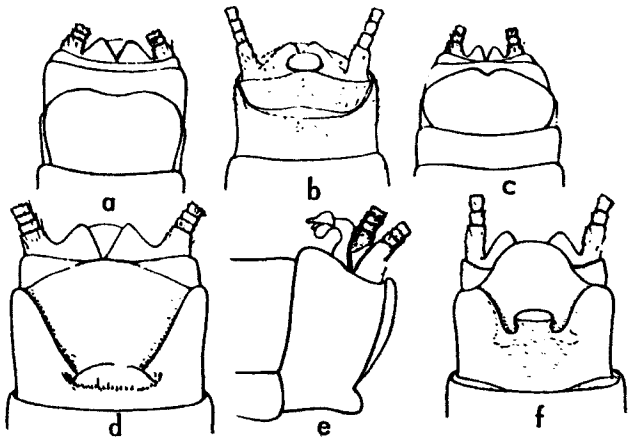

Fig. 6. Terminalia of *Peltoperla*. *a, cora*, ventral view of female; *b, brevis*, dorsal view of male; *c, brevis*, ventral view of female; *d, cora*, ventral view of male; *e, thyra*, lateral view of male; *f, brevis*, ventral view of male (Needham and Claassen, 1925).

Key to the California Subgenera and Species of *Peltoperla* (Figs. 6; 40, *a*)

1. No cervical gills; one pair of gills each on the meso- and metathorax . . *(Soliperla)* 2
   A pair of cervical gills present; gills on all thoracic segments 3
2(1). Aedeagus of male with a sclerotized, bilobed process . . . . . *thyra*
   Aedeagus of male with 4 bristlelike processes . . . . . *quadrispinula*
3(1). Two pairs of gills on each thoracic segment; adult 9-14 mm. in length . . . . . .(Subgenus *Yoraperla*) *brevis*
   Two pairs of gills on pro- and mesothorax, 1 bilobed pair on the metathorax; adult 18-26 mm. in length . . . . . (Subgenus *Sierraperla*) *cora*

1. *Peltoperla (Soliperla) thyra* Needham and Smith (Fig. 6, *e*)

Peltoperla thyra Needham and Smith, 1916, Can. Ent., 48:87, male.

Peltoperla thyra Needham and Claassen, 1925, Monog. Plecop., pp. 170-171; wing, pl. 15, fig. 2; male genitalia, pl. 31, figs. 9 and 10.

Peltoperla thyra Ricker, 1952, Syst. Studies Plecop., p. 157, placed in new subgenus *Soliperla*.

Peltoperla (Soliperla) thyra Jewett, 1954, Pan-Pac. Ent., 30 (3):167, female.

Type locality: Nevada.

Geographic range: Nevada and California.

California record:

Sonoma Co.: 6 mi. S. Middletown, male, V-11-26 (C.A.S.); same locality, male, 5 females, V-12-26 (C.A.S. and S.G.J.).

Discussion:

The members of the subgenus *Soliperla* have seldom been collected and little is known about them. In Oregon, *P. campanula* Jewett, a species related to *thyra*, has been taken with members of the subgenus *Yoraperla* in small, cold streams of the Cascade Mountains, but the collection dates indicate that its emergence is generally somewhat later than that of the two species of *Yoraperla* with which it is associated. Several nymphs of *Soliperla*, readily distinguished by the gill arrangement, have been examined from California, but these have not been associated with adult males so their specific identity is conjectural.

As indicated in the key, the species of *Soliperla* are most readily distinguished in the male by the shape of the sclerotized structure of the aedeagus; this is usually visible through the walls of the 9th segment. Females cannot yet be separated with certainty; more associated material of the sexes is needed for study.

2. *Peltoperla (Soliperla) quadrispinula* Jewett (Fig. 40, *a*)

Peltoperla (Soliperla) quadrispinula Jewett, 1954, Pan-Pac. Ent., 30(3):169; male and female.

Type locality: Wrangle Gap Camp, Rogue River National Forest, Jackson County, Oregon.

Geographic range: Oregon and California.

California record:

Trinity Co.: Coffee Cr., male, VI-7-34 (E.C. Van Dyke, C. A. S.).

3. *Peltoperla (Yoraperla) brevis* Banks (Fig. 6, *b, f*)

Peltoperla brevis Banks, 1907, Can. Ent., 39:328, female.

Peltoperla brevis Needham and Claassen, 1925, Monog. Plecop., pp. 171-172; wing, pl. 15, fig. 1; male and female genitalia, pl. 31, figs. 11-13.

Peltoperla brevis Ricker, 1943, Stoneflies SW B. C., pp. 46-48; nymph, figs. 6 and 9.

Peltoperla brevis Ricker, 1952, Syst. Studies Plecop., p. 157, placed in new subgenus *Yoraperla*.

Type locality: Glacier, British Columbia.

Geographic range: British Columbia, Alberta,

and Montana to California.
California record:

Inyo, Mariposa, Mono, Plumas, San Bernardino, Shasta, and Tuolumne counties. June to August.
Discussion:

This is the smallest Pacific coast species of the genus and is abundant in the small, mountain streams of California. *P. mariana* Ricker, a closely related and larger species found from British Columbia to Oregon, may occur in California. In the nymph, *P. mariana* is separated most readily by the differently shaped plate on the metasternum, the posterior border being straight instead of the corners turning rearward as in *P. brevis*.

The type of *P. nigrisoma* Banks (1948) from Sequoia National Park has not been examined, and the description is inadequate to distinguish it from *P. brevis* or *P. mariana*. Since *nigrisoma* may prove to be a synonym, this name has not been given separate listing.

4. *Peltoperla (Sierraperla) cora* Needham and Smith (Fig. 6, *a, d*)

Peltoperla cora Needham and Smith, 1916, Can. Ent., 48:86; female.

Peltoperla cora Needham and Claassen, 1925, Monog. Plecop., pp. 172-173; male and female genitalia, pl. 31, figs. 14-16.

Peltoperla cora Jewett, 1954, Pan-Pac. Ent., 30 (3):170-171; nymph, and placed in new subgenus *Sierraperla*.

Type locality: Reno, Nevada.
Geographic range: Nevada and California.
California records:

Colusa Co.: Paradise Cr., 2,400 ft., 2 nymphs, IV-18-51 (H. P. Chandler, H. P. C.).

El Dorado Co.: Pyramid Ranger Station, female, VII-12-48 (C. I. S.).

Plumas Co.: Howells, 2,000 ft., 1 nymph, VIII-29-46 (H. P. Chandler, S. G. J.); Tributaries of Smith Cr., el. *ca.* 6,500 ft., Blairsden, male, VI-11-52 (Wm. E. Ricker, W. E.R.).

Shasta Co.: Hat. Cr., 4 females, VI-23-47 (D. W. Adams, C. I. S.); Shingletown, 2 males, 2 females, VI-7-41 (C. W. Anderson, C. I. S. and S. G. J.).

Siskiyou Co.: Mt. Shasta, male, VI-27-14 (C. A. S.), Shasta Sprgs., 2 males, 1 female, VI-15-20 (E. P. Van Duzee, C. A. S. and S. G. J.).

Family NEMOURIDAE
Subfamily NEMOURINAE

California is rich in species of *Nemoura,* 15 of which are recorded to date. With the exception of *N. spiniloba* Jewett which has not yet been assigned to a subgenus, the species fall into six subgenera as described by Ricker (1952). Because the nymphs of so many species remain undescribed, no nymphal key is presented; however, for species possessing external gills, the key to females may be helpful in placing specimens.

Key to the Males of California Subgenera and Species of *Nemoura* (Figs. 7-9; 40, *b;* 41, *f-i*)

1. Cerci elongated and heavily sclerotized to the tip; at least on the outer surfaces, and with one or two spines or processes on the distal margin 2
   Cerci membranous or weakly sclerotized (except for a distinct mesobasal process, often sclerotized, in some species of *Malenka*); the tip blunt, without spines or processes 3

2(1). Tip of cercus with one spine; tip of subanal lobes slender but short; no gills on head or neck . . . . . *spiniloba*
   Tip of cercus with two spines; tip of subanal lobes long and slender; 2-branched gills inserted at the sides of the mentum . . . . . (Subgenus *Visoka) cataractae*

3(1). Veins A_1 and A_2 of the fore wing united a little before their outer end . . . . . (Subgenus *Soyedina*) 4
   Veins A_1 and A_2 separate at the tip; subanal lobes not as above 5

4(3). Paired tubercles on tergites 2 to 4 . . . . . *producta*
   Paired tubercles absent from tergites . . . . . *n. nevadensis*

5(3). Cervical gills present 6
   Cervical gills absent 14

6(5). Gills unbranched except in *cinctipes* which has gills often 5-branched and wings with contrasting clear and pigmented bands . . . (Subgenus *Zapada*) 7
   Gills with 6 or more branches; wings without any clear transverse bands; subanal lobes divided (except *marionae*) almost to the base into 2 parts, one or both of them spinulose . . . . . (Subgenus *Malenka*) 11

7(6). Wings uniformly dark; gills 12 to 15 times as long as wide . . . . . *frigida*
   Wings conspicuously banded or mostly clear; gills less than 10 times as long as wide 8

8(7). Gills branched one to several times (very rarely unbranched) tip of the wings clear . . . . . *cinctipes*

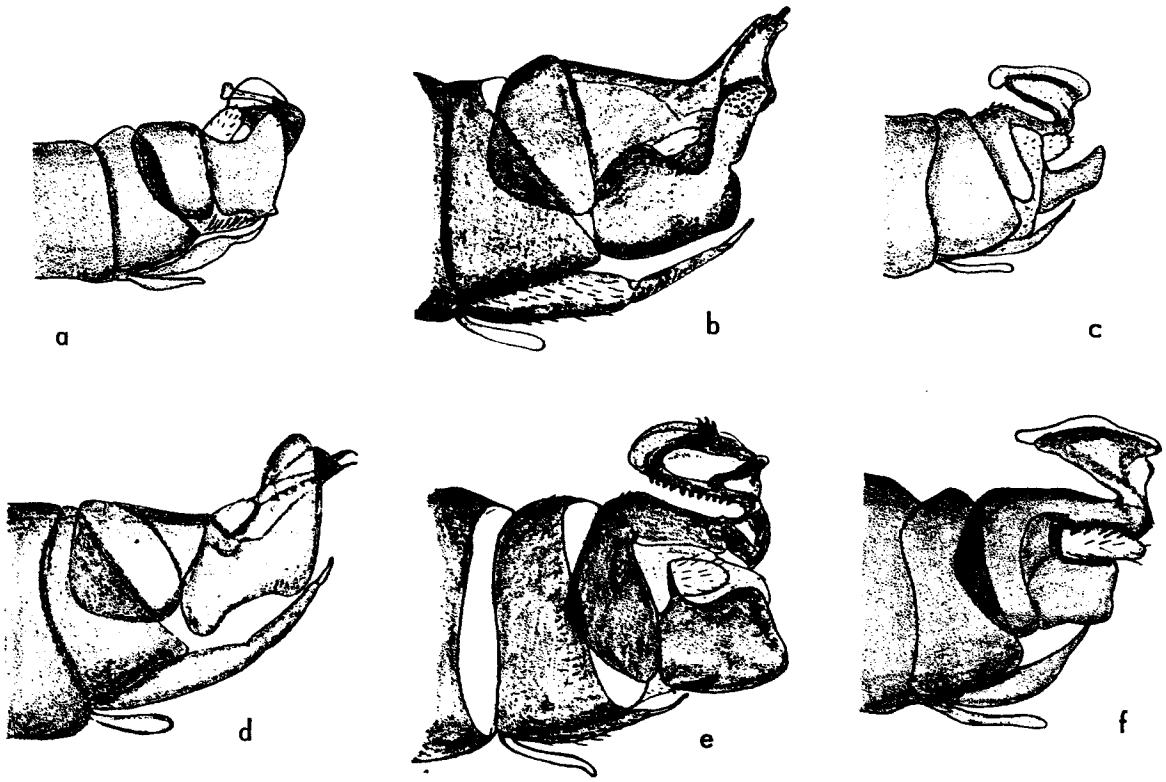

Fig. 7. Male terminalia of *Nemoura*, in lateral view. *a, columbiana; b, nevadensis interrupta; c, frigida; d, nevadensis nevadensis; e, oregonensis; f, cinctipes* (Needham and Claassen, 1925).

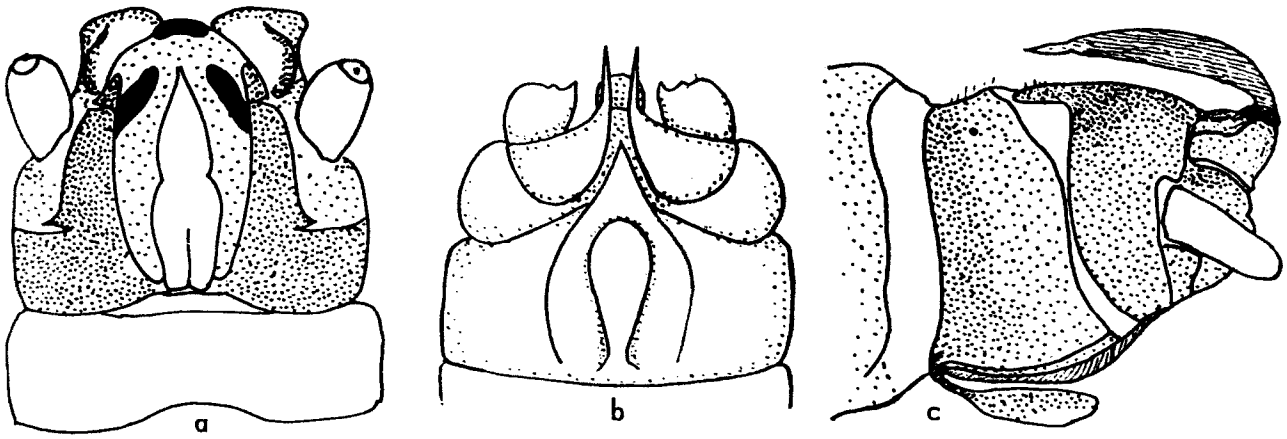

Fig. 8. Male terminalia of *Nemoura*. *a, haysi*, dorsal view; *b, cataractae*, ventral view; *c, besametsa*, lateral view (*a, c*, Ricker, 1952; *b*, Neave, 1933).

Gills simple 9

9(8). Gills constricted at the base and one or more times (usually twice) beyond the base . . . . . *columbiana*

Gills constricted at the base only, if at all (a slight subterminal constriction occasionally in *haysi*) 10

10(9). Subanal lobes quadrangular, the inner terminal angle rather sharp without any sclerotized knob on the inner membrane . . . . . *oregonensis*

Subanal lobes with the inner terminal angle obtuse and rounded so that the lobe appears almost triangular, and bearing a sclerotized knob on the distal lateral corner of the inner membrane . . . . . *haysi*

11(6). Mesobasal lobe of the cercus sclerotized and sharply pointed inward and backward . . . . . *californica*

Mesobasal lobe of the cercus rounded and usually membranous 12

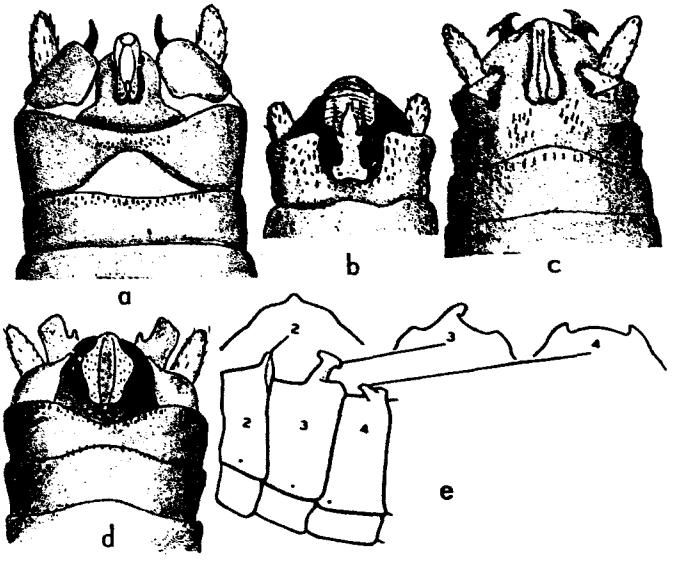

Fig. 9. Male terminalia of *Nemoura*. *a, depressa*, dorsal view; *b, delicatula*, dorsal view; *c, biloba*, dorsal view; *d, californica*, dorsal view; *e, producta*, lateral view (*a-d*, Needham and Claassen 1925; *e*, Frison, 1937).

12(11). Tip of the subanal lobes simple 13
Tip of the subanal lobes divided into 2 divergent and acute prongs . . . *biloba*

13(12). Subanal lobe simple, tip broad in dorsal view, coarsely serrate . . . . . *marionae*
Subanal lobes divided into two parts, tips slender in dorsal view, not serrate . . . . . *depressa*

14(5). Supra-anal process slender, completely recurved along the 10th and 9th tergites; wings banded . . . . . (Subgenus *Prostoia*) *besametsa*
Supra-anal process rather short, thick, complex in structure, and only slightly bent forward . . . . . (Subgenus *Podmosta*) *delicatula*

Key to Females of California Subgenera and Species of *Nemoura*[1]
(Figs. 10-11; 41, *h*)

1. Gills present under the neck or head . . 2
Gills absent 11

2(1). One branched gill present on each side of the mentum; wings not banded; 7th sternite moderately produced . . . . . (Subgenus *Visoka*) *cataractae*
Two gills present on each side of the neck, branched or simple; wing usually banded, spotted, or completely infuscated 3

3(2). Gills simple filaments (except in *cinctipes*); 7th sternite produced completely over the 8th which is very weak . . . . . (Subgenus *Zapada*) 4
Gills branched; 7th sternite moderately or little produced, not covering all of the 8th; 8th sternite bearing a distinct terminal or subterminal notch . . . . . (Subgenus *Malenka*) 8

4(3). Wings uniformly dark; gills 12 to 15 times as long as broad . . . . . *frigida*
Wings conspicuously banded or mostly clear; gills less than 10 times as long as wide 5

5(4). Gills branched 1 to several times (very rarely unbranched); tip of the wing clear . . . . . *cinctipes*
Gills simple 6

6(5). Gills constricted at the base and 1 or more times, usually twice, beyond the base . . . . . *columbiana*
Gills constricted only at the base if at all (a slight constriction, subterminal, occasionally in *haysi*) 7

7(6). Produced part of the 7th sternite light-colored and narrowly rounded, almost semicircular . . . . . *oregonensis*
Produced part of the 7th sternite dark-colored, at least along the broadly rounded or nearly straight hind margin . . . . . *haysi*

8(3). Median notch completely bisecting 8th sternite . . . . . *biloba*
Median notch not completely bisecting 8th sternite 9

9(8). A nipple on the 7th sternite 10
No nipple on the 7th sternite . . *marionae*

10(9). Nipple of the 7th sternite low, inconspicuous, often scarcely recognizable, its base confluent with the hind margin of the sternite . . . . . *depressa*
Nipple of the 7th sternite erect, easily distinguishable in side view at least, its base set somewhat anterior to the hind margin of the sternite . . . . . .

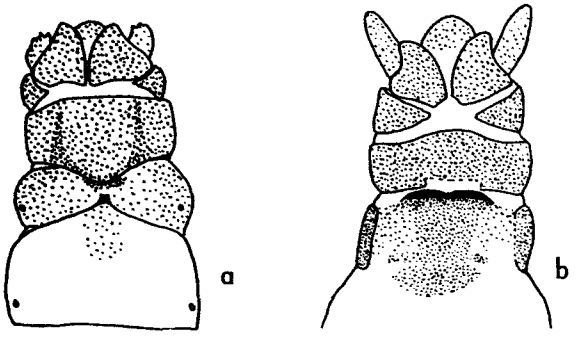

Fig. 10. Female terminalia of *Nemoura*, in ventral view. *a, cataractae; b, besametsa* (Ricker, 1943).

[1] Female of *N. spiniloba* unknown

. . . . . *californica*

11(1). Veins A_1 and A_2 united near the margin of the wing; 7th sternite produced over the full length of the 8th . . . . . (Subgenus *Soyedina*) 12

Veins A_1 and A_2 not united; 7th sternite not produced over the full length of the 8th 13

12(11). Subgenital plate of the 7th sternite more broadly rounded . . . . . *n. nevadensis*

Subgenital plate less broadly rounded . . . . . *producta*

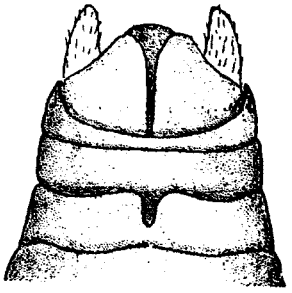

Fig. 11. Female terminalia of *Nemoura depressa*, in ventral view.

13(11). Wings mostly dark with a clear band across the middle of the outer field . . . . . (Subgenus *Prostoia*) *besametsa*

Wings entirely clear or with some of the veins darkened near the cord; median sclerotized stripe of the 8th sternite 3 to 4 times as long as its greatest breadth, of nearly uniform width throughout . . . (Subgenus *Podmosta*) *delicatula*

5. *Nemoura spiniloba* Jewett (Fig. 40, *b*)

Nemoura spiniloba Jewett, 1954, Pan-Pac. Ent., 30(3):172; male.

Type locality: Woodacre, Marin County, California.

Geographic range: California.

California records:

Marin Co.: Woodacre, holotype male, III-31-49 (L. W. Quate, C. A. S.).

Contra Costa Co.: Berkeley, male, IV-8-54 (P. D. Hurd, S. G. J.).

6. *Nemoura (Malenka) biloba* Claassen (Fig. 9, *c*)

Nemoura biloba Claassen, 1923, Can. Ent., 55: 282; male and female.

Nemoura biloba Needham and Claassen, 1925, Monog. Plecop., p. 205; male and female genitalia, pl. 35, figs. 1-4.

Nemoura biloba Seemann, 1927, Jour. Ent. and Zool., 19:54; wings and nymph, pl. 1, figs. 4-9.

Nemoura biloba Ricker, 1952, Syst. Studies Plecop., p. 32; placed in new subgenus *Malenka*.

Type locality: Los Angeles County, California.

Geographic range: Southwestern California.

California records:

Fresno Co.: Dry Cr., 10 mi. N. E. Academy, 1,000 ft., male, IV-10-55 (D. L. Abell, D.L.A.).

Kern Co.: Fort Tejon, 2 males, 2 females, IV-6-32 (E. P. Van Duzee, C. A. S. and S. G. J.).

Los Angeles Co.: Topanga Canyon, female, V-30-51 (U. C. L. A.); same locality, except 2 males, 1 female, V-19-51 (U.C.L.A.); Santa Monica Mts., male, V-24-51 (U.C.L.A.); Santa Anita Canyon, 4 males, 1 female, VI-7-52 (J. A. Norris (U. C. L. A.); Mandeville Canyon, Santa Monica Mts., male and female, VII-22-52 (W. A. MacDonald (U. C. L. A.).

7. *Nemoura (Malenka) californica* Claassen (Fig. 9, *d*)

Nemoura californica Claassen, 1923, Can. Ent., 55:284; male and female.

Nemoura californica Needham and Claassen, 1925, Monog. Plecop., p. 207; pl. 35, figs. 16-19, male and female genitalia (fig. 19, subgenital plate of female, is evidently *N. dimicki*).

Nemoura californica Neave, 1929, Contr. Can. Biol. N. S. 4, p. 162; female, fig. 8.

Nemoura lobata Frison, 1936, Ann. Ent. Soc. Amer., 29:260; male, pl. 1, figs. 5-7.

Nemoura californica Ricker, 1952, Syst. Studies Plecop., p. 33; placed in new subgenus *Malenka*.

Type locality: Oakland Hills, Alameda County, California.

Geographic range: Alberta and British Columbia to California and New Mexico.

California records:

El Dorado Co.: Gillmore L., Tahoe, 8,000 ft., 5 males, 4 females (H. P. Chandler, H. P. C.); Emerald Bay, Tahoe, 2 males, 1 female, VII-28-46 (H. P. Chandler, H. P. C.).

Marin Co.: Tamalpais, 1 female, VII-8-48 (H. E. Cott, C. I. S.).

Sierra Co.: Snag L., 7 mi. N. Sierra City, male, 11 females, X-26-52 (S. G. J.).

Discussion:

Nemoura californica is an abundant autumn species north of California, and occasionally emerges during the spring season at some localities. Another closely associated species, *N. cornuta* Claassen, occurs commonly from southern Oregon north to British Columbia and may occur in northwestern California. It is yellow-brown in color, and in the male the process at the base of the cercus has a prong which points straight back instead of mostly inward as in *N. californica*.

The adults emerge during the spring season.

8. *Nemoura (Malenka) depressa* Banks
(Figs. 9, *a;* 11)

Nemoura depressa Banks, 1898, Trans.Amer. Ent. Soc., 25:200; female.
Nemoura depressa Needham and Claassen, 1925, Monog. Plecop., p. 206; wing, pl. 32, fig. 6; male and female genitalia, pl. 35, figs. 9-12.
Nemoura depressa Ricker, 1952, Syst. Studies Plecop., p. 33; placed in new subgenus *Malenka.*
Type locality: Cottage Grove, Oregon.
Geographic range: Oregon and northern California, New Mexico.
California records:
Contra Costa Co.: Strawberry Canyon Berkeley, male, female, III-18-47 (H. P. Chandler, H. P. C.); Berkeley, male, III-6-46 (D. J. Raski, C. I. S.).
Marin Co.: Mill Valley, male, IV-26-47 (H. P. Chandler, H. P. C.); Phoenix L., male, V-30-27 (H. H. Keifer, C. A. S.).
Mariposa Co.: 7 mi. ENE Fish Camp, 6 males, VII-11-46 (H. P. Chandler, H.P.C. and S.G.J.).
Plumas Co.: Almanor hatchery, male, X-1-15-48 (S. G. J.).
San Mateo Co.: Moss Beach, male, female, III-21-48 (W. W. Wirth, C. I. S.).
Shasta Co. Burney Falls, male, VII-13-47 (R. L. Usinger, C. I.S.).
Sonoma Co.: Trinity, male, XII-20-37 (N. W. Frazier, C. I. S.).

9. *Nemoura (Malenka) marionae* Hitchcock
(Fig. 41, *f-i*)

Nemoura marionae Hitchcock, 1958, Pan-Pac. Ent., 34(2):78-80; male and female.
Type locality: Spring flowing into Sagehen Creek, near Hobart Mills, Nevada County, California.
Geographic range: California.
California record:
Nevada Co.: Spring flowing into Sagehen Cr., near Hobart Mills, holotype male, VIII-9-55 (S. W. Hitchcock, C. A. S.): same data except VII-26-55, allotype female (C. A. S.); paratypes, same data as for female (W. E. R., S. G. J., S. H.)

10. *Nemoura (Podmosta) delicatula* Claassen
(Fig. 9, *b*)

Nemoura delicatula Claassen, 1923, Can. Ent., 55:285; male and female.
Nemoura delicatula Needham and Claassen, 1925, Monog. Plecop., p. 204; male and female genitalia, pl. 34, figs. 14-17.
Nemoura delicatula Ricker, 1952, Syst. Studies Plecop., p. 43; placed in new subgenus *Podmosta.*
Type locality: Boulder, Colorado.
Geographic range: Central British Columbia to California and Colorado.
California records:
El Dorado Co. (?): Near L. Tahoe, 2 females, VI-27-53 (D. G. Denning, S. G. J.).
Tuolumne Co.: Gaylor Lakes, 10,000 ft., Yosemite National Park, male, female, VII-8-46 (H. P. Chandler, C. I. S.); Tuolumne Meadows, Yosemite National Park, male, VII-9-46 (H. P. Chandler, C. I. S.).

11. *Nemoura (Prostoia) besametsa* Ricker
(Figs. 8, *c;* 10, *b*)

Nemoura glabra Claassen, 1923, Can. Ent. 55:281 (in part: western specimens).
Nemoura glabra Needham and Claassen (in part), 1925, Monog. Plecop., p. 202.
Nemoura completa Ricker, 1943, Stoneflies SW B.C., p. 68; male, female, and nymph.
Nemoura species A Ricker, 1943, *ibid.*, p. 72; female genitalia and wing, p. 71, figs. 41 and 43.
Nemoura besametsa Ricker, 1952, Syst. Studies Plecop., p. 48; male genitalia, p. 44, fig. 20; male and female.
Type locality: Vedder Crossing, British Columbia.
Geographic range: Southern British Columbia to California and Colorado.
California records:
El Dorado Co. (?): Lake Tahoe, male and female, VI-23-25 (E. H. Nast, C. A. S.).
Madera Co.: Chilkoot L., 2 females, VII-23-46 (H. P. Chandler, C. I. S.).
Mariposa Co.: Fish Camp, 4 females, VII-11-46 (H. P. Chandler, H. P. C.); Yosemite Cr., 7,200 ft. 2 males, VI-21-50 (Wm. E. Ricker, W. E. R.); Merced R., Yosemite National Park, 45 females, VI-22-50 (Wm. E. Ricker, W. E. R.).
Plumas Co.: Bucks Lake, 9 males, 3 females, VI-29-50 (H. P. Chandler, H. P. C.); Small Creek 6 mi. W. of Portola, 2 females, VI-10-52 (Wm. E. Ricker, W. E. R.).
Tuolumne Co.: May Lake, 9,000 ft., Yosemite National Park, 5 males, 1 female, VII-9-46 (H. P. Chandler, H. P. C.).
Trinity Co.: Mouth Indian Cr., trib. Trinity R., nr. Douglas City, 2 males, female, III-2-55 (S.G. Jewett, Jr., C. A. S.).

12. *Nemoura (Soyedina) nevadensis nevadensis* Claassen
(Fig. 7, *d*)

Nemoura nevadensis Claassen, 1923, Can. Ent., 55:286; male and female.

Nemoura nevadensis Needham and Claassen, 1925, Monog. Plecop., p. 216; male and female genitalia pl. 38, figs. 8-11.

Nemoura nevadensis nevadensis Ricker, 1952, Syst. Studies Plecop., p. 52; placed in new subgenus *Soyedina*.

Type locality: Reno, Nevada.

Geographic range: California and western Nevada.

California records:

Alpine or Tuolumne Co.: Near Sonora Pass, 8,500 ft., male, VII-4-48 (H. K. Townes, W.E.R.).

Fresno Co.: Huntington L., 7,000 ft., female, VII-6-? (C. I. S.).

Inyo Co.: Lone Pine, female, V-26-37(E. C. Van Dyke, C. A. S.).

Marin Co.: Mt. Tamalpais, male (H. P. Chandler, H. P. C.).

Mariposa Co.: Fish Camp, 5,000 ft., male and female, VII-11-46 (H. P. Chandler, H. P. C.).

Nevada Co.: Truckee, male, VI-17-27 (E. P. Van Duzee, C. A. S.).

Plumas Co.: Tribs. of Smith Cr., *ca.* 6,500 ft., Blairsden, female, VI-11-52 (Wm. E. Ricker, (W. E.R.).

Shasta Co.: Burney Falls, 2 males, 1 female (all brachypterous), VI-29-47 (H. P. Chandler, S.G.J.).

Discussion:

The northern subspecies, *N. n. interrupta*, which ranges from Oregon to British Columbia, has not been taken in California although it occurs in southern Oregon along the coast (Pistol River, Curry County). It can be distinguished in the male by the notches in the mesal margin of the subanal lobes whereas the margin is regularly tapered in *nevadensis*.

13. *Nemoura (Soyedina) producta* Claassen (Fig. 9, *e*)

Nemoura producta Claassen, 1923, Can. Ent., 55: 286; male.

Nemoura producta Needham and Claassen, 1925, Monog. Plecop., p. 211; male and female.

Nemoura tuberculata Frison, 1937, Bull. Ill. Nat. Hist. Surv., 21:84; male and female.

Nemoura producta Ricker, 1943, Stoneflies SW B.C., pp. 65-67; female and nymph.

Nemoura producta Ricker, 1952, Syst. Studies Plecop., p. 52; placed in new subgenus *Soyedina*.

Nemoura producta Hitchcock, 1958, Pan-Pac. Ent. 34(2):80.

Type locality: Holotype male, allotype female without any label.

Geographic range: Coast and Cascade mountains from southern British Columbia to California.

California records:

Marin Co.: Woodacre, 3 males, III-26-55 (S.H.); same except IV-2-55, female (Stephen W. Hitchcock, S. H.); Fairfax, 4 males, III-26-55 (Stephen W. Hitchcock, S. H.); same except V-1-55, male, female (S. H.); Mill Valley, male, 2 females, III-6-55 (Stephen W. Hitchcock, S. H.); near Alpine L., 2 males, female, V-1-55 (Stephen W. Hitchcock, S. H.); Lily Lake, 2 males, female, III-16-56 (J. Powell, S. H.).

Monterey Co.: Redwood Sprgs., Los Padres Nat'l. Forest, IV-10-55 (Stephen W. Hitchcock, S. G. J.).

14. *Nemoura (Visoka) cataractae* Neave (Fig. 8, *b*)

Nemoura cataractae Neave, 1933, Can. Ent., 65: 238; male.

Nemoura cataractae Ricker, 1943, Stoneflies SW B.C.; female and nymph.

Nemoura cataractae Ricker, 1952, Syst. Studies Plecop., p. 54; placed in new subgenus *Visoka*.

Type locality: Lake O'Hara, British Columbia.

Geographic range: Southern British Columbia to Montana and California.

California records:

Mariposa Co.: Yosemite Valley, female, V-24-21 (E. C. Van Dyke, C. A. S.).

Siskiyou Co.: Little Castle Cr., 3 females, III-2-55 (S. G. Jewett, Jr., U. S. N. M.).

15. *Nemoura (Zapada) cinctipes* Banks (Fig. 7, *f*)

Nemoura cinctipes Banks, 1897, Trans. Amer. Ent. Soc., 24:21.

Nemoura cinctipes Needham and Claassen, 1925, Monog. Plecop., p. 212; wings, pl. 32, fig. 2; male and female genitalia, pl. 37, figs. 5-8.

Nemoura cinctipes Castle, 1939, Can. Ent., 71: 208-209, fig. 1; nymph.

Nemoura cinctipes Ricker, 1952, Syst. Studies Plecop., p. 57; placed in new subgenus *Zapada*.

Type locality: Olympia, Washington.

Geographic range: Alaska, British Columbia, and Alberta south to Utah and California.

California records:

Contra Costa Co.: Hills back of Oakland, female, IV-16-11 (E. C. Van Dyke, C. A. S.).

Nevada Co. (?): Truckee R., female, VI-29-25 (E. H. Nast, C. A. S.).

Plumas Co.: Bucks L., 2 males, 22 females, IV-29-50 (H. P. Chandler, H. P. C.).

Riverside Co.: Tahquitz Valley, San Jacinto Mts., male, VI-3-40 (F. H. Rindge, H. P. C.).

Siskiyou Co.: Etna Cr., trib. Scott R., III-1-55, 2 males, 3 females (S. G. Jewett, Jr., C. A. S.); trib. Shasta R. near Gazelle, III-2-55, male, female (S. G. Jewett, Jr., C. A. S.); Shasta R. near Gazelle, III-2-55, 2 males, 2 females (S. G. Jewett, Jr., C. A. S.); Little Castle Cr., III-2-55, 4 males, 3 females (S. G. Jewett, Jr., C. A. S.).

Sonoma Co.: Mill Cr., 3 mi. S. of Healdsburg, 2 females, IV-15-50 (C. I. S.).

Trinity Co.: Stuart Fork of Trinity R., near mouth, III-2-55, 3 males (S. G. Jewett, Jr., S.G .J.).

16. *Nemoura (Zapada) columbiana* Claassen (Fig. 7, *a*)

Nemoura columbiana Claassen, 1923, Can. Ent., 55:286; male.

Nemoura columbiana Needham and Claassen, 1925, Monog. Plecop., p. 203; genitalia of male, pl. 34, figs. 11-13.

Nemoura columbiana Neave, 1933, Can. Ent., 65:238; female, p. 236, fig. 5.

Nemoura columbiana Ricker, 1943, Stoneflies SW B.C., p. 61, fig. 24; nymph.

Nemoura columbiana Ricker, 1952, Syst. Studies Plecop., p. 57; placed in new subgenus *Zapada*.

Type locality: Laggan (Lake Louise), Alberta.

Geographic range: Alaska and Alberta south to Utah and California.

California records:

Sierra Co.: Bassetts, 6,000 ft., nymph, IX-20-46 (H. P. Chandler, H. P. C.).

Tuolumne Co.: Gaylor Lakes, 10,000 ft., Yosemite National Park, female, VII-8-46 (H. P. Chandler, H. P. C.).

17. *Nemoura (Zapada) frigida* Claassen (Fig. 7, *c*)

Nemoura frigida Claassen, 1923, Can. Ent., 55: 285; male.

Nemoura frigida Needham and Claassen, 1925, Monog. Plecop., p. 202; male genitalia, pl. 34, figs. 5-7.

Nemoura frigida Ricker, 1943, Stoneflies SW B.C., pp. 59-60; female and nymph, figs. 23 and 25.

Nemoura frigida Ricker, 1952, Syst. Studies Plecop., p. 57; placed in new subgenus *Zapada*.

Type locality: Sitka, Alaska.

Geographic range: Alaska to California and Colorado.

California records:

Del Norte Co.: Patrick Cr., trib. Smith R., male, 2 females, VI-28-53 (S. G. Jewett, Jr., S. G. J.).

Mariposa Co.: May L., 9,000 ft., Yosemite National Park, 2 males, 1 female, VII-9-46 (H. P. Chandler, H. P. C.).

Mono Co.: Tioga Pass Road, 1 mi. E. of summit, *ca.* 8,500 ft., female, VI-21-50 (W. E. Ricker, W. E. R.).

Plumas Co.: Tribs. of Smith Cr., *ca.* 6,500 ft., Blairsden, 3 males, 8 females, VI-11-52 (Wm. E. Ricker, W. E. R.).

Shasta Co.: Castle Cr., 3 males, 6 females, VI-25-43 (S. G. Jewett, Jr., S. G. J.).

Sonoma Co.: Austin Cr., 3 mi. S. of Cazadero, female, VI-15-50 (Hugh B. Leech, C.A. S.).

18. *Nemoura (Zapada) haysi* Ricker (Fig. 8, *a*)

Nemoura (Zapada) haysi Ricker, 1952, Syst. Studies Plecop., pp. 58-60; male and female genitalia, figs. 32-35.

Type locality: Upper Gallatin R., 5 mi. E. of Highway No. 191, Yellowstone National Park, Wyoming.

Geographic range: Alaska south to Colorado and California.

California record:

Mono Co. (?): Near Sonora Pass, 8,500 ft., male, VII-7-48 (H. K. Townes, W. E. R.).

Discussion:

This species is very difficult to distinguish from *N. oregonensis*. Generally, *oregonensis* has shorter, more tapered gills with a sharp constriction at their base, but the gills alone cannot be relied on for separating the two species. The male subanal lobes of *haysi* have a sharper angle mesally, and the female subgenital plate is more narrowly rounded and usually lighter in color than *oregonensis*. *Haysi* seems to be a widely distributed, though scarce, species.

19. *Nemoura (Zapada) oregonensis* Claassen (Fig. 7, *e*)

Nemoura oregonensis Claassen, 1923, Can.Ent., 55:288; male.

Nemoura oregonensis Needham and Claassen, 1925, Monog. Plecop., p. 213; male genitalia, pl. 37, figs. 9-11.

Nemoura oregonensis Frison, 1937, Bull. Ill. Nat. Hist. Surv., 21:83-84; female, fig. 70.

Nemoura oregonensis Ricker (in part), 1943, Stoneflies SW B.C., p. 62; fig. 31, p. 67, nymph.

Nemoura oregonensis Ricker, 1952, Syst. Studies

Plecop., pp. 60-61; placed in new subgenus *Zapada*.
Type locality: Harney County, Oregon.
Geographic range: Yukon south to Colorado and California.

California records:

Mariposa Co.: May L., Yosemite National Park, female, VII-9-46 (H. P. Chandler, H. P. C.).

Modoc Co.: Eagleville, 2 males, 2 females, VI-1-46 (W. F. Barr, H. P. C.).

Mono Co.: Tributary of Silver L., female, VI-20-50 (Wm. E. Ricker, W. E. R.).

Plumas Co.: Tribs. of Smith Cr., *ca.* 6,500 ft., Blairsden, male, VI-11-52 (Wm. E. Ricker, W. E.R.); Meadow Valley, 3,000-4,000 ft., female, VI-11-24 (E. C. Van Dyke, C. A. S.).

Shasta Co.: Kings Cr. Meadow, female, VII-2-47 (R. L. Usinger, C. I.S.).

Tulare Co.: Potwisha, Sequoia National Park, female, VI-13-29 (E. C. Van Dyke, C. A. S.); Wolverton, 7,000-9,000 ft., Sequoia National Park, female, VI-23-29 (E. C. Van Dyke, C. A. S.); Cabin Cr., Sequoia National Park, female, VII-5-47 (W. W. Wirth, C. I. S.).

Tuolumne Co.: Gaylor Lakes, 10,000 ft., Yosemite National Park, male, 3 females, VII-8-46 (H. P. Chandler, H. P. C.).

Subfamily LEUCTRINAE

In addition to the two genera of this subfamily which are known to occur in California, *Leuctra* and *Perlomyia*, the genus *Megaleuctra* may possibly be represented. Species of this genus resemble *Nemoura* in general appearance but are larger. Males of *Megaleuctra* have complicated genitalia with a very long supra-anal process; females have a peculiar long, drawn-out subgenital plate. Specimens of the genus are rare in collections.

Key to the California Subgenera and Species of *Leuctra* [2]
(Figs. 13-14, 41)

1. Body of nymph nearly naked (legs moderately hairy); segments of first 5 abdominal segments divided laterally by a fold; femora of nymphal hind leg very large; no ventral lobe on the 9th sternite of male; abdomen of female not sclerotized dorsally and only in very small patches on sides . . . (Subgenus *Despaxia*) *augusta*
   Body of described nymphs at least moderately hairy; segments of first 6 abdominal segments divided laterally by a fold; hind femora of nymph normal; ventral lobe present on the male 9th sternite; abdomen of female normally sclerotized on the sides and below 2

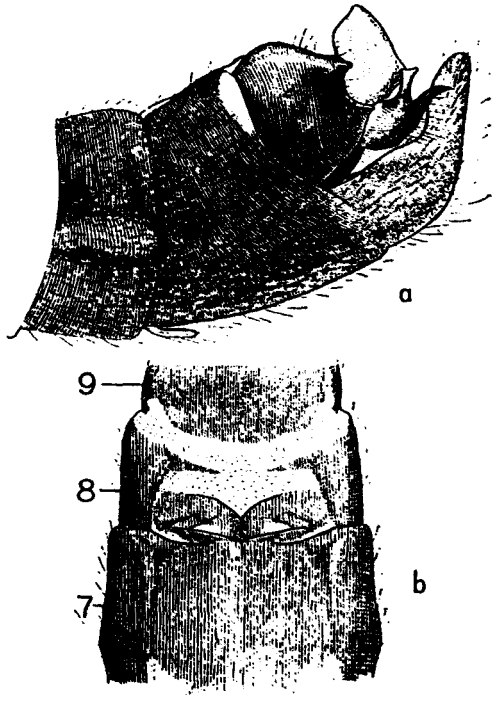

Fig. 12. *Perlomyia collaris*. *a*, lateral view of male terminalia; *b*, ventral view of female terminalia (Frison, 1936).

2(1). Body of nymph moderately hairy; abdominal tergites of nymph with a band of unusually long hairs on either side, about a third of the way from the anterior margin *(occidentalis)*; cerci of male heavily sclerotized with terminal and lateral pointed projections; body color usually black; subgenital plate of female with lateral projections and a median notch . . . . . (Subgenus *Paraleuctra*) 4
   Body of nymph very hairy *(infuscata)*; cerci of male large, membranous or weakly sclerotized, without sharp angles, subgenital plate of female with a median projection below and anterior to the 2 lateral projections *(infuscata)* 3

3(2). A whitish stripe along the costal space of the fore wing; 10th tergite of male entire . . . . . (Subgenus *Moselia*) *infuscata*
   No whitish stripe along the costal space of the fore wing; 10th tergite of male completely bisected . . . . . *divisa*

4(2). Titillator of the male with a large membranous bulb at the tip; the longer prong of the bifurcate cercus hooked; female subgenital plate extending little beyond the 8th sternite . . . . . *occidentalis*

[2] Female and nymph of *L. divisa* Hitchcock undescribed.

Titillator of male without bulbous tip; female subgenital plate extending about its own length beyond the 8th sternite 5

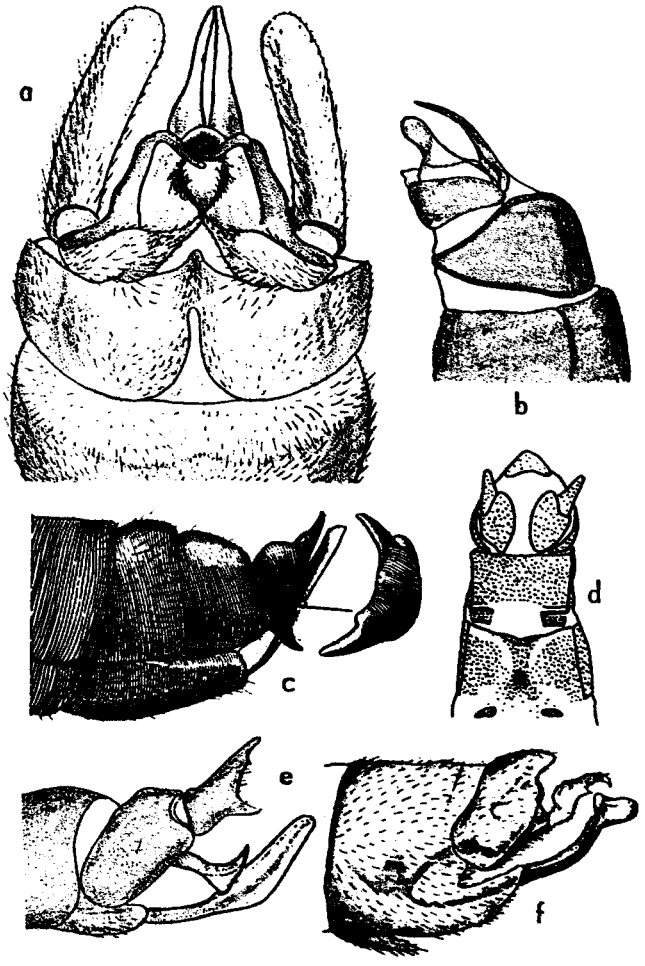

Fig. 13. Terminalia of *Leuctra*. *a, infuscata*, dorsal view of male; *b, augusta*, lateral view of male; *c, forcipata*, lateral view of male; *d, augusta*, ventral view of female; *e, sara*, lateral view of male; *f, occidentalis*, lateral view of male (*a, b, e, f*, Needham and Claassen, 1925; *c*, Frison, 1937; *d*, Ricker, 1943).

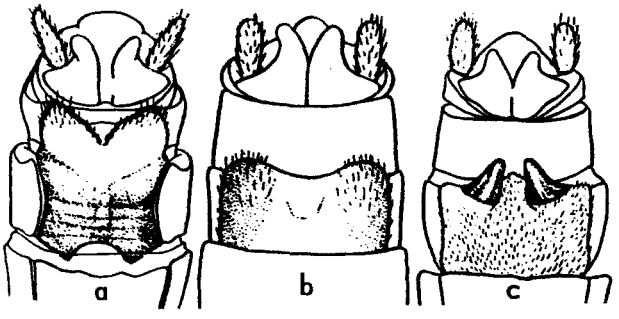

Fig. 14. Female terminalia of *Leuctra*, in ventral view. *a, sara; b, occidentalis; c, infuscata* (Needham and Claassen, 1925).

5(4). Upper prong of the male cercus longer than the lower and with a small tooth on the inner margin . . . . . *sara*

Two prongs of the male cercus widely spaced and of about equal length, without teeth . . . . . *forcipata*

20. *Leuctra (Despaxia) augusta* Banks (Fig. 13, *b*)

Leuctra augusta Banks, 1907, Can. Ent., 39:330; female.

Leuctra glabra Claassen, 1923, Can. Ent., 55:261; male.

Leuctra augusta Needham and Claassen, 1925, Monog. Plecop., p. 224; female genitalia, pl. 42, fig. 1.

Leuctra glabra Needham and Claassen, 1925, *ibid.*, p. 228; male genitalia, pl. 41, figs. 9-11.

Leuctra glabra Neave, 1929, Contr. Can. Biol. Fish., 4:162; female.

Leuctra glabra Ricker, 1943, Stoneflies SW B.C., pp. 79-80, figs. 46-49; male, female, and nymph and placed in new subgenus *Despaxia*.

Leuctra (Despaxia) augusta Ricker, 1954, Proc. Ent. Soc. B.C., 51:37-38; above synonymy indicated.

Type locality: Port Renfrew, British Columbia.

Geographic range: Alaska and Alberta to California.

California record:

Marin Co.: The holotype of *L. glabra* was taken at Tamalpais, Nov. 15, 1899, by L. O. Howard.

Discussion:

This species is common during autumn from British Columbia to Oregon and undoubtedly will be found in abundance along small streams in California when sought during the proper season.

21. *Leuctra (Moselia) infuscata* Claassen (Figs. 13, *a*; 14, *c*)

Leuctra infuscata Claassen, 1923, Can. Ent., 55:262; male and female.

Leuctra infuscata Needham and Claassen, 1925, Monog. Plecop., pp. 230-231; male and female genitalia, pl. 43, figs. 3-5.

Leuctra infuscata Ricker, 1943, Stoneflies SW B.C., p. 81; nymph, p. 79, fig. 50; placed in new subgenus *Moselia*.

Type locality: Seattle, Washington.

Geographic range: British Columbia to California.

California records:

Madera Co.: Nelder Grove, female, VII-4-46 (H.P.C.).

Mariposa Co.: Mariposa Grove, 9,000 ft., male, VII-7-46 (H. P. Chandler, C. I. S.).

Plumas Co.: Meadow Valley, 4,000-5,000 ft., male, 9 females, VI-9-24 (E.C.Van Dyke, C.A.S.); Tribs. of Smith Cr., *ca.* 6,500 ft., Blairsden, 10 males, 9 females, VI-11-52 (Wm. E. Ricker, W. E. R.).

Shasta Co.: King Cr. Meadow, female, VII-2-

47 (R. L. Usinger, C. I. S.); Summit L., female, VI-11-47 (T. F. Leigh, C. I. S.); Hat L., male, VII-11-47 (T. F. Leigh, C. I. S.).

22. *Leuctra divisa* Hitchcock (Fig. 41, *d-e*)

Leuctra divisa Hitchcock, 1958, Pan-Pac. Ent. 34(2):77-78; male.
Type locality: Woodacre, Marin County, California.
Geographic range: California.
California record:
The holotype male was taken April 14, 1956, by Stephen W. Hitchcock and is deposited in the California Academy of Sciences.

23. *Leuctra (Paraleuctra) occidentalis* Banks (Figs. 13, *f*; 14, *b*)

Leuctra occidentalis Banks, 1907, Can. Ent., 39:329-330 (not Needham and Claassen, 1925).
Leuctra bradleyi Claassen, 1923, Can. Ent., 55: 257; male.
Leuctra bradleyi Needham and Claassen, 1925, Monog. Plecop., pp. 225-226; wing, pl. 32, fig. 1; male genitalia, pl. 41, figs. 12-15.
Leuctra (Paraleuctra) bradleyi Ricker, 1943, Stoneflies SW B.C., p. 76, female and nymph; nymph, p. 79, fig. 44; placed in *Paraleuctra*.
Leuctra (Paraleuctra) augusta Ricker, 1952, Syst. Studies Plecop., p. 172
Leuctra (Paraleuctra) occidentalis Ricker, 1954, Proc. Ent. Soc. B.C., 51:38; above synonymy indicated.

Type locality: Laggan, Alberta.
Geographic range: southern British Columbia to Utah and California.
California records:
Marin Co.: Mill Valley, 4 males, 2 females, II-21-26 (E. P. Van Duzee, C. A. S.); Lagunitas, female, III-29-08 (E. C. Van Dyke, C. A. S.).
Plumas Co.: Bucks L., mature male nymph, IV-29-50 (H. P. Chandler, H. P. C.).
Siskiyou Co.: Mouth Butler Cr., trib. Salmon R., III-1-55, 2 females (S. G. Jewett, Jr., C.A.S.); Etna Cr., trib Scott R., 3 males, 5 females, III-1-55 (S. G. Jewett, Jr., S. G. J.); trib. Shasta R. nr. Gazelle, 2 males, female, III-2-55 (S. G. Jewett, Jr., C. A. S.); Little Castle Cr., 29 males, 46 females, III-2-55 (S. G. Jewett, Jr., C. A. S.).
Trinity Co.: Trinity R. *ca.* 7 mi. S. of Trinity Center, 2 males, 2 females, III-2-55 (S. G. Jewett, Jr., C. A. S.); Stuart Fork of Trinity R. nr. mouth, 5 males, 6 females, III-2-55 (S. G. Jewett, Jr., U. S. N.M.).

24. *Leuctra (Paraleuctra) forcipata* Frison (Fig. 13, *c*)

Leuctra forcipata Frison, 1937, Bull. Ill. Nat. Hist. Surv., vol. 23, Art 3, p. 85; male and female genitalia, fig. 72.
Type locality: Corvallis, Oregon.
Geographic range: Oregon and California.
California record:
Del Norte Co.: Patrick Cr., trib. Smith R., male, IV-9-52 (S. G. Jewett, Jr., S. G. J.).
Discussion:
There is some question whether or not *L. forcipata* is actually a distinct species or merely a variant of *L. sara*. Male specimens of *sara* from various western localities show considerable variation in the shape of the claspers, but since complete gradation in the shape of the claspers between *sara* and *forcipata* has not been demonstrated, two species are considered to be involved.

25. *Leuctra (Paraleuctra) sara* Claassen (Figs. 13, *e*; 14, *a*)

Leuctra occidentalis Needham and Claassen, 1925, Monog. Plecop., p. 231; male genitalia, pl. 41, figs. 6-8; female genitalia, pl. 42, fig. 12.
Leuctra sara Claassen, 1937, Jour. Kans. Ent. Soc., 10 (2); 44; male and female genitalia, fig. 11.
Paraleuctra sara Hanson, 1941, Bull. Brooklyn Ent. Soc., 36:64; nymph, figs. 12-14.
Leuctra (Paraleuctra) sara Ricker, 1954, Proc. Ent. Soc. B.C., 51:38; above synonymy indicated.
Type locality: Ringwood Lloyd Preserve, near Ithaca, New York.
Geographic range: New York and Massachusetts; southern British Columbia to Colorado and California.
California records:
Colusa, Del Norte, Marin, Mariposa, Plumas, Riverside, San Mateo, Sonoma, and Tuolumne counties. April-July.

26. *Perlomyia collaris* Banks (Fig. 12)

Perlomyia collaris Banks, 1906, Can. Ent., 38:338; female.
Perlomyia collaris Needham and Claassen, 1925, Monog. Plecop., p. 235; female genitalia, pl. 43, fig. 6.

Perlomyia solitaria Frison, 1936, Ann. Ent. Soc. Amer., 29:261; male genitalia, pl. II, figs. 24-27.

Perlomyia sobrina Frison, 1936, *ibid.*, 29:262; female genitalia, pl. II, fig. 28.

Perlomyia collaris Ricker, 1943, Stoneflies SW B.C., pp. 82-83; synonymy.

Perlomyia collaris Jewett, 1954, J. Fish Res. Rd. Canada, 11 (5):545, nymph.

Type locality: Wellington, British Columbia.

Geographic range: southern British Columbia to California.

California records:

Marin Co.: Cascade Cr., Mill Valley, male and female, IV-9-52 (Robt. E. Leech, C. A. S.).

Santa Clara Co.: Stephens Cr., female, 7-1-27 (E. H. Nast, C. A. S.).

Shasta Co.: Clear Cr., 3 mi. S. French Gulch, 2 females, III-2-55 (S. G. Jewett, Jr., C. A. S.).

Sonoma Co.: Mill Cr., 3 mi. S. of Healdsburg, female, IV-15-50 (Robt. E. Leech, C. A. S.); Glen Ellen, female, IV-29-50 (Hugh B. Leech, C.A.S.).

Stanislaus Co.: Adobe Cr., female, III-17-48 (P. D. Hurd, C. I. S.).

Discussion:

Perlomyia utahensis Needham and Claassen occurs in Oregon to the north and Utah to the east, but has not been taken to date in California. It is distinguished in the male by having a supra-anal process with a slender pointed tip instead of the process ending in a broad blunt tip, and by having the dorsal process of the cercus pointed instead of truncate, and in the female by possessing long, dense hairs on the 7th sternite instead of being hairless or with hairs no longer than on the rest of the sternite. Both species occur in medium-sized streams.

Subfamily CAPNIINAE

California is very rich in species in this subfamily. Since most of the species emerge during the winter season when few other insects are on the wing, they are not taken commonly by entomologists unless specifically sought. Actually, many species of the genus *Capnia* are extremely abundant in January and February on concrete bridges over streams, and frequently several species can be secured at one location. There are probably a number of undiscovered species of this subfamily in California. The nymphs of very few are known, and our knowledge of the females is too limited to construct a key for their determination.

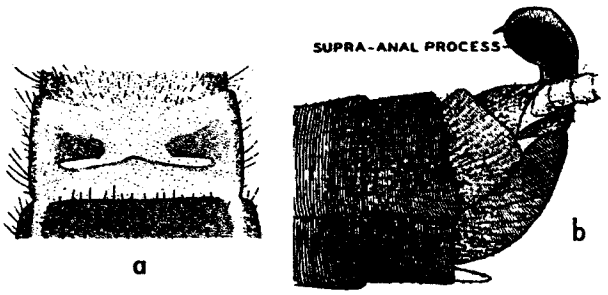

Fig. 15. *Eucapnopsis brevicauda*. *a*, ventral view of female terminalia; *b*, lateral view of male terminalia (Frison, 1937).

Key to the Males of California Species of *Capnia*[3] (Figs. 16-17, 41)

1. Ninth sternite of male with a ventral appendage; wings spotted . . . . *maculata*
   Ninth sternite of male without a ventral appendage; wings not spotted but may be banded 2
2(1). Supra-anal process slender, completely divided into a dorsal and ventral part 3
   Supra-anal process not both slender and divided 4
3(2). A pair of spinous processes on tergites 8 and 9 . . . . . *spinulosa*
   No spinous processes on tergites 8 and 9 . . . . . *columbiana*
4(2). Supra-anal process rather broad and divided into a longer ventral process and a shorter dorsal process . . . . *barberi*
   Supra-anal process not divided, often slender 5
5(4). Supra-anal process much expanded at the middle, about half as wide as long . . 6
   Supra-anal process slender and tapered, or if expanded, the greatest width less than half of the total length 9
6(5) Ninth tergite with raised knobs on either side of the mid-line 7
   Ninth tergite without knobs 8
7(6). Seventh tergite with a median tubercle overhanging the 8th . . . . . *teresa*
   Seventh tergite without a tubercle . . . . . *californica*
8(6). Eighth tergite with a median elevation which is notched at the tip in side view; no knob on the 7th tergite; supra-anal process lacking long bristles . . . . . *excavata*
   Eighth tergite largely membranous; 7th tergite with a knob; supra-anal process

[3] Male of *C. bakeri* (Banks) unknown.

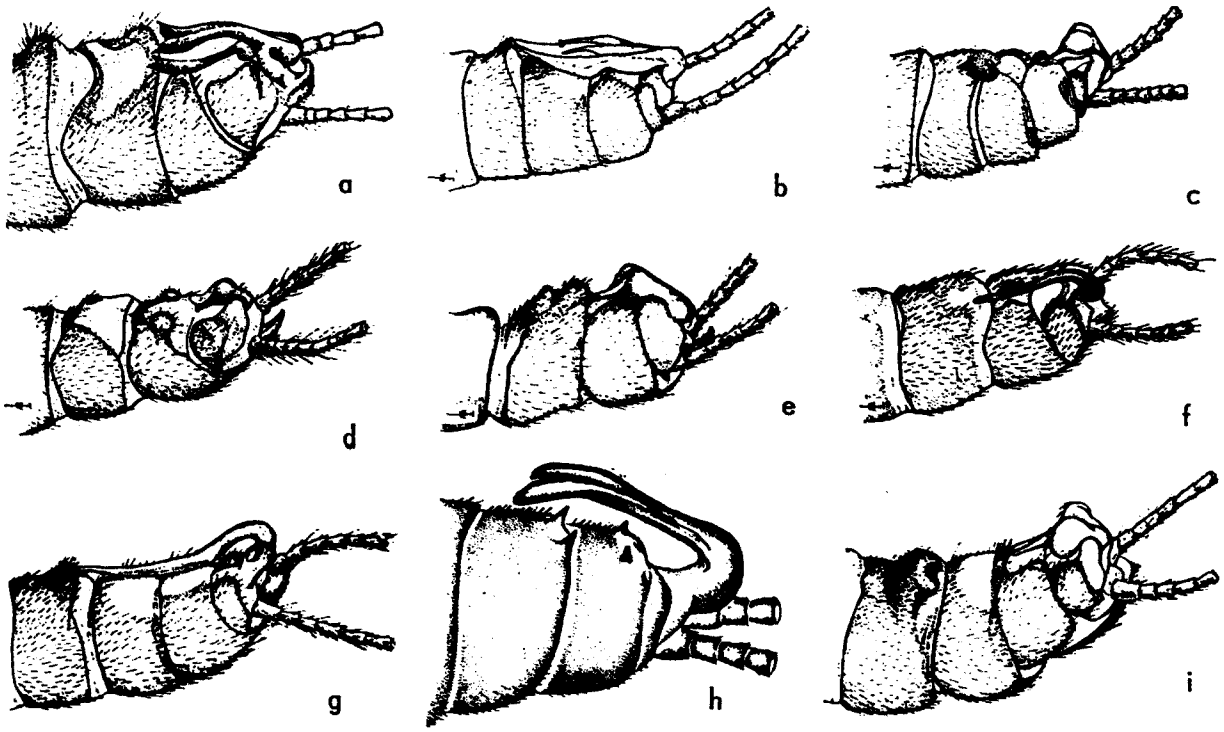

Fig. 16. Male terminalia of *Capnia*, in lateral view. *a, columbiana; b, barberi; c, teresa; d, californica; e, excavata; f, glabra; g, elongata; h, spinulosa; i, tumida (a-g, i,* Needham and Claassen, 1925; *h,* Claassen, 1937 *a*).

fringed dorsally with long forward-pointing bristles . . . . . *tumida*

9(5). A conspicuous hump or process present on the 7th tergite; supra-anal process reaching to the 7th tergite . . *elongata*

No hump on the 7th tergite 10

10(9). A hump or process on 8th tergite . . . 11

No hump on the 8th tergite 14

11(10). With a rather low hump or process . . 12

With a high, scabrous hump 13

12(11). In dorsal view supra-anal process slender throughout its length . . . . . *gracilaria*

In dorsal view supra-anal process expanded to twice its width near the base . . . . . *promota*

13(11). No pair of humps also present on 9th tergite . . . . . *umpqua*

A pair of humps also on the 9th tergite . . . . . *quadrituberosa*

14(10). Supra-anal process blunt or merely pointed at the tip 15

Supra-anal process with a definite, acute spine at the tip, marked off from the process in dorsal and side view . . . 16

15(14). Ninth tergite with longitudinal, raised tubercles on either side of a median membranous area . . . . . *glabra*

Ninth tergite without longitudinal, raised tubercles . . . . . *lineata*

16(14). Spine at the tip of the supra-anal process continuous with the ventral margin of the process; the process about 1/6 as wide as long . . . . . *projecta*

Spine at the tip of the supra-anal process median in position; the process about 1/10 as wide as long . . . . . *porrecta*

27. *Capnia bakeri* (Banks)

Arsapnia bakeri Banks, 1918, Bull. Mus. Comp. Zool., Harvard 62, No. 1, p. 9; female.

Capnia bakeri Needham and Claassen, 1925, Monog. Plecop., p. 268; female genitalia, pl. 49, fig. 11.

Type locality: Mountains near Claremont, California.

California record:

The female type from near Claremont is the only known specimen.

28. *Capnia barberi* Claassen (Fig. 16, *b*)

Capnia barberi Claassen, 1924, Can. Ent., 56:55; male.

Capnia barberi Needham and Claassen, 1925, Monog. Plecop., p. 267; male genitalia, pl. 49, fig. 10.

Type locality: Feather River Canyon, near Caribou, Plumas Co., California (Sunnyside Mine

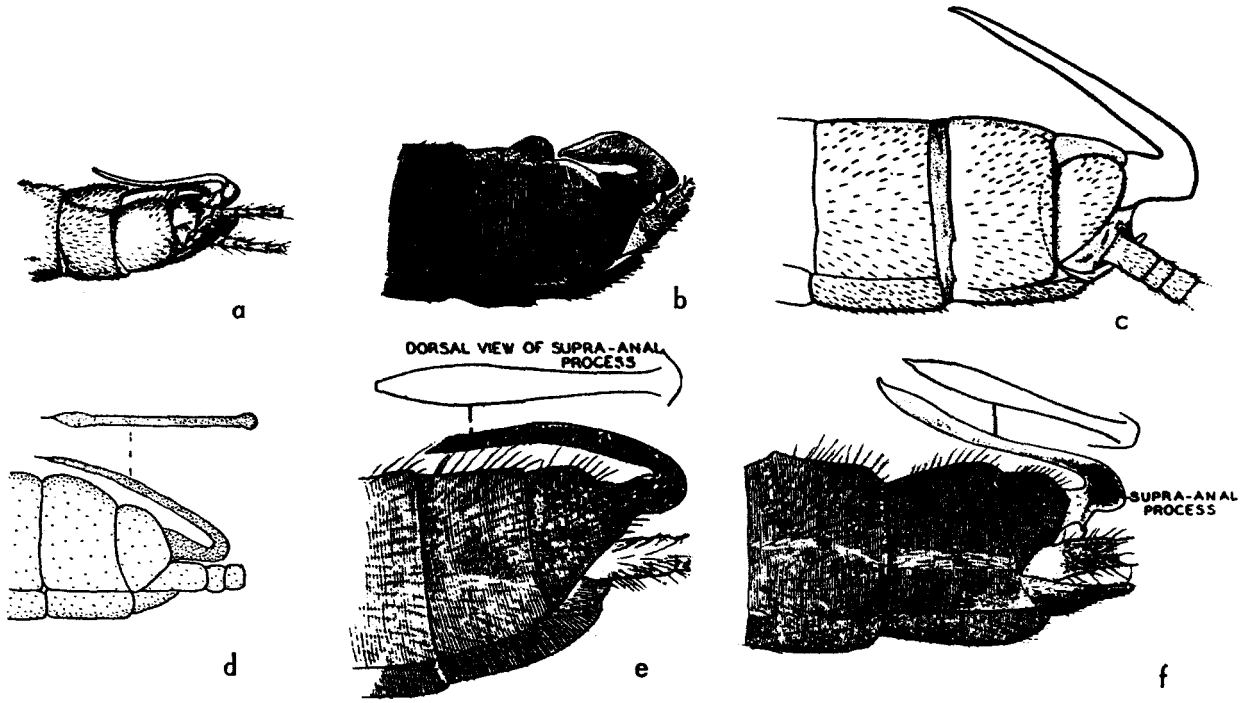

Fig. 17. Male terminalia of *Capnia*, in lateral view. *a, gracilaria; b, umpqua; c, lineata; d, porrecta; e, projecta; f, promota* (*a*, Needham and Claassen, 1925; *b*, Frison, 1942*a*; *c*, Hanson, 1943; *d*, Jewett, 1954 *a*; *e*, *f*, Frison, 1937).

to near Belden).
Geographic range: California.
California record:
Nevada Co.: Saghen Cr., 2 males, II-14-52 (Eli Dietsch, C.I.S. and S.G.J.).

29. *Capnia californica* Claassen
(Fig. 16, *d*)

Capnia californica Claassen, 1924, Can. Ent., 56: 57; male.
Capnia californica Needham and Claassen, 1925, Monog. Plecop., pp. 262-263; male genitalia, pl. 48, fig. 11.
Capnia californica Jewett, 1954, Pan-Pac. Ent., 30 (3):175; female.
Type locality: Cazadero, California.
Geographic range: Santa Clara and Sonoma counties, California.
California record:
Santa Clara Co.: Small creek near Saratoga, 7 males, 7 females, II-25-40 (S. G. Jewett, Jr., S. G. J.).

30. *Capnia columbiana* Claassen
(Fig. 16, *a*)

Capnia columbiana Claassen, 1924, Can. Ent. 56:47, male and female.
Capnia columbiana Needham and Claassen, 1925, Monog. Plecop., p. 265, male and female; male and female genitalia, p. 389, figs. 6-7.
Capnia columbiana Jewett, 1955, Wasmann Jour. Biol., 13 (1):146-147, male and female genitalia, p. 153, figs. 2 and 2a.
Capnia columbiana Hitchcock, 1958, Pan-Pac. Ent., 34 (2):80.
Type locality: Terrace, British Columbia.
Geographic range: southern British Columbia to Montana, Utah, and Oregon.
California record:
Nevada Co.: Saghen Cr., *ca.* 6,800 ft., male, 2 females, III-12-52 (E. M. Brock, S. H.); same place, II-14-52, female (S. H.).

31. *Capnia elongata* Claassen
(Fig. 16, *g*)

Capnia elongata Claassen, 1924, Can. Ent., 56: 56; male.
Capnia elongata Needham and Claassen, 1925, Monog. Plecop., p. 260; male genitalia, pl. 48, fig. 7.
Type locality: Near Caribou, Plumas County, California.
Geographic range: British Columbia to California.
California records:
Siskiyou Co.: Salmon R. at Crapo Cr., III-1-

55, 2 males (S. G. Jewett, Jr., C. A. S.).

Trinity Co.: Trinity R. *ca.* 7 mi. S. of Trinity Center, 125 males, 33 females, III-2-55 (C. A. S.); Stuart Fork of Trinity R., nr. mouth, 3 males, 5 females, III-2-55 (S. G. Jewett, Jr., U. S. N. M.).

32. *Capnia excavata* Claassen
(Fig. 16, *e*)

Capnia excavata Claassen, 1924, Can. Ent., 56: 47; male.

Capnia excavata Needham and Claassen, 1925, pp. 260-261; male genitalia, pl. 48, fig. 8.

Capnia excavata Frison, 1937, Bull. Ill. Nat. Hist. Surv., 21:87; female genitalia, fig. 75.

Type locality: Feather River Canyon near Caribou, Plumas County, California.

Geographic range: British Columbia to California.

California record:

Siskiyou Co.: Little Castle Cr., male, 5 females, III-2-55 (S. G. Jewett, Jr., U. S. N. M.).

33. *Capnia glabra* Claassen
(Fig. 16, *f*)

Capnia glabra Claassen, 1924, Can. Ent., 56:55; male.

Capnia glabra Needham and Claassen, 1925, Monog. Plecop., p. 258; male genitalia, pl. 48, fig. 4.

Type locality: Sunnyside Mine, Plumas County, California.

Geographic range: Oregon and California.

California record:

The holotype male was taken by H. S. Barber, December 25-26, 1922. Many male paratypes were taken between December 25 and January 24.

34. *Capnia lineata* Hanson
(Fig. 17, *c*)

Capnia lineata Hanson, 1943, Proc. Ent. Soc. Wash.,45 (4):85-86, male and female genitalia, p. 87, figs. 2-3.

Capnia lineata Hitchcock, 1958, Pan-Pac. Ent., 34 (2):80; Calif. record.

Type locality: Troy, Idaho.

Geographic range: Idaho and California.

California record:

Santa Clara Co.: Arroyo Mocho, 20 mi. S. Livermore, 11 males, female (J. Herring, S. H. and S. G. J.).

35. *Capnia gracilaria* Claassen
(Fig. 17, *a*)

Capnia gracilaria Claassen, 1924, Can. Ent., 56: 57, desc. of male.

Capnia gracilaria Needham and Claassen, 1925, Monog. Plecop., p. 258, male; male genitalia, p. 387, fig. 5.

Capnia gracilaria Ricker, 1943, Stoneflies SW B.C., pp. 99-100, female and nymph; female genitalia, p. 101, fig. 82.

Type locality: Aweme, Manitoba.

Geographic range: British Columbia and Manitoba south to Montana and California.

California records:

Siskiyou Co.: Etna Cr., trib. Scott R., III-1-55, 60 males, 39 females (S. G. Jewett, Jr., C. A. S.); Scott R. nr. Etna, III-1-55, 24 males, 29 females (S. G. Jewett, Jr., C. A. S.).

36. *Capnia maculata* Jewett
(Fig. 40, *c*)

Capnia maculata Jewett, 1954, Pan-Pac. Ent., 30 (3):174; male and female.

Type locality: Marsh Creek, Contra Costa County, California.

Geographic range: San Francisco Bay area of California.

California records:

The holotype male from Marsh Creek was taken III-6-50 by L. W. Quate.

Alameda Co.: Livermore, female, III-31-29 (E. C. Van Dyke, S. G. J.).

Santa Clara Co.: Colorado Creek and Mines Road, female, allotype, IV-6-49 (Ray F. Smith, C. A. S.).

37. *Capnia porrecta* Jewett
(Fig.17, *d*)

Capnia porrecta Jewett, 1954, Jour. Fish. Res. Bd. Can., 11 (5):546-547.

Type locality: Santiam River near Jefferson, Linn County, Oregon.

Geographic range: western Oregon and California.

California records:

Fresno Co.: Dry Cr., 7 mi. NE Academy, 800 ft., male (D. L. Abell, D. L. A.).

Madera Co.: Coarse Gold Cr., 1,200 ft., II-23-53, male (D. L. Abell, D. L. A.).

38. *Capnia projecta* Frison
(Fig. 17, *e*)

Capnia projecta Frison, 1937, Bull. Ill. Nat. Hist. Surv., 21:87-88, fig. 76; male and female.

Capnia projecta Ricker, 1943, Stoneflies SW B.C.,

p. 103; male genitalia, p. 101, figs. 76-78.
Type locality: Corvallis, Oregon.
Geographic range: British Columbia to California.
California records:

Alameda Co.: Niles Canyon, male, III-30-49 (Ray F. Smith, C. I. S.).

Contra Costa Co.: Berkeley, many females (C. I. S.).

Los Angeles Co.: Elizabeth Lake Canyon, 1 male, 1 female, 6 nymphs, IV-12-52 (B. Covey, B. Tinglof, E. A. Harris, U. C. L. A.); Elizabeth Lake Canyon, 1 male, 6 females, IV-29-52 (U.C.L.A.).

Mariposa Co.: Merced R., Yosemite National Park, 4 males (dried), VI-22-50 (Wm. E. Ricker, (W. E. R.).

Discussion:

Considerable variation is exhibited in material presently assigned to this specific name from various locations along the Pacific coast. Typical material is found in British Columbia and Oregon during late autumn and winter and occasionally in early spring. Specimens taken at some localities in Oregon during March and April have less pigmented wings and may represent an undescribed species; on hand is one small series of such specimens from Tehama County, California.

39. *Capnia promota* Frison
(Fig. 17, *f*)

Capnia promota Frison, 1937, Bull. Ill. Nat. Hist. Surv., vol. 21, Art. 3, pp. 88-89, male and female; p. 88, fig. 77, male and female genitalia.
Type locality: Corvallis, Oregon.
Geographic range: Oregon and California.
California record:

Contra Costa Co.: Berkeley, male, I-27-38 (K. D. Snyder, C. I. S.).

40. *Capnia spinulosa* Claassen
(Fig. 16, *h*)

Capnia spinulosa Claassen, 1937, Can. Ent., 69:80; male and female; male and female genitalia, pl. 3, figs. 1 and 2.
Type locality: southern California.
Geographic range: southern California.
California record:

The single holo- and allotypes from southern California are the only known specimens.

41. *Capnia teresa* Claassen
(Fig. 16, *c*)

Capnia teresa Claassen, 1924, Can. Ent., 56:54; male.
Capnia teresa Needham and Claassen, 1925, Monog. Plecop., p. 262; male genitalia, pl. 48, fig. 10.
Type locality: Evey Canyon, Claremont, California.
Geographic range: California.
California record:

Mariposa Co.: Merced R., Yosemite National Park, male (dried abdomen only), VI-22-50 (Wm. E. Ricker, W. E. R.).

42. *Capnia tumida* Claassen
(Fig. 16, *i*)

Capnia tumida Claassen, 1924, Can. Ent., 56:47-48; male.
Capnia tumida Needham and Claassen, 1925, Monog. Plecop., pp. 261-262; male genitalia, pl. 48, fig. 9.
Capnia tumida Frison, 1942, Pan-Pac. Ent., 18: 65; male and female genitalia, p. 67, fig. 10a-c.
Type locality: Sunnyside Mine near Seneca, Plumas County, California.
Geographic range: British Columbia to California.
California record:

Siskiyou Co.: Etna Cr., trib. Scott R., III-1-55, 8 males, 7 females (S. G. Jewett, Jr., U.S.N.M.).

43. *Capnia umpqua* Frison
(Fig. 17, *b*)

Capnia umpqua Frison, 1942, Pan-Pac.Ent., 18 (2):65; male and female; male and female genitalia, p. 62, fig. 9a-9c.
Type locality: Umpqua River, Douglas County, Oregon.
Geographic range: Western Oregon to California.
California record:

Trinity Co.: Mouth Indian Cr., trib. Trinity R., nr. Douglas City, male, 2 females, III-2-55 (S. G. Jewett, Jr., U. S. N. M.).

44. *Capnia quadrituberosa* Hitchcock
(Fig. 41, *b-c*)

Capnia quadrituberosa Hitchcock, 1958, Pan-Pac. Ent., 34 (2):77; male and female.
Type locality: Small stream tributary to Feather River crossing Route 40A north of Oroville, California.
Geographic range: California.
California record:

Butte Co.: Type locality, holotype, allotype,

7 male, 1 female paratypes, I-22-55 (Stephen W. Hitchcock, holo- and allotypes, C.A.S., paratypes, S.H. and S.G. J).

45. *Eucapnopsis brevicauda* (Claassen) (Fig. 15)

Capnia brevicauda Claassen, 1924, Can. Ent., 56:55; female.
Capnia brevicauda Needham and Claassen, 1925, Monog. Plecop., p. 269; wing, pl. 47, fig. 2; female genitalia, pl. 49, fig. 12.
Eucapnopsis brevicauda Neave, 1934, Can. Ent., 66:6; male.
Eucapnopsis brevicauda Frison, 1937, Bull. Ill. Nat. Hist. Surv., 21-86; male and female genitalia, fig. 73.
Eucapnopsis brevicauda Ricker, 1943, Stoneflies SW B.C., pp. 85-86; nymph.
Type locality: Boulder, Colorado.
Geographic range: British Columbia to Colorado and California.
California records:
Plumas Co.: Bucks L., 2 males, IV-29-50 (H. P. Chandler, H. P. C.).
Siskiyou Co.: Little Castle Cr., III-2-55, male, 2 females, (S. G. Jewett, Jr., C. A. S.).
Trinity Co.: Indian Cr. mouth, trib . Trinity R., nr. Douglas City, male, III-2-55 (S. G. Jewett, Jr., U. S. N. M.).

Key to the California Species of *Isocapnia* (Fig. 18)

1. Wings tan, brachypterous in male, male supra-anal process shaped like a bird's head . . . . . *spenceri thujae*
   Wings hyaline or fumose; male supra-anal process slender 2
2(1). Size large, fore wing at least 12 mm. in length; male supra-anal process long and weakly S-shaped . . . . . *grandis*
   Size small, fore wing less than 11 mm. in length; male supra-anal process short, no longer than the length of the basal cercal segment . . . . . *abbreviata*

46. *Isocapnia abbreviata* Frison (Fig. 18, *a*)

Isocapnia abbreviata Frison, 1942, Pan-Pac. Ent., 18(2):71-72; male genitalia, p. 67, fig. 17a, c.
Isocapnia abbreviata Jewett, 1954, J. Fish Res. Bd. Canada, 11(5):548, female.
Type locality: Oak Creek, Benton County, Oregon.

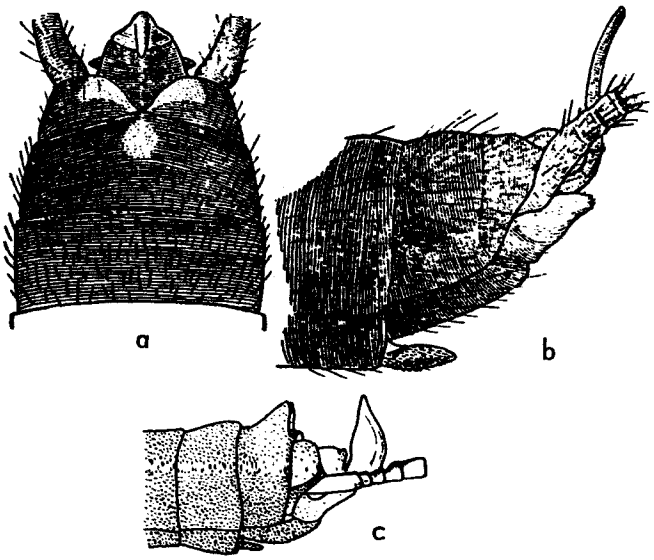

Fig. 18. Male terminalia of *Isocapnia*. *a*, *abbreviata*, dorsal view; *b*, *grandis*, lateral view; *c*, *spenceri thujae*, lateral view (*a*, *b*, Frison, 1942*a*; *c*, Ricker, 1943).

Geographic range: Oregon and California.
California record:
Santa Cruz Co.: Scranton, Waddell Cr., male paratype, IV-16-33 (F. H. Sumner, record from Frison, 1942).
Discussion:
This species differs from *I. grandis* (Banks) in its much smaller size, and in the male by the very short supra-anal process.

47. *Isocapnia grandis* (Banks) (Fig. 18, *b*)

Arsapnia grandis Banks, 1908, Can. Ent., 37:329; male.
Capnia grandis Needham and Claassen, 1925, Monog. Plecop., pp. 259-260; male genitalia, pl. 48, fig. 6.
Capnia fumigata Claassen, 1937, Can. Ent., 69:79; male and female.
Isocapnia fumosa Banks, 1938, Psyche, 45(1):74; female.
Isocapnia grandis Hanson, 1943, Brooklyn Ent. Soc., 38 (5):158-159; male and female genitalia, p. 161, fig. 3 - fig. 5.
Isocapnia grandis Ricker, 1943, Stoneflies SW B.C., p. 89; nymph, figs. 56, 59, 60; male genitalia, figs. 57 and 64; wing, fig. 61.
Type locality: Victoria, British Columbia.
Geographic range: Alaska to California.
California record:
Sacramento Co.: American R., Folsom, 3 males, 1 female, III-2-52 (T. Haig, C. I. S.).

48. *Isocapnia spenceri thujae* Ricker
(Fig. 18, *c*)

Isocapnia spenceri var. *thujae* Ricker, 1943, Stoneflies SW B.C., p. 92-93, male, male genitalia, p. 93, fig. 73.
Type locality: Chilliwack River at Vedder Crossing, British Columbia.
Geographic range: British Columbia to California.
California record:
Trinity Co.: Trinity River about 7 mi. S. of Trinity Center, male, III-2-55 (S. G. Jewett, Jr., S. G. J.).
Discussion:
There are several other species of *Isocapnia* from the Pacific Northwest, and it seems probable that others will be found in California. Much variation occurs in some species particularly in size, and it seems that brachypterous specimens may be conspecific with long-winged forms even though small differences are found in the male genitalia.

Subfamily TAENIOPTERYGINAE

California probably leads all the states in the number of species in this subfamily. The nymphs of few are known, and the females are very difficult to distinguish with certainty. Therefore only the following key to males is presented.

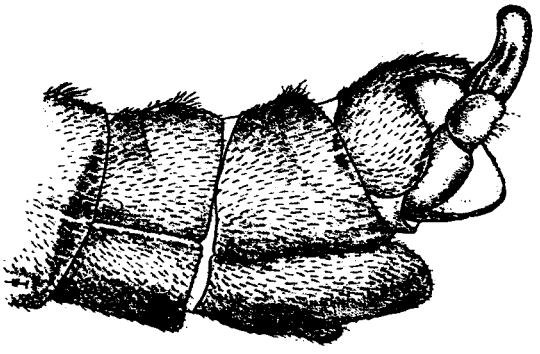

Fig. 19. Male terminalia of *Taeniopteryx maura*, in lateral view (Needham and Claassen, 1925).

Key to the Males of California Species of *Brachyptera*
(Figs. 20-21)

1. A median keel present near the end of the subgenital plate; 10th tergite with 2 processes, each very narrow at the base, broad and with 2 sharp corners at the tip; Cu_1 in the fore wing with 4 or 5 branches; wings spotted . . . . . (Subgenus *Doddsia) occidentalis*
   Ninth sternite without a keel; processes of the 10th tergite rounded if present; Cu_1 of the fore wing usually with only 2 branches; wings not spotted but may have a clear band across the wing between the cord and the tip . . . . . (Subgenus *Taenionema)* 2
2(1). Tenth abdominal tergite without 2 raised, rearward-pointing appendages 3
   Tenth abdominal tergite with 2 raised, rearward-pointing appendages 5
3(2). Lobes at base of cerci large, rounded, and directed forward . . . . . *vanduzeei*
   Lobes at base of cerci spinelike and directed backward 4
4(3). Supra-anal process gradually tapering to a point; wings usually heavily infuscated . . . . . *nigripennis*
   Supra-anal process enlarged toward the tip which is broadly rounded; wings lightly infuscated with a clear band across the wing between the cord and the tip . . . . . *grinnelli*
5(2). Supra-anal process broadly bifurcate in side view with a short tooth near the base of the bifurcation . . . . . *californica*
   Supra-anal process not broadly fiburcate . 6
6(5). Lobes of the 10th tergite large and markedly excavated laterally; wings moderately fumose but with an irregular clear band across the fore wing in the area of the cord . . . . . *raynoria*
   Lobes of the 10th tergite smaller and not markedly excavated laterally; wings clear or slightly fumose with a clear band across the fore wing in the area of the cord 7
7(6). Lobes of the 10th tergite separated at their base by a distance no more than their length; wings clear . . . . . *pallida*
   Lobes of the 10th tergite separated at their base by a distance 2 or 3 times their length; wings clear or slightly fumose with a clear band in the area of the cord . . . . . *pacifica*

49. *Brachyptera (Doddsia) occidentalis* (Banks)
(Fig. 20, *d*)

Taeniopteryx occidentalis Banks, 1900, Trans. Am. Ent. Soc., 24:244; female.
Taeniopteryx occidentalis Needham and Claassen, 1925, Monog. Plecop., pp. 25-151; wings, pl. 33, fig. 3; male genitalia, pl. 45, figs. 1-2; female genitalia, pl. 46, fig. 1.

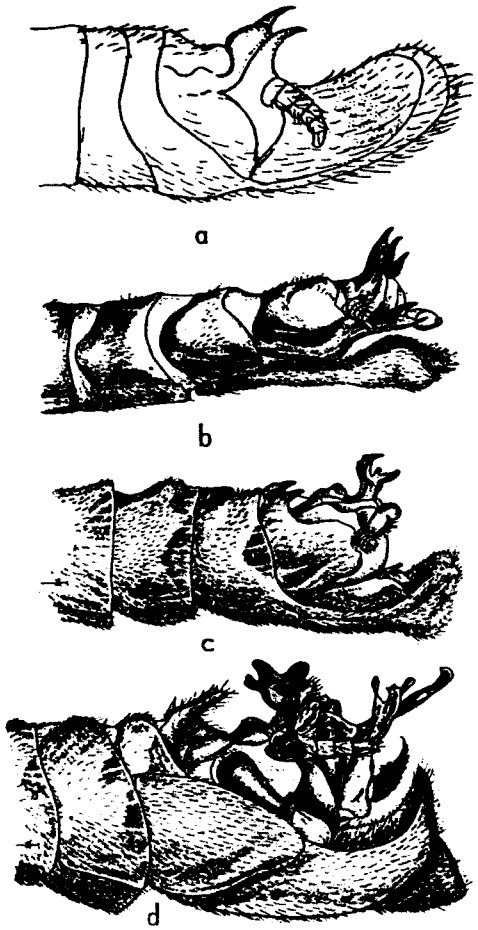

Fig. 20. Male terminalia of *Brachyptera*, in lateral view. *a, grinnelli; b, nigripennis; c, californica; d, occidentalis* (Needham and Claassen, 1925).

Type locality: Mt. Rainier, Washington.
Geographic range: British Columbia to Colorado and California.
California record:
Mono Co.: Leavitt Meadows, 5 females, VI-28-51 (E. L. Silver, U. C. L. A.).

50. *Brachyptera (Taenionema) californica* (Needham and Claassen) (Fig. 20, *c*)

Taeniopteryx californica Needham and Claassen, 1925, Monog. Plecop., p. 247; male genitalia, pl. 45, figs. 9 and 10; female genitalia, pl. 46, fig. 5.
Type locality: Palo Alto, California.
Geographic range: California.
California records:
Los Angeles Co.: male, IV-11-37 (N. F. Hardman, C. I. S.).
Mendocino Co.: Ryan Cr., male, III-26-49 (P. D. Hurd, C.I.S.).

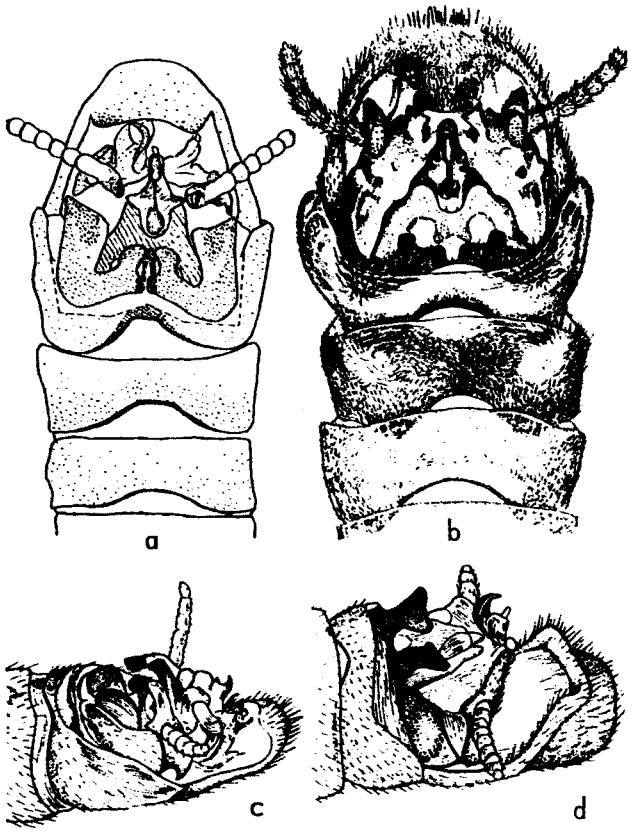

Fig. 21. Male terminalia of *Brachyptera*. *a. pallida*, dorsal view; *b, pacifica*, dorsal view; *c, vanduzeei*, dorsolateral view; *d, raynoria*, dorsolateral view (*a*, Ricker, 1943; *b*, Needham and Claassen, 1925; *c, d*, Claassen, 1937*b*).

51. *Brachyptera (Taenionema) grinnelli* (Banks) (Fig. 20, *a*)

Taeniopteryx grinnelli Banks, 1918, Bull. Mus. Comp. Zool., 62:8; male.
Taeniopteryx grinnelli Needham and Claassen, 1925, Monog. Plecop., p. 248; male genitalia, pl. 46, fig. 6.
Type locality: Millard Canyon, Los Angeles, Pasadena, California.
Geographic range: southern California.
California records:
Fresno Co.: Dry Cr., N. E. Academy, several males, females, II-III-53 (D. L. Abell, D. L. A. and S. G. J.).
Los Angeles Co.: Lake Elizabeth Canyon, 1 female, 22 nymphs, VI-12-52 (D. Covey, B. Tinglof, E. A. Harris, U. C. L. A.); Lake Elizabeth Canyon, 7 males, 3 females, 1 nymph, IV-29-52 (U. C. L. A.).

52. *Brachyptera (Taenionema) nigripennis* (Banks) (Fig. 20, *b*)

Taeniopteryx (Rhabdiopteryx) nigripennis Banks,

1918, Bull. Mus. Comp. Zool., 62(1):8.

Taeniopteryx nigripennis Needham and Claassen, 1925, Monog. Plecop., p. 245; male genitalia, pl. 45, figs. 7-8; female genitalia, pl. 46, fig. 4.

Taeniopteryx (Taenionema) nigripennis Ricker, 1943, Stoneflies SW B.C., pp. 53-54; male nymph.

Type locality: Wenatchee, Washington.

Geographic range: British Columbia and Alberta to Colorado and California.

California records:

Butte Co.: Oroville, female, III-10-28 (H. H. Keifer, C. A. S.).

Tulare Co.: Wolverton, 7,000-9,000 ft., Sequoia National Park, female, VI-17-29 (E. C. Van Dyke, C. A. S.).

53. *Brachyptera (Taenionema) pacifica* (Banks) (Fig. 21, *b*)

Taeniopteryx pacifica Banks, 1900, Trans. Amer. Ent. Soc., 26:244.

Taeniopteryx pacifica Newcomer, 1918, Jour. Agric. Res., 13(1):37-41; figs. of male, female, and nymph.

Taeniopteryx pacifica Needham and Claassen, 1925, Monog. Plecop., p. 246; wing. pl. 33, fig. 5; male genitalia, pl. 45, figs. 11-12; female genitalia, pl. 46, fig. 3.

Type locality: Pullman, Washington.

Geographic range: British Columbia and Alberta to Colorado and California; New York to Virginia.

California records:

Mono Co. (?): Yosemite Cr., 7,200 ft., Yosemite National Park, male, VI-21-50 (Wm. E. Ricker, W. E. R.).

Trinity Co.: Trinity R. *ca.* 7 mi. S. of Trinity Center, III-2-55, 43 males, 9 females, (S. G .Jewett, Jr., C. A. S.).

54. *Brachyptera (Taenionema) pallida* (Banks) (Fig. 21, *a*)

Nemoura pallida Banks, 1902, Can. Ent., 34:125; female.

Taeniopteryx pallida Banks, 1918, Bull. Mus. Comp. Zool., 62(1):9 (described as a new species).

Taeniopteryx banksii Needham and Claassen, 1925, Monog. Plecop., p. 249 (new name for *T. pallida* Banks, 1918).

Taeniopteryx pallida Needham and Claassen, 1925, *ibid.*, p. 250.

Nemoura pallidura Claassen, 1936, Ann. Ent. Soc. Amer., 29:623 (new name for *N. pallida* Banks, 1902).

Taeniopteryx kincaidi Hoppe, 1938, Univ. Wash. Publ. Zool., 4:164; male and female.

Brachyptera pacifica Frison (in part), 1942, Bull. Ill. Nat. Hist. Surv., 22:251 (not *pacifica* Banks).

Taeniopteryx (Taenionema) kincaidi Ricker, 1943, Stoneflies SW B.C., pp. 52-53; nymph.

Brachyptera (Taenionema) pallida Ricker, 1952, Syst. Studies Plecop., pp. 158-159; corrected synonymy.

Type locality: Little Beaver, Colorado.

Geographic range: British Columbia to Colorado and California.

California records:

Mono Co. (?): Near Sonora Pass, 8,000 ft., female, VII-6-48 (H. K. Townes, W. E. R.); near Sonora Pass, 8,500 ft., female, VIII-7-48 (H. K. Townes, W. E. R.).

Tuolumne Co.: Strawberry, female, VI-1951 (S. G. J.).

55. *Brachyptera (Taenionema) raynoria* (Claassen) (Fig. 21, *d*)

Taeniopteryx raynoria Claassen, 1937, Jour. Kans. Ent. Soc., 10:46; descr. and fig. of male.

Brachyptera pacifica Frison (in part), 1942, Bull. Ill. Nat. Hist. Surv., 22(2):251 (not *pacifica* Banks); genitalia of male and female, fig. 12.

Brachyptera (Taenionema) raynoria Ricker, 1952, Syst. Studies Plecop., p. 159; corrected synonymy and identification notes.

Type locality: Yosemite, California.

Geographic range: California.

California records:

Mono Co. (?): Yosemite Cr., 7,200 ft., Yosemite National Park, male, 12 females, VI-21-50 (Wm. E. Ricker, W. E. R.); Smoky Jack Camp, 7,000 ft., Yosemite National Park, 4 males, 7 females, VI-22-50 (Wm. E. and Angus Ricker, W. E. R.).

Shasta Co.: Viola, male, V-18-41 (C. D. Michener, C. I. S.).

Stanislaus Co.: Adobe Cr., 4 females, IV-6-49 (Ray F. Smith, C. I. S.).

56. *Brachyptera (Taenionema) vanduzeei* (Claassen) (Fig. 21, *c*)

Taeniopteryx vanduzeei Claassen, 1937, Jour. Kans. Ent. Soc., 19(2):46-47; desc. and fig. of male.

Brachyptera vanduzeei Frison, 1942, Bull. Ill. Nat. Hist. Surv., 22(2):253; fig. of male.
Type locality: Alpine Creek, Tahoe, California.
Geographic range: California.
California records:
Mono Co. (?): Smoky Jack Camp, 7,000 ft., Yosemite National Park, male, VI-22-50 (Wm. E. and Angus Ricker, W. E. R.).
Plumas Co.: small creek in Portola, 3 males, 12 females, 2 nymphs, exuviae, VI-10-52 (Wm. E. Ricker, W. E. R.); Small creek 6 mi. W. of Portola, 3 females, VI-10-52 (Wm. E. Ricker, W. E. R.).

57. *Taeniopteryx maura* (Pictet) (Fig. 19)

Nemoura maura Pictet, 1841, female.
Taeniopteryx nivalis Fitch, 1847, Emmons Jour. Agric. Sci., 5:274.
Taeniopteryx maura Needham and Claassen, 1925, Monog. Plecop., pp. 239-240; wing, pl. 33, fig. 4; male genitalia, pl. 44, figs. 5-6; female genitalia, pl. 46, fig. 7.
Taeniopteryx nivalis Needham and Claassen, 1925, *ibid.*, pp. 240-241.
Taeniopteryx nivalis Claassen, 1931, Plecop. Nymphs, pp. 103-104; nymph.
Taeniopteryx maura Claassen, 1931, *ibid.*, pp. 104-105; nymph.
Taeniopteryx maura Frison, 1942, Bull. Ill. Nat. Hist. Surv., 22(2):248; synonymy.
Type locality: Pennsylvania.
Geographic range: Eastern North America, Minnesota, Oregon, and California.
California record:
Siskiyou Co.: Shasta R., 8 females, II-10-52 (S. G. Jewett, Jr., S. G. J.).

Family PTERONARCIDAE

Members of this family include California's largest stoneflies which belong to the genus *Pteronarcys*. The recorded species are all common though *Pteronarcella* is less often encountered than *Pteronarcys*. Nymphs of *Pteronarcys* are frequently abundant in medium-sized rivers, and the adults may occasionally be seen flying in great numbers across highways paralleling large streams. The following key may be used for placing both nymphs and adults of both sexes.

The record of *Pteronarcys (Allonarcys) proteus* Newman for California in Needham and Claassen (1925, p. 40) is regarded as an error for no authentic specimens of *Allonarcys*, an Appalachian subgenus, have been taken in the western United States.

Key to the Pteronarcidae of California (Fig. 22)

1. Abdominal gills, reduced in the adult, on first 3 segments; adults and mature nymphs less than 30 mm. in length . . . . . (Genus *Pteronarcella) regularis*
   Abdominal gills on first 2 segments only; adult and mature nymph usually at least 35 mm. in length . . (Genus *Pteronarcys*) 2
2(1). Nymph with lateral thoracic processes long, slender, directed outward and wing pads pointed; erect lobes of the divided 10th tergite of male rather broadly rounded; processes at the apex of the female subgenital plate are somewhat equilateral triangles approximated at the base . . . . . *californica*
   Nymph with lateral thoracic processes short, not markedly directed outward and wing pads rounded; erect lobes of the divided 10th tergite of the male rather narrow, much higher than wide; processes at the apex of the female subgenital plate are very elongate triangles, twice as high as broad and more widely separated at the base . . . . . *princeps*

58. *Pteronarcella regularis* (Hagen) (Fig. 22, *e, f*)

Pteronarcella regularis Hagen, 1873, Bull. Geol. Surv. Colo., p. 573.
Pteronarcella regularis Needham and Claassen, 1925, Monog. Plecop., pp. 45-46; male genitalia, pl. 7, fig. 15; female genitalia, pl. 8, figs. 3-5.
Pteronarcella regularis Claassen, 1931, Plecop. Nymphs Amer., pp. 36-37; description and figures of nymph.
Type locality: Nevada.
Geographic range: Alaska to California and Nevada.
California record:
Lassen Co.: Susan R. Camp, female, VI-10-49 (D. Cox, C. I. S.).
Discussion:
This species is probably present in most of the permanent stream systems of the state. Another species of the genus, *P. badia* (Hagen), is common in the Rocky Mountain states and has been taken in Nevada. In *badia* the recurved, scoop-shaped appendage on the dorsum of the 9th abdominal segment of the male is broadly rounded instead of having straight sides and coming to a point at the apex, and the female plate

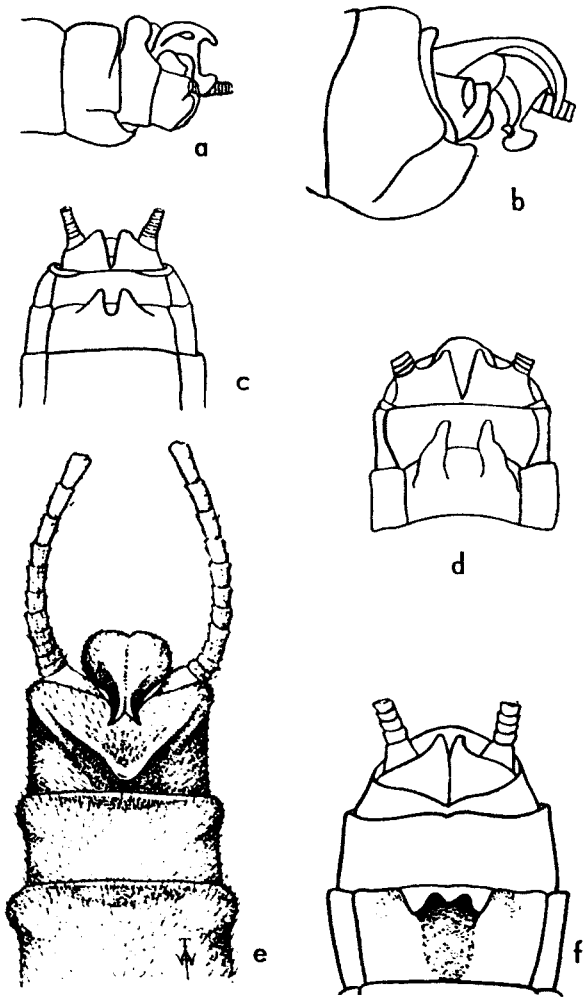

Fig. 22. *a, c, Pteronarcys californica; b, d, Pteronarcys princeps; e, f, Pteronarcella regularis; a, b,* lateral view of male terminalia; *e,* dorsal view of male terminalia; *c, d, f,* ventral view of female terminalia (Needham and Claassen, 1925).

may be more or less trilobate but is never acutely notched in the middle.

59. *Pteronarcys (Pteronarcys) californica* Newport (Fig. 22, *a, c*)

Pteronarcys californica Newport, 1848, Proc. Linn. Soc., 1:388.

Pteronarcys californica Needham and Claassen, 1925, Monog. Plecop., pp. 37-38; male and female genitalia, pl. 7, figs. 5 and 6.

Pteronarcys californica Claassen, 1931, Plecop. Nymphs Amer., p. 32; description and figures of nymph.

Type locality: California.

Geographic range: British Columbia to California.

California records:

Butte, Kern, Marin, Mendocino, Placer, Plumas, San Mateo, Santa Clara, Sonoma, and Stanislaus counties. April-July.

60. *Pteronarcys (Pteronarcys) princeps* Banks (Fig. 22, *b, d*)

Pteronarcys princeps Banks, 1907, Can. Ent., 39:327; male and female.

Pteronarcys princeps Needham and Claassen, 1925, Monog. Plecop., p. 38; male and female genitalia, pl. 7, figs. 7 and 8.

Type locality: Mission, British Columbia.

Geographic range: British Columbia to New Mexico and California.

California records:

El Dorado Co.: Strawberry Valley, female, VIII-7-12 (E. C. Van Dyke, C. A. S.).

Mariposa Co.: Merced R., Yosemite National Park, male exuvia, 2 females, VI-22-50 (Wm. E. Ricker, W. E. R.).

Riverside Co.: Taquitz Cr., Palm Sprgs., female, IV-9-44 (E. S. Ross, C. A. S.).

Tuolumne Co.: Dardanelle, 3 females, VIII-8-48 (W. E. R.): Strawberry, 4 nymphs, VI-1951 (U. C. L. A.).

Suborder SETIPALPIA
Family PERLODIDAE

This family was recently revised by Ricker (1952) whose arrangement of subfamilies and generic concepts differ in many details from earlier workers like Klapálek (1912) and Frison (1935*a*; 1942 *b*). Many species are yet known only by one sex, and the nymphs of a very large number have not been described. It is therefore necessary to base much of the classification on the male genitalia. The key on pages 128 to 130 will place males to the genera known to occur in California. The mesosternal ridge patterns (fig. 23) offer good characters to separate many subgenera.

In addition to the recorded subfamilies, *Diura (Dolkrila) knowltoni* (Frison), representing the subfamily Perlodinae, may occur in California; it is recorded from Vancouver Island and Alberta south to Oregon and Utah. In this species the male subanal lobes are distinctive in being extended straight backward and meeting along their mesal surfaces.

Subfamily ISOGENINAE

In addition to the recorded subgenera of this subfamily definitely known to occur in California, one other is fairly sure to occur at least in some of the larger streams of the northwestern corner of the state. *Isogenus (Isogenoides) frontalis colubrinus* Hagen is a common western species which occurs abundantly in the Rogue River of southern Oregon. It is readily recognized by the median mesosternal ridge present on both sexes.

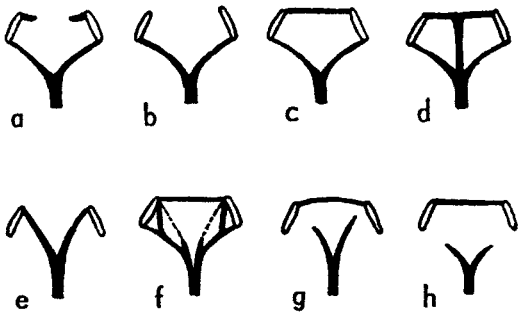

Fig. 23. Diagrams of perlodid mesosternal ridge patterns. *a*, nymphs and adults of *Perlinodes;* nymphs of *Oroperla; b*, adults of *Dolkrila; c*, adults of most subgenera of *Isogenus*, nymphs of many *Isoperla; d*, nymphs and adults of *Isogenoides; e*, nymphs and adults of *Skwala; f*, adult of *Chernokrilus; g*, adult of *Osobenus; h*, nymphs and adults of many *Isoperla* (Ricker, 1952).

Key to the California Subgenera and Species of *Arcynopteryx* (Fig. 24)

1. Lateral abdominal gills present (adult unknown) . . . (Subgenus *Oroperla) barbara*
   Abdominal gills absent 2
2(1). Three pairs of thoracic gills and 1 pair of cervical gills present . . . . . (Subgenus *Perlinodes) aurea*
   Cervical gills absent 3
3(2). Gills present on all 3 thoracic segments; found in Hudsonian and Alpine life zones . . . . . (Subgenus *Megarcys) yosemite*
   Thoracic gills absent . . . . . (Subgenus *Skwala*) 4
4(3). Male hooks on 10th tergite short, 2 to 3 times as long as the breadth of its constricted middle part . . . . . *parallela*
   Male hooks on 10th tergite long, 4 to 5 times as long as the breadth of its constricted middle part . . . . . *curvata*

61. *Arcynopteryx (Megarcys) yosemite* Needham and Claassen (Fig. 24, *a*)

Perlodes yosemite Needham and Claassen, 1925, Monog. Plecop., pp. 56-57; male genitalia, pl. 10, fig. 8; female genitalia, pl. 7, fig. 20.
Arcynopteryx yosemite Ricker, 1952, Syst. Studies Plecop., p. 78; notes on female and placement in new subgenus *Megarcys*.
Type locality: Mt. Lyell at 11,000 ft., California.
Geographic distribution: Mt. Rainier, Washington; Mt. Hood, Oregon; Mt. Lyell, California.
California record:

The single male holotype and single female allotype are the only recorded California specimens.

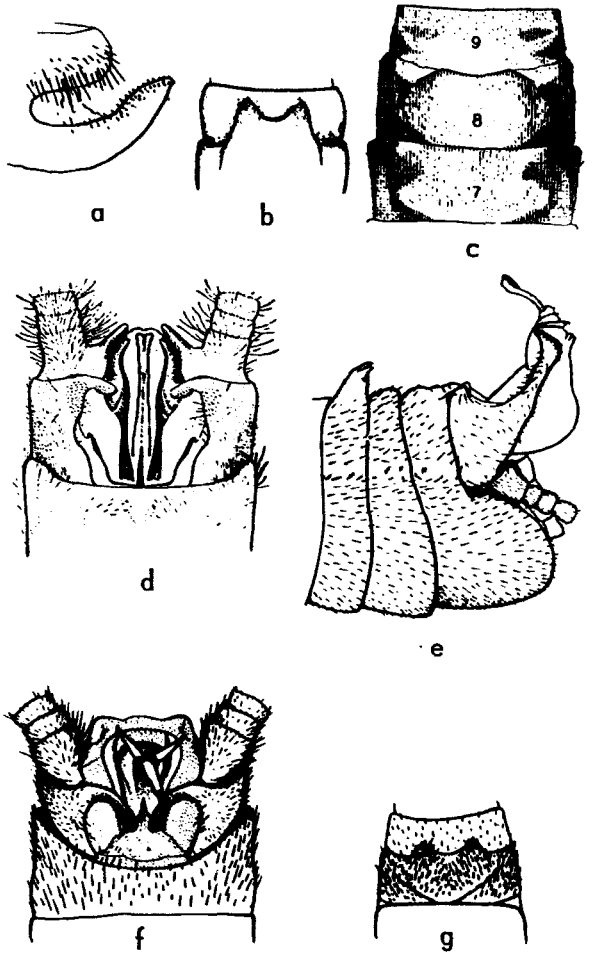

Fig. 24. Terminal abdominal structures of *Arcynopteryx*. *a, yosemite*, hook on tenth tergite of male; *b, aurea*, ventral view of female terminalia; *c, parallela*, ventral view of female terminalia; *d*, dorsal view of male terminalia; *e, aurea*, lateral view of male terminalia; *f, curvata*, dorsal view of male terminalia; *g*, ventral view of female terminalia (*a*, Needham and Claassen, 1925; *b, e, f, g*, Hanson, 1942; *c*, Frison, 1937; *d*, Frison, 1936).

Discussion:

Five kinds of *Megarcys* occur in the western cordilleran region and seem to be sufficiently distinct on both morphological and ecological grounds to be treated as separate species. *A. (Megarcys) subtruncata* (Hanson) is a common species from British Columbia to Oregon and may occur in California. It is found in streams in the Canadian and Transition life zones and differs from *yosemite* in the male by having the tips of the lateral stylets bluntly rounded instead of having them tapered to a spine and in the female by having the notch in the subgenital plate broadly rounded instead of narrowly rounded.

62. *Arcynopteryx (Oroperla) barbara* (Needham)

Oroperla barbara Needham, 1933, Jour. Ent. and

Zool., 25:17; desc. and fig. of nymph.

Arcynopteryx (Oroperla) barbara Ricker, 1952, Syst. Studies Plecop., p. 79; placed in subgenus *Oroperla* and nymphal mouth parts illustrated on p. 76, figs. 39 and 40.

Type locality: Rubicon River (American R. drainage), near Lake Tahoe, California.

Geographic range: Sierra Nevada of California.

California record:

El Dorado Co.: S. Fork American R. nr. Kyburz, nymph, IX-7-54 (S. Hitchcock, C. A. S.).

Discussion:

The adult of this species, as yet undiscovered, will be of much interest and will be readily recognizable by abdominal gill remnants.

63. *Arcynopteryx (Perlinodes) aurea* Smith (Fig. 24, *b, e*)

Arcynopteryx aurea Smith, 1917, Trans. Am. Ent. Soc., 43:477-478; desc. and figs. of female genitalia and wings.

Arcynopteryx vagans Smith, 1917, *ibid.*, pp. 478-479; desc. of male genitalia and wings.

Perlodes aurea Needham and Claassen, 1925, Monog. Plecop., p. 62; female genitalia, pl. 7, fig. 23.

Perlodes vagans Needham and Claassen, 1925, *ibid.*, pp. 66-67; male genitalia, pl. 10, figs. 2 and 9.

Perlodes aurea Frison, 1942, Bull. Ill. Nat. Hist. Surv., 22 (2):288; figs. of head, pronotum, sterna, and female subgenital plate.

Perlinodes aurea Hanson, 1942, Amer. Midland Nat., 28:401, desc. of male and female; female genitalia, p. 405, fig. 18; head, p. 405, fig. 10.

Arcynopteryx (Perlinodes) aurea Ricker, 1952, Syst. Studies Plecop., pp. 80-81, desc. of nymph.

Type locality: California.

Geographic range: Washington to California.

California records:

Mono Co.: Rush Cr., female, VII-7-46 (Fraser, C. I. S.).

Plumas Co.: Tribs. of Smith Cr., *ca.* 6,500 ft., Blairsden, female, VI-11-52 (Wm. E. Ricker, W. E. R.).

Sierra Co.: Fiddle Cr., Downieville, 3,500 ft., 8 nymphs, IX-20-46 (H. P. Chandler, C. I. S.).

64. *Arcynopteryx (Skwala) curvata* Hanson (Fig. 24, *f, g*)

Arcynopteryx curvata Hanson, 1942, Amer. Midland Nat., 28:395, desc. of male and female; female genitalia, p. 405, fig. 13; male genitalia, p. 406, fig. 22.

Arcynopteryx parallela curvata Ricker, 1943, Stoneflies SW B.C., p. 114, desc. of male and female; fore wing, male and female genitalia, p. 115, figs. 93-95, 97-98; placed in new subgenus *Skwala*.

Type locality: Wallace, Idaho.

Geographic range: southern British Columbia to California.

California record:

Trinity Co.: Indian Cr. mouth, trib. Trinity R., nr. Douglas City, III-2-55, 16 males, 4 females (S. G. Jewett, Jr., C. A. S.).

65. *Arcynopteryx (Skwala) parallela* (Frison) (Fig. 24, *c, d*)

Perlodes americana Needham and Claassen, 1925, Monog. Plecop., p. 61, desc. of male and female; pl. 7, fig. 21, female subgenital plate; male genital hook, pl. 10, fig. 5 (not Klapalek, 1912).

Perlodes americana Claassen, 1931, Plecop. Nymphs, p. 44, incomplete desc. of nymph.

Hydroperla parallela Frison, 1936, Ann. Ent. Soc. Amer., 29:261, desc. and figs. of male.

Hydroperla parallela Frison, 1937, Bull. Ill. Nat. Hist. Surv., 21:90, desc. of female and figs. of female plate, head, and pronotum.

Hydroperla parallela Frison, 1942, *ibid.*, 22:298, desc. and figs. of nymph.

Arcynopteryx americana Hanson, 1942, Amer. Midland Nat., 28:394, desc. of male and female.

Arcynopteryx (Skwala) parallela Ricker, 1952, Syst. Studies Plecop., p. 85; placed in new subgenus *Skwala*.

Type locality: Corvallis, Oregon.

Geographic range: southern British Columbia to California and Utah.

California records:

Sacramento Co.: Fair Oaks, female (C. A. S.).

Shasta Co.: Clear Cr., 3. mi. S. French Gulch, male, female, III-2-55 (S. G. Jewett, Jr., C. A.S.).

Trinity Co.: Trinity R. *ca.* 7 mi. S. of Trinity Center, 2 females, III-2-55 (S. G. Jewett, Jr., C. A. S.).

Key to the California Subgenera and Species of *Isogenus*[4] (Males and Females) (Figs. 25, 26, 27, 40, *d*)

1. Arms of the mesosternal Y-ridge meet the anterior corners of the furcal pits 2
   Arms of the mesosternal Y-ridge meet or approach the posterior corners of the furcal pits 3

[4] See text for *I. sorptus* (Needham and Claassen)

2(1). Wings almost clear; male lateral stylets, short, with 2 or 3 terminal spinules; a yellowish species . . . . . (Subgenus *Osobenus) yakimae*
Wings dark brown; male lateral stylets long, smoothly rounded . . . . . (Subgenus *Chernokrilus)* in part
3(1). Submental gills present; wings heavily infuscated; lateral stylets rounded at the tip . . . . (Subgenus *Chernokrilus*) *erratus*
Submental gills absent 4
4(3). Lateral stylets of male slender, acute; a yellowish species . . . . . (Subgenus *Cultus*) *tostonus*
Lateral stylets absent from the male supra-anal apparatus . . (Subgenus *Kogotus*) 5
5(4). A large, three-rayed spot on the head, the middle ray within the ocellar triangle, the others reaching the eye; paragenital plates of male subacute . . . . . *nonus*
Head mostly brown without a yellow spot; tips of paragenital plates of male rounded, upturned, and spinulose; wings heavily infuscated . . . . . *alameda*

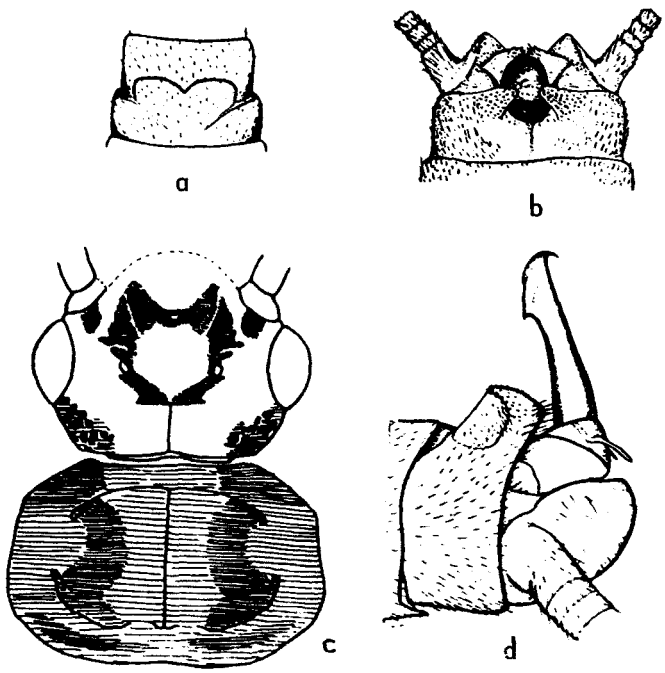

Fig. 25. *a, Isogenus frontalis colubrinus,* ventral view of female terminalia; *b, Isogenus alameda,* dorsal view of male terminalia; *c, Isogenus sorptus,* head and pronotum of female; *d, Isogenus f. colubrinus,* lateral view of male terminalia (*a, d,* Hanson, 1943; *b,* Needham and Claassen, 1925; *c,* Ricker, 1952).

66. *Isogenus sorptus* (Needham and Claassen) (Fig. 25, *c*)

Perla sorpta Needham and Claassen, 1925, Monog. Plecop., p. 90, female; wings, pl. 12, fig. 4; female genitalia, pl. 25, fig. 10.

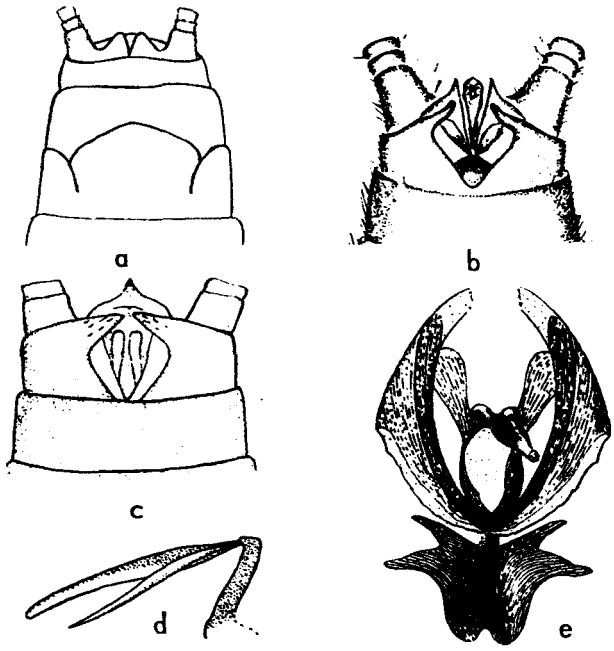

Fig. 26. Terminal abdominal structures of *Isogenus. a, b, nonus; c, yakimae; d, tostonus; e, erratus; a,* ventral view of female terminalia; *b, c, e,* dorsal view of male terminalia; *d,* supra-anal process of male, lateral view (*a,* Needham and Claassen, 1925; *b,* Claassen, 1937*b; c,* Hoppe, 1938; *d,* Ricker, 1943; *e,* Ricker, 1952).

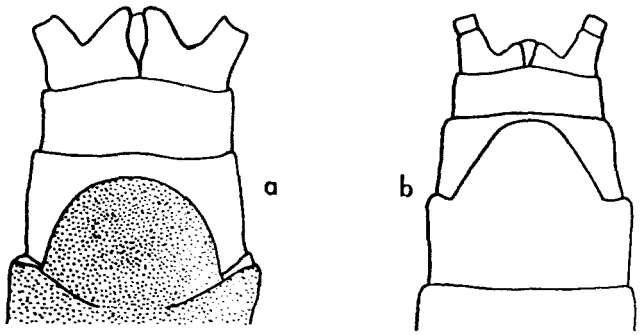

Fig. 27. Ventral view of female terminalia of *Isogenus. a, yakimae; b, tostonus* (Ricker, 1952).

Isogenus sorptus Ricker, 1952, Syst. Studies Plecop., p. 131, female; p. 129, fig. 79 and fig. 81, female plate and head.
Type locality: Sequoia National Park, California.
Geographic range: Oregon and California.
California record:
The holotype female from Sequoia National Park is the only recorded specimen of this rare species from California.

67. *Isogenus (Chernokrilus) erratus* (Claassen) (Fig. 26, *e*)

Perla venosa Needham and Claassen, 1925, Monog. Plecop., pp. 93-94; wings, pl. 11. fig. 8; male genitalia, pl. 18, figs. 11 and 12.
Perla errata Claassen, 1936, Ann. Ent. Soc. Amer.

29:62; new name.

Isogenus erratus Ricker, 1952, Syst. Studies Plecop., p. 94; male genitalia, p. 94, figs. 44-46; placed in new subgenus *Chernokrilus*.

Type locality: Fieldbrook, California.

California record:

The holotype male is the only known specimen of this species.

Discussion:

Specimens of the subgenus *Chernokrilus* are extremely rare in collections. In *erratus* the arms of the mesosternal Y-ridge meet the anterior corners of the furcal pits, whereas in *misnomus* (Claassen), known only from Oregon, the arms approach or reach the posterior corners.

68. *Isogenus (Cultus) tostonus* Ricker (Figs. 26, *d;* 27, *b*)

Diploperla aestivalis Ricker, 1943, Stoneflies SW B.C., p. 107; fig. 88, head and pronotum; fig. 89, supra-anal process and lateral stylets of male genitalia. (Not *aestivalis* Needham and Claassen.)

Isogenus (Cultus) tostonus Ricker, 1952, Syst. Studies Plecop., pp. 97-98, desc. of male and female.

Type locality: Toston, Montana.

Geographic range: British Columbia and Montana south to Wyoming and California.

California records:

El Dorado Co.: Chile Bar, male and female, VII-5-48 (K. W. Tucker, C. I. S.).

Tulare Co.: Sequoia National Park, 2,000-5,000 ft., male, V-24-29 (E. C. Van Dyke, C. A. S.).

Discussion:

Isogenus pilatus Frison, the other described species of the subgenus from the Pacific coast, is known to occur from British Columbia to southern Oregon. It is a larger species than *tostonus* and is readily separated from it by dark markings on the head.

69. *Isogenus (Kogotus) alameda* (Needham and Claassen) (Figs. 25, *b;* 40, *d*)

Perla alameda Needham and Claassen, 1925, Monog. Plecop., p. 78, desc. of male; wings, pl. 12, fig. 8; male genitalia, pl. 18, fig. 4.

Isogenus alameda Ricker, 1952, Syst. Studies Plecop., p. 128, placed in genus *Isogenus;* supra-anal apparatus of holotype male, p. 129, fig. 80.

Isogenus alameda Jewett, 1954, Pan-Pac. Ent., 30(3):178; placed in subgenus *Kogotus* and female described.

Type locality: Alameda County, California.

Geographic range: California.

California records:

Alameda Co.: Livermore, 3 males, 1 female, V-11-30 (E. C. Van Dyke, C. A. S. and S. G. J.).

Lake Co.: Lake Curry, Solano City, male, IV-13-50 (J. N. Simons, C. I. S.).

Napa Co.: Pope Valley, 2 females, V-8-30 (E. C. Van Dyke, C. A. S. and S. G. J.).

San Benito Co.: Pinnacles National Monument, male and female, V-3-46 (H.P. Chandler, H. P. C.).

Santa Clara Co.: Silver Cr. Hills, female, V-18-41 (Kenneth Frick, C. I. S.).

Discussion:

Ricker (1952, p. 128) suggested that this species might best be placed in the subgenus *Kogotus* but stated that the paragenital plates are not produced; actually these are produced upward into rounded, spinulose tips, and it seems best to place the species in *Kogotus*. As in *I. nonus* there is a coiled process within the tip of the supra-anal apparatus.

70. *Isogenus (Kogotus) nonus* (Needham and Claassen) (Fig. 26, *a, b*)

Perla nona Needham and Claassen, 1925, Monog. Plecop., p. 86, desc. of female; female genitalia, pl. 17, fig. 21.

Perla nona Claassen, 1937, Jour. Kans. Ent. Soc., 10:49, desc. of male; male genitalia, p. 51, figs. 5 and 14.

Isogenus nonus Ricker, 1952, Syst. Studies Plecop., pp. 116-117; placed in new subgenus *Kogotus*.

Type locality: Corvallis, Oregon.

Geographic range: southern British Columbia to California.

California records:

San Mateo Co.: Portola State Park, female, V-8-50 (C. I. S.).

Shasta Co.: Burney Falls, male, VI-29-47 (R. L. Usinger, H. P. C.).

Stanislaus Co.: Del Puerta Canyon, female, IV-20-49 (P. D. Hurd, C. I. S.); Adobe Cr., 22 mi. W. of Patterson, male, 4 females, IV-23-49 (Hugh B. Leech, C. A. S.).

71. *Isogenus (Osobenus) yakimae* (Hoppe) (Figs. 26, *c;* 27, *a*)

Perla yakimae Hoppe, 1938, Univ. Wash. Publ. Biol. 4, p. 150, desc. of male; male genitalia,

p. 171, figs. 1 and 2.

Isogenus yakimae Ricker, 1952, Syst. Studies Plecop., p. 118, desc. of male and female and placed in new subgenus *Osobenus;* male and female genitalia, figs. 68-72.

Type locality: Yakima, Washington.

Geographic range: Washington to California.

California records:

Lake Co.: Putah Cr., Middletown, male, V-11-26 (C. A. S.).

Marin Co.: Lagunitas, male, 3 females, V-30-28 (E. H. Nast, C. A. S.); Lagunitas, 7 females, VII-1-28 (E. H. Nast, C. A. S.).

Riverside Co.: Idyllwild, male, VI-9-40 (C. D. Michener, C. I. S.); Idyllwild, 2 males, VI-10-39 (E. G. Linsley, C. I. S.); Idyllwild, female, VI-17-40 (D. J. Raski, C. I. S.); Herkey Cr., San Jacinto Mts., male, VI-1-40 (C. D. Michener, S. G. J.); Herkey Cr., San Jacinto Mts., female, VI-14-40 (C. D. Michener, C. I. S.).

Subfamily ISOPERLINAE

Except for the monotypic genera *Calliperla* and *Rickera,* the California fauna of this subfamily is placed in the genus *Isoperla.* The nymphs of only a few members of the subfamily have been described, and no key is offered for these.

Key to Adults of California Species of *Isoperla* (Figs. 28-30; 40, *e*)

1. Tip of male 10th tergite with two small recurved processes; no lobe on male 8th sternite; female 8th sternite not produced except for a small median process; head with a complete median dark stripe, darkest between the ocelli; pronotum with broad median and lateral light stripes . . . . . *trictura*

   Tip of male 10th tergite without processes; male 8th sternite with a lobe; female sternite not as above; color not as above 2

2(1). Lobe at the tip of the 8th sternite nearly square with subacute angles; spinules present on the male 9th tergite; female subgenital plate very little produced; a small yellowish species . . . . . *mormona*

   Lobe on the male 8th sternite broadly rounded behind; male 9th tergite without spinules, though with short stout hairs in *patricia;* female subgenital plates vary; medium to large species 3

3(2). Pronotum with a checkered pattern of black on yellow; female subgenital plate moderately produced, slightly excavated at the middle; male subanal lobes flat, recurved, acute, bent outward near the tips . . . . . *pinta*

   Pronotum striped or reticulately marked; female subgenital plates vary; male subanal lobes not bent outward close to their tips 4

4(3). Female subgenital plate long, its sides parallel or nearly so near the base; hind margin of the male 8th sternite with a hairless yellow area, but scarcely a lobe; head with a sharp pattern of brown on yellow, including an ocellar and a preocellar yellow spot . . . . . *ebria*

   Female subgenital plate shorter, usually its sides turned inward making an angle of at least 135° with the side margin of the segment; male with a definite lobe on the 8th sternite 5

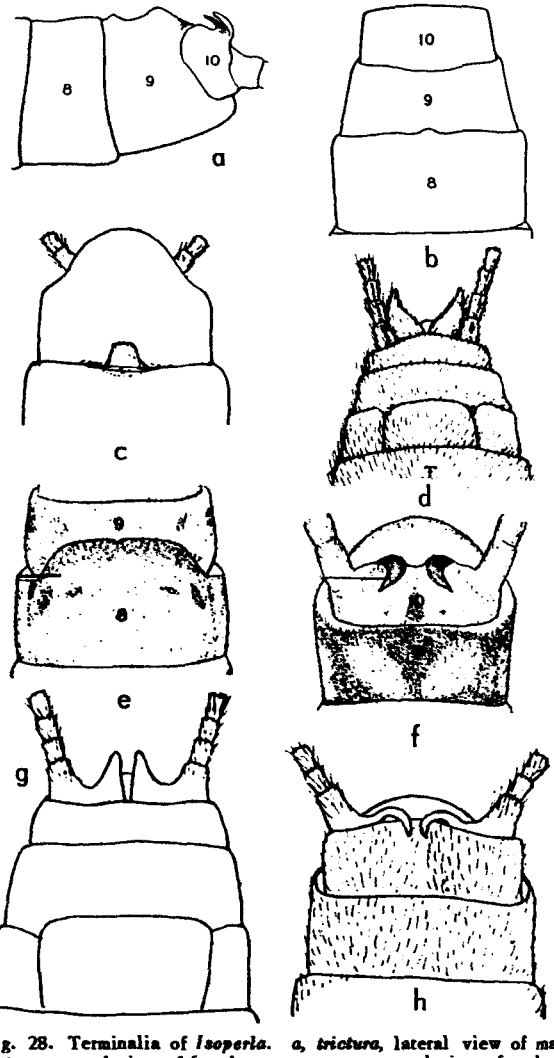

Fig. 28. Terminalia of *Isoperla*. *a, trictura,* lateral view of male; *b, trictura,* ventral view of female; *c, mormona,* ventral view of male; *d, mormona,* ventral view of female; *e, pinta,* ventral view of female; *f, pinta,* dorsal view of male; *g, sordida,* ventral view of female; *h, sordida,* dorsal view of male (*a, b,* Frison, 1942*b; c, d, g, h,* Needham and Claassen, 1925; *e, f,* Frison, 1937).

5(4). Female subgenital plate only slightly produced; male subanal lobes acutely bent upward, long 6
Female subgenital plate distinctly produced; male subanal lobes not acutely bent nor long 7
6(5). Wings subhyaline; hind wing with intercubital cross veins . . . . . *marmorata*
Wings with a yellowish tinge; no intercubital cross veins in hind wing . . *sordida*
7(5). Head pattern interrupted at the transverse occipital suture . . . . . *fulva*
Head pattern not interrupted at the transoccipital suture 8
8(7). Wings usually dark; female subgenital plate usually with a shallow median notch; aedeagus of male with a sclerotized process C-shaped in lateral view . . . . . *denningi*
Wings hyaline; female subgenital plate usually with a wide, deep excavation at the tip; aedeagus of male without a sclerotized process . . . . . *patricia*

72. *Calliperla luctuosa* (Banks)
(Fig. 29, *a, b*)

Perla luctuosa (Banks, 1906, Can. Ent., 38:336; desc. of female.
Perla luctuosa Needham and Claassen, 1925, Monog. Plecop., p. 97, desc. of male and female; pl. 12, fig. 8, wings; male and female genitalia, pl. 18, figs. 16-19.
Type locality: San Francisco, California.
Geographic range: California and Oregon.
California record:
Humboldt Co.: Orick, male, female, VII-9-37 (E. C. Van Dyke, C. A. S.); Deer Lodge, near Trinidad, female, VI-5-36 (C. A. S.); Prairie Cr., near Orick, male, 5 females, VI-9-26 (E. C. Van Dyke. C. A. S.).

73. *Rickera venusta* Jewett
(Fig. 29, *c-e*)

Rickera venusta Jewett, 1954, Pan-Pac. Ent., 30 (3):176; desc. of male and female, male and female genitalia, p. 177, fig. 10.
Rickera venusta Jewett, 1955, Wasmann Jour. Biol. 13(1):149; desc. of nymph; nymphal head and mouth parts, p. 153, fig. 6.
Type locality: Rogue R. at Muir Cr., Jackson County, Oregon.
Geographic range: Oregon and California.
California records:
El Dorado Co.: Pyramid Ranger Station, VII-19-15, male (F. B. Herbert, C. A. S.).
Tuolumne Co.: Strawberry, VI-1951 (S.G.J.).

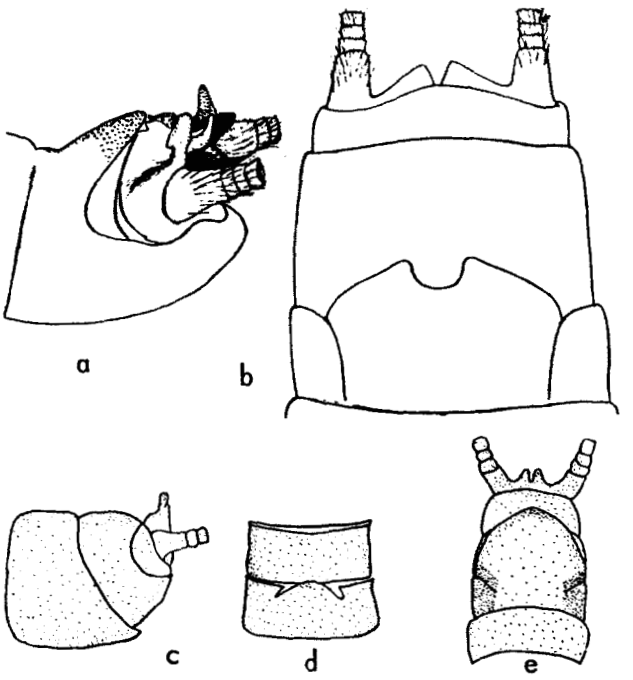

Fig. 29. *a, b, Calliperla luctuosa; c-e, Rickera venusta. a, c,* lateral view of male terminalia; *b, e,* ventral view of female terminalia; *d,* seventh and eighth sternites of male.

74. *Isoperla denningi* Jewett
(Fig. 30, *g, h, i*)

Isoperla denningi Jewett, 1955, Wash. Jour. Biol. 13(1):150; desc. of male and female; male and female genitalia, p. 153, fig. 7.
Type locality: 4 miles west of Tanbark Flat, Los Angeles County, California.
Geographic range: California.
California records:
Fresno Co.: Dry Creek, 13 males, 16 females, V-14-54 (D. L. Abell, S. G. J.).
Los Angeles Co.: Tanbark Flat, male, 2 females, VI-21-50 (H. L. Hanson, C. A. S. and S. G. J.).
Orange Co.: Fullerton, male, V-30-52 (J. W. Hinerman, C. A. S.).
Riverside Co.: Idyllwild, San Jacinto Mts., 2 males, female, VI-18-52 (Cazier, Gertsch, Schrammel, S. G. J.).
Trinity Co.: Carrville, 2,400 to 2,500 ft., female, V-19-34 (E. C. Van Dyke, C. A. S.).

75. *Isoperla ebria* (Hagen)
(Fig. 30, *a, e*)

Perla ebria Hagen, 1875, Bull. Geol. Surv. Terr., p. 577.
Clioperla ebria Needham and Claassen, 1925, Monog. Plecop., pp. 141-142; male and female

genitalia, pl. 25, figs. 1-3.

Clioperla ebria Claassen, 1931, Plecop. Nymphs, p. 71, desc. of nymph.

Isoperla ebria Ricker, 1943, Stoneflies SW B.C. pp. 121-122; desc. of nymph; nymph, nymphal mouth parts, and female subgenital plate, p. 123, figs. 107-110.

Type locality: Colorado.

Geographic range: British Columbia to Colorado and California.

California records:

Alpine or Tuolumne Co.: near Sonora Pass, 8,500 ft., male, VII-4-48 (H. K. Townes, W. E. R.).

Mariposa Co.: Tenaya Cr., nr. Merced R., Yosemite National Park, 6 exuviae, VI-22-50 (Wm. E. Ricker, W. E. R.).

Plumas Co.: Tribs. of Smith Cr., Blairsden, *ca.* 6,500 ft., 2 males, VI-11-52 (Wm. E. Ricker, W. E. R.).

Shasta Co.: Burney Falls, female, IX-17-46 (H. P. Chandler, H. P. C.).

Tulare Co.: Woodlake, female, IV-24-32 (E. P. Van Duzee, C. A. S.).

76. *Isoperla fulva* Claassen
(Fig. 30, *d, f*)

Isoperla fulva Claassen, 1937, Can. Ent., 69:80, desc. of male and female.

Isoperla chrysannula Hoppe, 1938, Univ. Wash. Publ. Biol. 4, p. 156; male genitalia, pl. 18, figs. 13 and 14.

Isoperla cascadensis Hoppe, 1938, *ibid.*, p. 158; male and female genitalia, pl. 18, figs. 17-19.

Isoperla fulva Frison, 1942, Bull. Ill. Nat. Hist. Surv., 22(2):337; syn. of *chrysannula* and *cascadensis* Hoppe.

Type locality: Logan R., Utah.

Geographic range: British Columbia to California and Utah.

California records:

El Dorado Co.: 3 mi. S. Camino, 2 males, VI-26-48 (R. C. Bynum, C. I. S.).

Modoc Co.: Eagleville, female, VI-1-46 (W. F. Barr, H. P. C.).

77. *Isoperla marmorata* (Needham and Claassen)
(Fig. 40, *e*)

Clioperla marmorata Needham and Claassen, 1925, Monog. Plecop., pp. 142-143, desc. of female; wings, pl. 13, fig. 6; female genitalia, pl. 25, fig. 11.

Isoperla marmorata Jewett, 1954, Pan-Pac. Ent., 30(3):178; desc. of male.

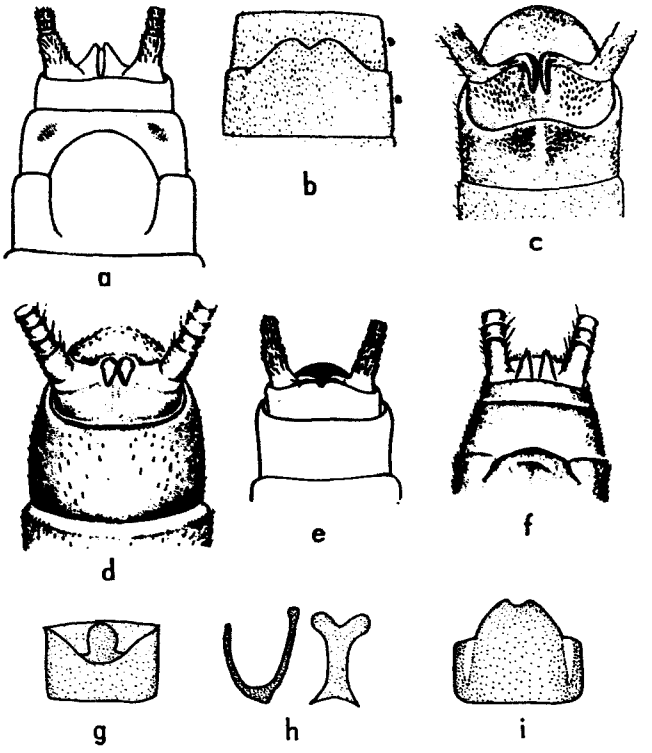

Fig. 30. Terminalia of *Isoperla*. *a, e, ebria; b, c, patricia; d, f, fulva; g, h, i, denningi; a, b, f, i,* ventral view of female, *c, d, e,* dorsal view of male; *g,* eighth sternite of male; *h,* aedeagal structure.

Type locality: Nevada.

Geographic range: Nevada, California, Oregon.

California records:

Plumas Co.: Tribs. of Smith Cr., *ca.* 5,000 ft., Blairsden, male and female, VI-11-52 (Wm. E. Ricker, W. E. R.); Meadow Valley, female, VI-9-24 (E. C. Van Dyke, C. A. S.).

Shasta Co.: Ono, female, IV-8-34 (E. C. Van Dyke, C. A. S.).

Sutter Co.: Marysville Buttes, female, V-2-25 (H. H. Keifer, C. A. S.).

Tehama Co.: Deer Cr., female, VII-2-47 (H. P. Chandler, H. P. C.).

78. *Isoperla mormona* Banks
(Fig. 28, *c, d*)

Isoperla mormona Banks, 1920, Harvard Coll. Mus. Comp. Zoöl. Bull., 64:322; desc. of female.

Isoperla mormona Needham and Claassen, 1925, Monog. Plecop., pp. 153, 154, desc. of male and female; male and female genitalia, pl. 27, figs. 1-3.

Isoperla insipida Hoppe, 1938, Univ. Wash. Publ. Biol. 4, p. 157, male and female.

Type locality: Vinyard, Utah.

Geographic range: British Columbia to California, Wyoming, and Arizona.

California records:

Alameda Co.: Niles Canyon, male, IV-27-47 (H. P. Chandler, H. P. C.).

Inyo Co.: Big Pine, male, female, VI-19-29 (Van Dyke and Usinger, C. A. S.).

Los Angeles Co.: Topanga Canyon, female, V-12-50 (U. C. L. A.); Lake Elizabeth Canyon, 3 males, 3 females, IV-26-50 (U.C.L.A.).

Mendocino Co.: Hopland, male, V-9-26 (E. P. Van Duzee, C. A. S.).

Riverside Co.: Herkey Cr., San Jacinto Mts., male, VI-4-40 (R. L. Usinger, C. I. S.).

San Bernardino Co.: Forest Home, male, VI-14-26 (E. C. Van Dyke, C. A. S.); Big Meadow, 3 males, VII-8-50 (U. C. L. A.).

79. *Isoperla patricia* Frison
(Fig. 30, *b, c*)

Isoperla patricia Frison, 1942, Bull. Ill. Nat. Hist. Surv., 22(1):313-315; desc. and figs. of male, female, nymph, and nymphal mouth parts.

Type locality: Spearfish, South Dakota.

Geographic range: British Columbia to California, South Dakota, and Colorado.

California records:

Los Angeles Co.: Camp Baldy, male, female, VI-26-50 (P. D. Hurd, C. I. S.).

Mariposa Co.: Fish Camp, 3 males, VII-11-46 (H. P. Chandler, H. P.C.). 7 mi. ENE Fish Camp 7,000 ft., male, VII-1-46 (H. P. Chandler, S.G.J.).

Shasta Co.: Kings Cr. Mdws., female, VII-2-47 (T. F. Leigh, C. I. S.); Big Spring, male, V-23-41 (P. D. Hurd, H. P. C.).

Sonoma Co.: Vineburg, female, V-25-33 (J.W. Tilden, C. A. S.).

Tuolumne Co.: Bridgeport, male, VII-9-34 (E. P. Van Duzee, C. A. S.).

Discussion:

Isoperla 5-punctata (Banks), described from New Mexico, is recorded from California by Needham and Claassen (1925, p. 1952) and Seemann (1927, p. 57). I have seen no specimens which I consider to be *5-punctata* from California. This species differs from *patricia* in the male in lacking the stout hairs on the posterior margin of the 9th tergite; the females are very similar and cannot be separated with certainty.

I. patricia is a common species frequently emerging with *I. mormona*.

80. *Isoperla pinta* Frison
(Fig. 28, *e, f*)

Isoperla pinta Frison, 1937, Bull. Ill. Nat. Hist. Surv., 21:92-93; desc. and figs. of male, female, and nymph.

Type locality: Curry County, Oregon.

Geographic range: British Columbia to California and Wyoming.

California records:

Lake Co.: 6 mi. S. of Middletown, female, V-11-16 (C. A. S.).

Mariposa Co.: Merced R., Yosemite National Park, female, 2 exuviae, VI-22-50 (Wm. E. Ricker, W. E. R.).

Mendocino Co.: Ukiah grade, 3 females, V-10-26 (E. P. Van Duzee, C. A. S.); Yorkville, female, IV-30-34 (E. P. Van Duzee, C. A. S.).

Plumas Co.: Feather R. at Blairsden, female, 2 exuviae, VI-11-52 (Wm. E. Ricker, W. E. R.).

San Mateo Co.: Portola State Park, female, V-8-50 (E. S. Ross, C. A. S.).

Sonoma Co.: Mill Cr., 3 mi. W. Healdsburg, 2 males, IV-15-50 (Robt. E. Leech, C. A. S.).

Tulare Co.: Lemoncove, 2 males, 2 females, IV-14-50 (R. L. Usinger, C. I. S.).

81. *Isoperla sordida* (Banks)
(Fig. 28, *g, h*)

Perla sordida Banks, 1906, Can. Ent., 38:338; desc. of female.

Isoperla sordida Needham and Claassen, 1925, Monog. Plecop., pp. 152-153; male and female genitalia, pl. 27, figs. 13-15.

Type locality: Los Angeles County, California.

Geographic range: Washington to California.

California records:

Los Angeles Co.: Topanga Canyon, 2 females, 9 nymphs, V-12-50 (U. C. L. A.); Lake Elizabeth Canyon, 3 males, 8 females, IV-26-50 (U. C. L. A.).

82. *Isoperla trictura* (Hoppe)
(Fig. 28, *a, b*)

Isoperla trictura Hoppe, 1938, Univ. Wash. Publ. Biol. 4, p. 151, desc. of male and female; genitalia, pl. 17, figs. 3 and 4.

Isoperla trictura Frison, 1942, Bull. Ill. Nat. Hist. Surv., 22(2):336; figs. of male and female genitalia.

Type locality: Cedar River (Maple Valley), Washington.

Geographic range: Washington to California.

California records:

Madera Co.: Oakhurst, male, V-26-42 (Arthur Walz, H. P. C.).

Marin Co.: Lagunitas, female, V-2-27 (E. H. Nast, C. A. S.).

Mariposa Co.: Yosemite National Park, 3,880-4,000 ft., male, V-29-31 (Pendergast, C. I. S.); same except V-28-31, female (C. I. S.); Miami

Ranger Station, female, VI-4-42 (Arthur J. Walz, (S. G. J.).

Shasta Co.: Shingletown, female, VI-1-41 (C. W. Anderson, C. I. S.).

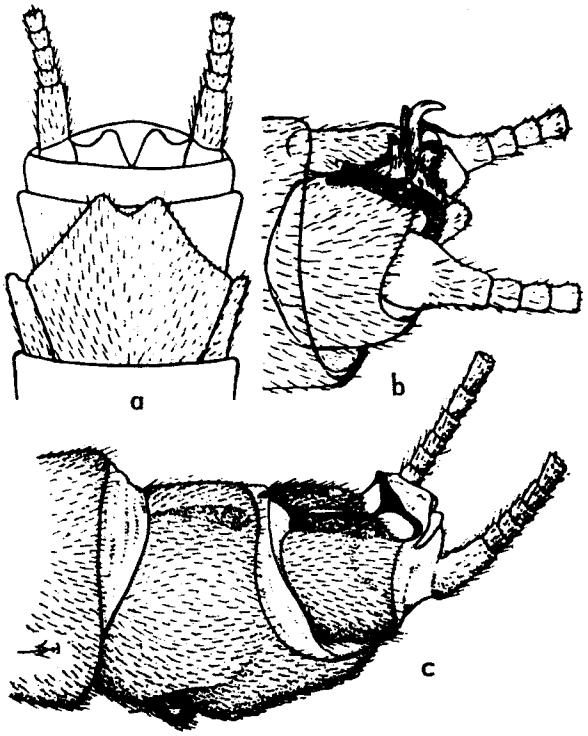

Fig. 31. *a, Kathroperla perdita,* ventral view of female terminalia; *b, Paraperla frontalis,* dorsolateral view of male terminalia; *c, K. perdita,* dorsolateral view of male terminalia (Needham and Claassen, 1925).

Family CHLOROPERLIDAE

California has a rich representation of this family including two of the three monotypic genera in the subfamily Paraperlinae. Few species of *Alloperla,* the largest genus of the family in North America, are known in the nymphal stage so it is not possible to present a key for them. *Paraperla, Kathroperla,* and *Hastaperla* may be placed by use of the key on pages pages 128 to 130.

Subfamily PARAPERLINAE

83. *Kathroperla perdita* Banks (Fig. 31, *a, c*)

Kathroperla perdita Banks, 1920, Bull. Mus. Comp. Zool., 64:315.

Kathroperla perdita Needham and Claassen, 1925, Monog. Plecop., pp. 132-133, desc. of male and female; wings, pl. 15, fig. 6; male and female genitalia, pl. 23, figs. 7 and 8.

Kathroperla perdita Neave, 1934, Can. Ent., 66:2, desc. of nymph.

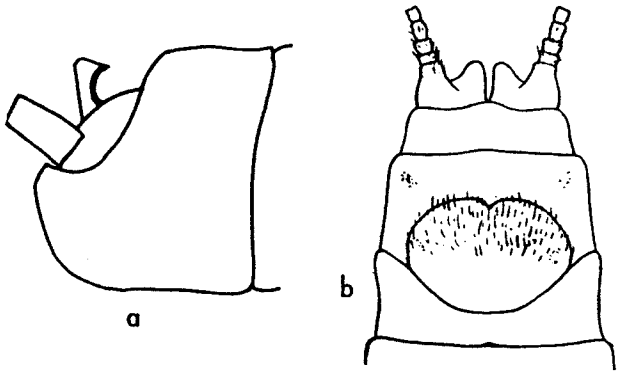

Fig. 32. *a, Hastaperla chilnualna,* lateral view of male terminalia; *b, Paraperla frontalis,* ventral view of female terminalia (*a,* Ricker, 1952; *b,* Needham and Claassen, 1925).

Type locality: Kaslo, British Columbia.

Geographic range: Alaska to California.

California records:

Marin Co.: Lagunitas, 2 females, V-2-27 (E. H. Nast, C. A. S.); Redwood Cr., female, V-17-08 (E. C. Van Dyke, C. A. S.).

Plumas Co.: Tribs. of Smith Cr., *ca.* 5,000 ft., Blairsden, exuvia, VI-11-52 (Wm. E. Ricker, W. E. R.).

84. *Paraperla frontalis* (Banks) (Figs. 31, *b;* 32, *b*)

Perlinella frontalis Banks, 1902, Can. Ent., 34: 123.

Paraperla frontalis Needham and Claassen, 1925, Monog. Plecop., pp. 130-131, desc. of male and female; wings, pl. 15, fig. 8; male and female genitalia, pl. 23, figs. 4-6.

Paraperla frontalis Claassen, 1931, Plecop. Nymphs Amer., p. 65, desc. of nymph; figs. of mouth parts, pl. 7, figs. 100-105; wing pads, pl. 10, figs. 167-168; fig. of nymph, pl. 18, fig. 193.

Type locality: New Mexico.

Geographic range: British Columbia to New Mexico and California.

California records:

Inyo Co.: Whitney Road, female, VI-12-37 (E. C. Van Dyke, C. A. S.).

Mariposa Co.: Merced R., Yosemite National Park, 3 exuviae, VI-22-50 (Wm. E. Ricker, W. E. R.).

Mendocino Co.: Yorkville, female, V-1-24 (E. P. Van Duzee, C. A. S.).

Mono Co.: Tioga Pass Road, Yosemite National Park, 1 mi. E. of summit, *ca.* 8,500 ft., male, VI-21-50 (Wm. E. Ricker, W.E.R.).

Plumas Co.: Tribs. of Smith Cr., *ca.* 5,000 ft.,

Blairsden, male, female, 3 exuviae, VI-11-52 (Wm. E. Ricker, W.E.R.).

Sonoma Co.: Mill Cr., 3 mi. W. of Healdsburg, 6 females, IV-15-50 (Robt. E. Leech, C. A. S.).

Key to the Males of California Subgenera and Species of *Alloperla*
(Figs. 33-36; 40, *f*)

1. A fingerlike process pointing inward from the basal segment of each cercus; supra-anal body a membranous lobe with a very small hairy process at its tip . . . . . (Subgenus *Suwallia*) *pallidula*
   Cerci normal; no process at the base of the cerci; supra-anal body elongate, its terminal process usually larger 2
2(1). Color usually green in life; no dark abdominal stripe; no process on the 9th tergite . . . . . (Subgenus *Alloperla*) 3
   Color mostly yellow in life; a dark dorsal stripe on the abdomen; usually a process on the 9th tergite 4
3(2). A truncate process dorsally on tip of supra-anal body; supra-anal body very thin in lateral view . . . . . *delicata*
   No dorsal process on tip of supra-anal body; supra-anal body about as deep in lateral view as wide in dorsal view . . . . . *chandleri*
4(2). Body of the supra-anal body lying in a deep groove of the 10th tergite and attached to its sides, bearing at its posterior end a terminal part which is well marked off from the rest of the apparatus . . . . . (Subgenus *Sweltsa*) 5
   Body of the supra-anal apparatus obscure, short, and lying along the surface of and fused with the 10th tergite, usually in a slight depression but never in a groove; supra-anal process short, sharply recurved . . . . . (Subgenus *Triznaka*) 12
5(4). A definite elevated transverse and usually notched process near the anterior border of the 9th tergite 6
   No process on the 9th tergite . . . *fraterna*
6(5). A bifurcate transverse process on the 8th tergite . . . . . *pacifica*
   No process on the 8th tergite 7
7(6). Supra-anal process slender, somewhat expanded in dorsal view toward the tip 8
   Supra-anal process broadly flattened . . 11
8(7). Supra-anal process extending barely beyond the 10th tergite . . . . . *tamalpa*
   Supra-anal process extending well beyond the 10th tergite 9
9(8). Disk of the pronotum with a dusky central stripe . . . . . *continua*
   Disk of the pronotum with reticulate dark markings (occasionally clear in *fidelis*) 10
10(9). Supra-anal process about 1.7 times as broad near the tip as it is near the base . . . . . *fidelis*
   Supra-anal process about 1.2 times as broad near the tip as it is near the base . . . . . *borealis*
11(7). Supra-anal process with a short, upturned hook at the tip; not club-shaped in lateral view . . . . . *coloradensis*
   Supra-anal process without a hook at the tip; club-shaped in lateral view . . . . . *tounesi*
12(4). Head unmarked except for the ocellar ring; pronotum yellow except for dusky lateral margins; no lobe on the 7th sternite . . . . . *diversa*
   Head and pronotum with conspicuous median markings of black on yellow; anterior dark mark on head about twice as wide as long; a small posterior lobe on the 7th sternite . . . . . *pintada*

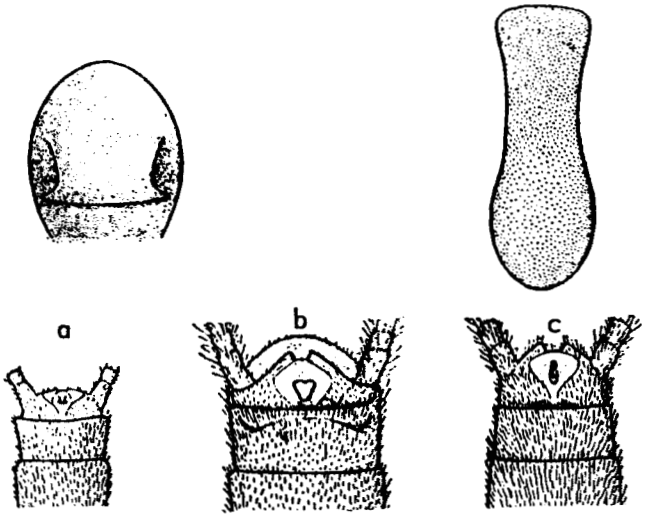

Fig. 33. Male terminalia of *Alloperla*, in dorsal view with enlarged dorsal view of tip of supra-anal process for *a* and *c*. *a, delicata; b, diversa; c, fraterna* (Frison, 1935).

85. *Alloperla (Alloperla) chandleri* Jewett
(Fig. 40, *f*)

Alloperla (Alloperla) chandleri Jewett, 1954, Pan-Pac. Ent., 30(3):179, desc. of male and female.

Type locality: 6 mi. E. of Miami Ranger Station, 6,000 ft., Mariposa Co., Calif. Known only from the type locality.

California record:
Mariposa Co.: As noted above.

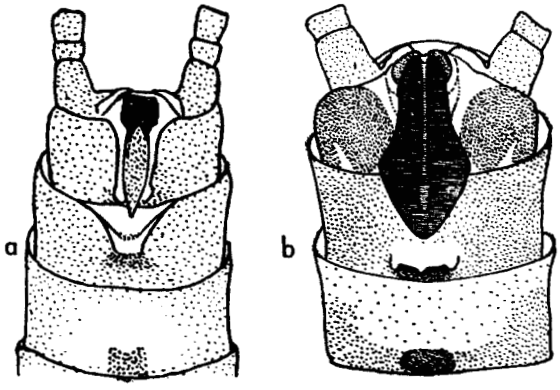

Fig. 34. Male terminalia of *Alloperla*, in dorsal view. *a, tamalpa; b, townesi* (Ricker, 1952).

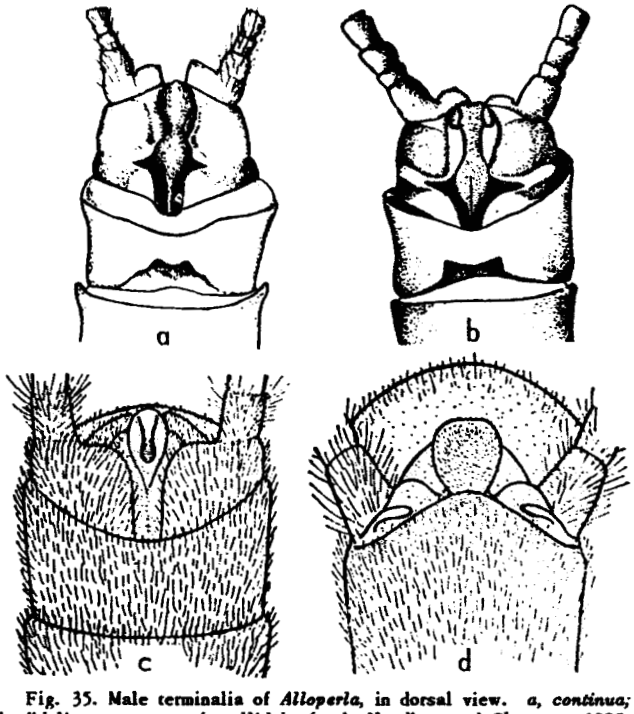

Fig. 35. Male terminalia of *Alloperla*, in dorsal view. *a, continua; b, fidelis; c, severa; d, pallidula* (*a, b,* Needham and Claassen, 1925; *c, d,* Frison, 1935).

86. *Alloperla (Alloperla) delicata* Frison (Fig. 33, *a*)

Alloperla delicata Frison, 1935, Trans. Amer. Ent. Soc., 61:334; male.
Alloperla (Alloperla) delicata Jewett, 1954, Jour. Fish. Res. Bd. Can., 11(5):549; female.
Alloperla delicata Hitchcock, 1958, Pan-Pac. Ent., 34(2):80.
Type locality: Oak Creek, Corvallis, Oregon.
Geographic range: Vancouver Island south to California.
California record:
Sierra Co.: Sagehen Cr., near Hobart Mills, male, VI-21-54 (S. W. Hitchcock, S. H.); same except VI-25-54, male, (S. H.).

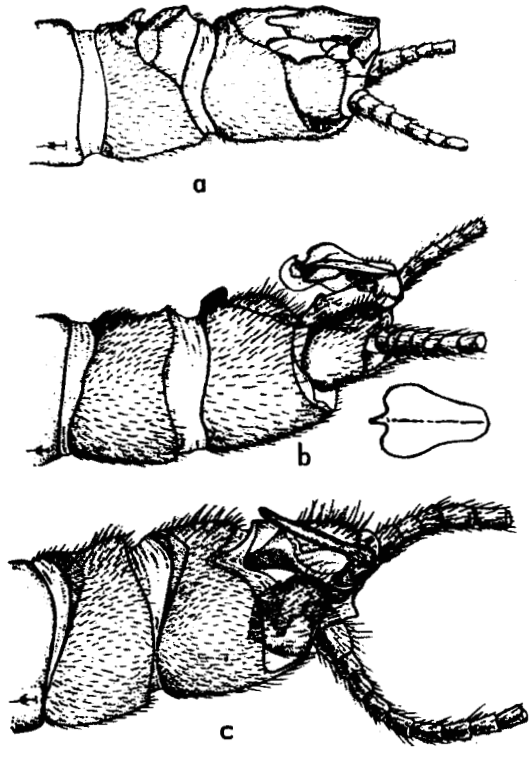

Fig. 36. Male terminalia of *Alloperla*, *a* and *c* in dorsolateral view and *b* in lateral view. *a, pacifica; b, coloradensis; c, borealis* (Needham and Claassen, 1925).

87. *Alloperla (Suwallia) pallidula* (Banks) (Figs. 35, *d*; 38, *e*)

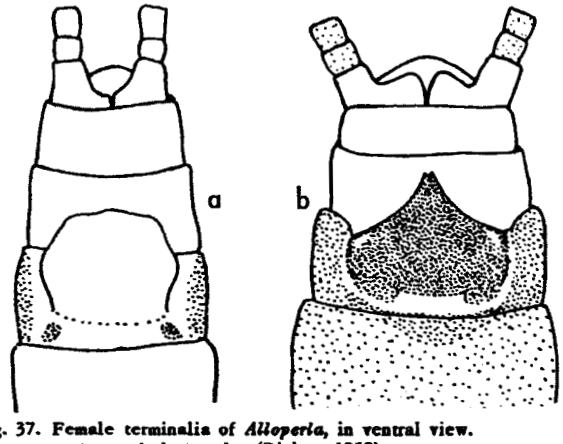

Fig. 37. Female terminalia of *Alloperla*, in ventral view. *a, townesi; b, tamalpa* (Ricker, 1952).

Chloroperla pallidula Banks, 1904, Trans. Amer. Ent. Soc., 30:99; female.
Alloperla pallidula Needham and Claassen, 1925, Monog. Plecop., pp. 108-109; male and female; male and female genitalia, pl. 22, figs. 12-13.
Alloperla dubia Frison, 1935, Trans. Amer. Ent. Soc., 61:338-339, desc. of male and female; male genitalia, pl. 11, figs. 8-9, pl. 14, fig.

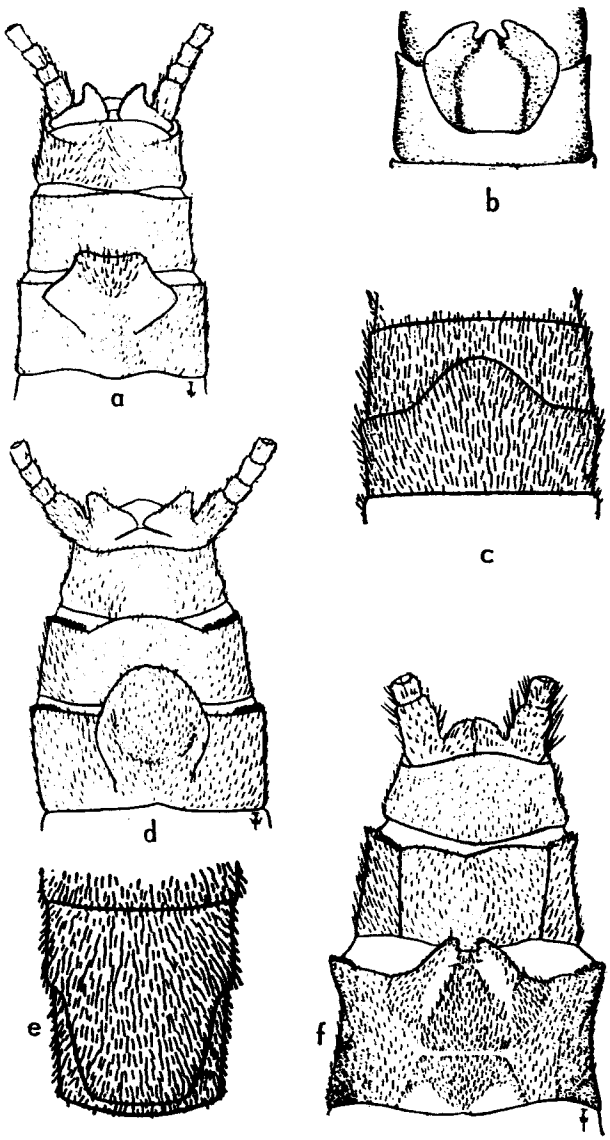

Fig. 38. Female terminalia of *Alloperla*, in ventral view. *a, coloradensis; b, fidelis; c, fraterna; d, pacifica; e, pallidula; f, borealis* (*a, b, d, f*. Needham and Claassen, 1925; *c, e*, Frison, 1935).

33; female genitalia, pl. 14, fig. 37.

Type locality: New Mexico.

Geographic range: British Columbia to California and Alberta to Wyoming.

California records:

Alameda Co.: Niles Canyon, 2 males, V-23-17 (W. M. Gifford, C. A. S.).

Alpine Co.: Markleeville, female, VII-4-49 (Day, C. I. S.).

Del Norte Co.: 10 mi. NE of Fort Dick, 5 females, V-29-52 (B. Malkin, B. M.).

Madera Co.: Boggy Mdws., 6,000 ft., 7 males, 8 females, VII-15-46 (H. P. Chandler, H. P. C.).

Marin Co.: Muir Woods, female, VII-15-17 (W. M. Gifford, C. A. S.).

Mariposa Co.: Fish Camp, 5,000 ft., male, VII-7-46 (H. P. Chandler. C. I. S.); Yosemite Valley, male, VII-5-27 (E. H. Nast, C. A. S.); Five mi. N. Yosemite, 3,880-4,000 ft., 2 males, VII-21-46 (H. P. Chandler, C. I. S.).

Mono Co.: Shore of Silver L., 2 males, 3 females, VI-20-50 (Wm. E. Ricker, W. E. R.).

San Bernardino Co.: Forest Home, male, VI-14-28 (E. C. Van Dyke, C. A. S.).

Shasta Co.: Hat Cr., Olb Station, male, IX-7-46 (H. P. Chandler, C. I. S.).

Siskiyou Co.: Scott R. at Klamath R., male, VIII-10-49 (Day, C. I. S.).

Tehama Co.: Deer Cr., 2 females, VII-2-47 (H. P. Chandler, H. P. C.).

Discussion:

This is the commonest of the three western species of the subgenus *Suwallia;* the other two species may be eventually taken in California. *A. autumna* Hoppe emerges in the fall of the year and is darkish in color; the male has distinctive penial appendages. *A. lineosa* Banks has a distinctive female subgenital plate which is concave along its distal margins; it is difficult to distinguish the male from *pallidula.*

88. *Alloperla (Sweltsa) borealis* (Banks) (Figs. 36, *c;* 38, *f*)

Chloroperla borealis Banks, 1895, Trans. Amer. Ent. Soc., 22:313, desc. of male and female.

Alloperla borealis Needham and Claassen, 1925, Monog. Plecop., p. 118, desc. of male and female; wings, pl. 14, fig. 1; male and female genitalia, pl. 21, figs. 1-3.

Alloperla borealis Claassen, 1931, Plecop. Nymphs Amer. p. 60, desc. of nymph; nymphal mouth parts, pl. 6, figs. 89-93; nymph, pl. 17, fig. 192.

Type locality: Olympia, Washington.

Geographic range: British Columbia to Colorado and California.

California records:

Marin Co.: Bear Valley, female, IV-12-20 (C. L. Fox, C. A. S.); Lagunitas, 3 males, 2 females, IV-7-46 (H. P. Chandler, H. P. C.); Mt. Tamalpais, male (H. P. Chandler, H. P. C.).

Mariposa Co.: May L., Yosemite National Park, female, VII-9-46 (H. P. Chandler, H.P.C.).

89. *Alloperla (Sweltsa) coloradensis* (Banks) (Figs. 36, *b;* 38, *a*)

Chloroperla coloradensis Banks, 1898, Trans. Amer. Ent. Soc., 25:199.

Alloperla coloradensis Needham and Claassen, 1925, Monog. Plecop., pp. 113-114, desc. of male and female; male and female genitalia,

pl. 22, figs. 4 and 5.

Alloperla coloradensis Claassen, 1931, Plecop. Nymphs Amer., pp. 60-61, desc. of nymph; nymphal mouth parts, pl. 6, figs. 83-88.

Type locality: Colorado.

Geographic range: British Columbia to California; Montana to Colorado.

California record:

Sonoma Co.: Sonoma, male, VII-4-26 (E. C. Van Dyke, C. A. S.).

90. *Alloperla (Sweltsa) continua* Banks (Fig. 35, *a*)

Alloperla continua Banks, 1911, Trans. Amer.Ent. Soc., 37:336.

Alloperla continua Needham and Claassen, 1925, Monog. Plecop., p. 117, desc. of male and female; male and female genitalia, pl. 21, figs. 11 and 12.

Type locality: San Gabriel Mts., California.

Geographic range: California.

California records:

Alpine or Tuolumne Co.: Near Sonora Pass, *ca.* 8,500 ft., 2 males, female, VIII-7-48 (H. K. Townes, W. E. R.); same, except male, female, VII-4-48 (H. K. Townes, W. E. R.).

Los Angeles Co.: Tanbark Flat, 3 females, VI-27-50 (F. X. Williams, C. A. S.); Topanga Canyon, female, V-12-50 (U. C. L. A.).

Mariposa Co.: May L., Yosemite National Park, female, VII-17-48 (H. K. Townes, W. E. R.).

Plumas Co.: Tribs. of Smith Cr., *ca.* 6,500 ft., Blairsden, 24 males, 11 females, nymphs, exuviae, VI-11-52 (Wm. E. Ricker, W. E. R.).

Riverside Co.: Keen Camp, 2 females, VI-6-12-17, (E. P. Van Duzee, C. A. S.).

San Bernardino Co.: Forest Home, 3 males, 6 females, VI-14-28 (E. C. Van Dyke, C. A. S. and S. G. J.).

91. *Alloperla (Sweltsa) fidelis* Banks (Figs. 35, *b*; 38, *b*)

Alloperla fidelis Banks, 1920, Bull. Mus. Comp. Zool., 64:323, desc. of male and female.

Alloperla fidelis Needham and Claassen, 1925, Monog. Plecop., pp. 119-120, desc. of male and female; male and female genitalia, pl. 21, figs. 8-10.

Alloperla fidelis Frison, 1942, Bull. Ill. Nat. Hist. Surv., 22(2):346, desc. and figs. of male and female with brachypterous wings.

Type locality: Great Alpine Creek, Tahoe, California.

Geographic range: British Columbia to California; Idaho to Wyoming.

California records:

Del Norte Co.: 10 mi. NE of Fort Dick, 10 males, 10 females, V-29-52 (B. Malkin, B. M.).

Lake Co.: Mt. St. Helena, female, V-12-26 (E. P. Van Duzee, C. A. S.).

Marin Co.: Lagunitas, female, IV-7-46 (E. C. Van Dyke, C. A. S.).

Mariposa Co.: 7 mi. ENE of Fish Camp, 9,000 ft., 5 females, VII-1-46 (H. P. Chandler, H.P.C.).

Shasta Co.: S. Fk. Sacramento R., 15 mi. SW of Mt. Shasta City, female, VII-19-48 (W. Wirth, C. I. S.).

Trinity Co.: Carrville, 2,400-2,500 ft., 4 females, V-17-34 (E. C. Van Dyke, C. A. S.).

92. *Alloperla (Sweltsa) fraterna* Frison (Figs. 33, *c*; 38, *c*)

Alloperla fraterna Frison, 1935, Trans. Amer. Ent. Soc., 61:334-335, desc. of male and female; prothorax, pl. 11, fig. 4; abdomen, pl. 12, fig. 19; male genitalia pl. 12, figs. 15 and 19; female genitalia, pl. 14, fig. 39.

Type locality: Oak Creek, Corvallis, Oregon.

Geographic range: British Columbia to California.

California records:

Del Norte Co.: Patrick Cr., trib. of Smith R., 6 males, 4 females, VI-4-49 (S. G. Jewett, Jr., S. G. J.).

Marin Co.: Bootjack Camp, Tamalpais State Park, male, 5 females, VI-25-50 (Wm. E. Ricker, W. E. R.).

93. *Alloperla (Sweltsa) pacifica* (Banks) (Figs. 36, *a*; 38, *d*)

Chloroperla pacifica Banks, 1895, Trans. Amer. Ent. Soc., 22:313.

Alloperla pacifica Needham and Claassen, 1925, Monog. Plecop., p. 111, desc. of male and female genitalia, pl. 22, figs. 2 and 3.

Alloperla spatulata Needham and Claassen, 1925, Monog. Plecop., pp. 120-121; male and female genitalia, pl. 21, figs. 13 and 14.

Alloperla spatulata Claassen, 1931, Plecop. Nymphs. Amer., pp. 62-63, desc. of nymph; nymph, pl. 17, fig. 191.

Alloperla (Sweltsa) pacifica Ricker, 1952, Syst. Studies Plecop., p. 182, synonomized *spatulata* N. & Clsn.

Type locality: Skokomish River, Washington.

Geographic range: British Columbia and Montana to California.

California records:

Alpine Co.: Hope Valley, 2 males, VII-9-48

(K. W. Tucker, C. I. S.).

Lake Co.: Anderson Cr., N. of Middletown, male, V-29-49 (Hugh B. Leech, C. A. S.).

Los Angeles Co.: Topanga Canyon, 4 males, 2 females, V-12-50 (U. C. L. A.).

Marin Co.: Lagunitas Canyon, 1,000 ft., male, IV-20-47 (H. P. Chandler, H. P. C.); Taylor State Park, male, female, IV-20-47 (E. S. Ross, C. A. S.).

Mariposa Co.: Yosemite Valley, male, VI-23-21 (E. C. Van Dyke, C. A. S.): Chilnualna R., 4,000 ft., Yosemite National Park, 3 males, 5 females, VI-22-50 (Wm. E. Ricker, W. E. R.); Merced R., Yosemite National Park, male and female (both dried), VI-22-50 (Wm. E. Ricker, W. E. R.).

Plumas Co.: Keddie, male, female, at light, VI-11-41 (Fred. H. Rindge, H. P. C.).

Riverside Co.: Tahquitz Valley, San Jacinto Mts., male, VI-7-40 (Fred. H. Rindge, H. P. C.).

San Mateo Co.: Portola State Park, 2 males, V-8-50 (E. S. Ross, C. A. S.).

94. *Alloperla (Sweltsa) tamalpa* Ricker (Figs. 34, *a;* 37, *b*)

Alloperla (Sweltsa) tamalpa Ricker, 1952, Syst. Studies Plecop., pp. 182-183, figs. 140 and 143, desc. and figs. of male and female.

Type locality: Bootjack Camp, Mt. Tamalpais State Park, California.

Geographic range: California.

California record:

San Benito Co.: Pinnacles National Monument, 1,000 ft., 4 males, 4 females, V-3-46 (H. P. Chandler, H. P. C., W. E. R., and S. G. J.).

95. *Alloperla (Sweltsa) townesi* Ricker (Figs. 34, *b;* 37, *a*)

Alloperla (Sweltsa) townesi Ricker, 1952, Syst. Studies Plecop., p. 184; male and female genitalia, p. 183, figs. 144 and 146.

Type locality: Dardanelle, California.

Geographic range: California.

California records:

El Dorado Co.: Pyramid Cr., male, 4 females, VII-22-52 (S. G. Jewett, Jr., S. G. J.).

Madera Co.: Boggy Meadows, 6,000 ft., female, VII-15-46 (H. P. Chandler, H. P. C.); Agnew Meadows, female, VIII-4-52 (W. A. McDonald, U. C. L. A.).

Shasta Co.: Burney Falls, male, female, VII-27-52 (D. G. Denning, S. G. J.).

Tuolumne Co.: Strawberry, 2 males, 2 females, VII-4-51 (C. I. S.).

96. *Alloperla (Triznaka) diversa* Frison (Fig. 33, *b*)

Alloperla diversa Frison, 1935, Trans. Amer. Ent. Soc., 61:333, desc. of male and female; pronotum, pl. 11, fig. 5; abdomen, pl. 12, fig. 20; male genitalia, pl. 12, figs. 16 and 20; 8th and 9th tergites of male, pl. 13, fig. 31; female genitalia, pl. 14, fig. 40.

Type locality: East Fork of Hood River, Parkdale, Oregon.

Geographic range: Alaska to California.

California records:

Mariposa Co.: Smoky Jack Camp, 7,000 ft., Yosemite National Park, male and female, VI-22-50 (Wm. E. and Angus Ricker, W. E. R.).

Mono Co.: Trib. of Silver L., 8 males, 9 females, VI-20-50 (Wm. E. Ricker, W. E. R.).

Tuolumne Co.: Dardanelle, 3 males, 5 females, VIII-4-48 (H. K. Townes, W. E. R.).

97. *Alloperla (Triznaka) pintada* Ricker

Alloperla (Triznaka) pintada Ricker, 1952, Syst. Studies Plecop., desc. of male and female; head and thorax pattern and male and female genitalia, p. 188, figs. 147-150.

Type locality: Edloe, Colorado, 10,000 ft.

Geographic range: Washington to California; Colorado, New Mexico, South Dakota.

California records:

Nevada Co.: Truckee R. near Myers, 5 males, 14 females, VII-22-52 (S. G. Jewett, Jr., S. G. J.).

Riverside Co.: Herkey Cr., San Jacinto Mts., female, VI-12-39 (E. S. Ross, C. I. S.).

98. *Hastaperla chilnualna* Ricker (Fig. 32, *a*)

Hastaperla chilnualna Ricker, 1952, Syst. Studies Plecop., p. 190, desc. of male; male genitalia, p. 188, fig. 151.

Type locality: Chilnualna R. Camp, 4,000 ft., Yosemite National Park, California.

Geographic range: Washington to California.

California records:

Los Angeles Co.: Topanga Canyon, female, V-12-50 (U. C. L. A.).

Madera Co.: 3 mi. W. Bass L., male, female, VII-1-46 (H. P. C.).

Riverside Co.: Herkey Cr., San Jacinto Mts., 3 males, 4 females, VI-12-39 (C. I. S. and S. G. J.).

San Bernardino Co.: Barton Flats, 2 males, female, VII-41 (R. J. Pence, U. C. L. A.).

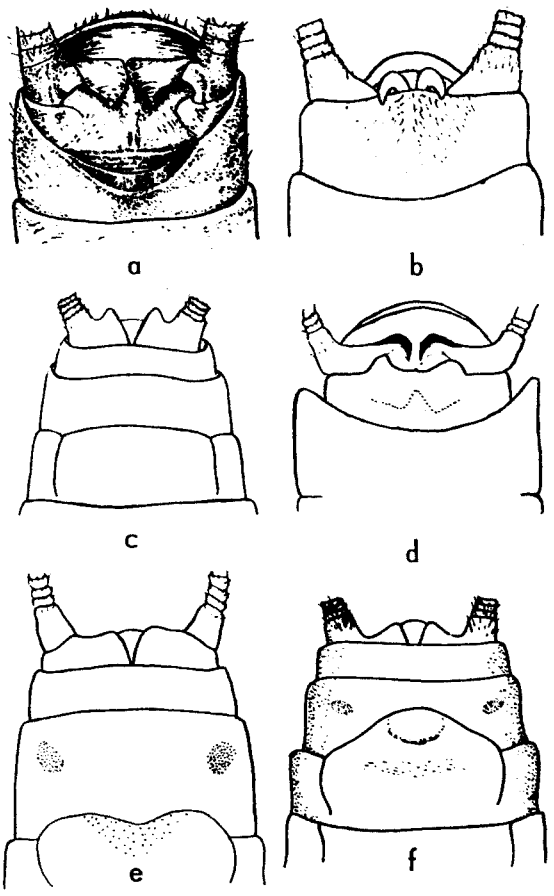

Fig. 39. Terminalia of *Acroneuria*. *a, f, pacifica; b, c, theodora; d, e, californica; a, b, d,* dorsal view of male; *c, e, f,* ventral view of female (Needham and Claassen, 1925).

Family PERLIDAE
Subfamily ACRONEURINAE

Three species of this predominantly North American subfamily are known to occur in California, all in the genus *Acroneuria*. Records of a fourth species in the genus, *depressa* Needham and Claassen, in Needham and Claassen's monograph (1925, p. 191) are believed to be of *A. theodora*.

Key to the California Subgenera and Species of *Acroneuria* (Fig. 39)

1. Grooves of the mesosternum short and nearly parallel; anal gills present . . . . . (Subgenus *Hesperoperla*) *pacifica*
   Grooves of the mesosternum widely divergent . . . . . (Subgenus *Calineuria*) 2
2(1). Head and thorax of adult blackish; male hammer longitudinally rectangular with ridged surface; ocellar triangle dark in nymph and head and thorax not strikingly patterned . . . . . *theodora*
   Head and thorax of adult brownish; male hammer without ridged surface; ocellar triangle yellow in nymph and head and thorax strikingly patterned . . . . . *californica*

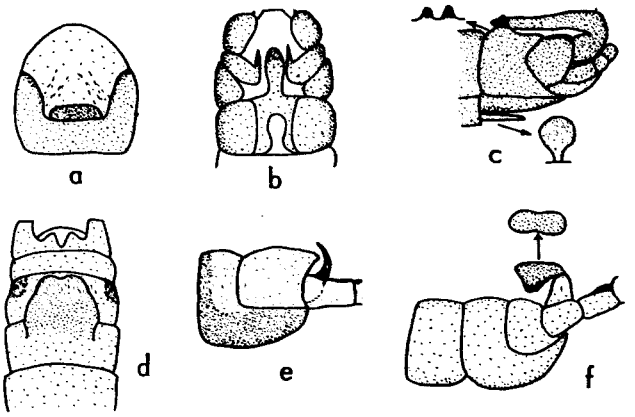

Fig. 40. *a, Peltoperla quadrispinula,* aedeagal structure through the ninth sternite; *b, Nemoura spiniloba,* ventral view of male terminalia; *c, Capnia maculata,* lateral view of male terminalia; *d, Isogenus alameda,* ventral view of female terminalia; *e, Isoperla marmorata,* lateral view of male terminalia; *f, Alloperla chandleri,* lateral view of male terminalia (Jewett, 1954*b*).

99. *Acroneuria (Calineuria) californica* (Banks) (Fig. 39, *d, e*)

Perla californica Banks, 1905, Invertebrata Pac., 1:87, desc. of male and female.

Acroneuria californica Needham and Claassen, 1925, Monog. Plecop., pp. 192-193, desc. of male and female; male and female genitalia, pl. 28, figs. 17-20; egg, pl. 30, fig. 1.

Acroneuria californica Claassen, 1931, Plecop. Nymphs. Amer., pp. 85-86, desc. of nymph; pl. 26, fig. 205.

Acroneuria californica Ricker, 1954, Proc. Ent. Soc. B.C., 51:39, placed in new subgenus *Calineuria*.

Type locality: California.

Geographic range: British Columbia to California.

California records:

Butte, Contra Costa, El Dorado, Fresno, Humboldt, Lake, Los Angeles, Marin, Mendocino Nevada, San Bernardino, Sonoma, Trinity, and Tuolumne counties. April-July.

100. *Acroneuria (Calineuria) theodora* Needham and Claassen (Fig. 39, *b, c*)

Acroneuria theodora Needham and Claassen, 1922, Can. Ent., 54:254, desc. of male and female.

Acroneuria theodora Needham and Claassen, 1925,

Monog. Plecop., p. 192, desc. of male and female; wings, pl. 16, fig. 9; male and female genitalia, pl. 28, figs. 21-23; egg, pl. 30, fig.4.

Acroneuria theodora Claassen, 1931, Plecop. Nymphs Amer., p. 90, desc. of nymph; nymph, pl. 26, fig. 206.

Acroneuria theodora Frison, 1942, Bull. Ill. Nat. Hist. Surv., 22(2):284-285, desc. and figs. of head and prothorax, male and female genitalia, and nymphal mouth parts.

Acroneuria theodora Ricker, 1954, Proc. Ent. Soc. B.C., 51:39, placed in new subgenus *Calineuria*.

Type locality: Yellowstone National Park, Wyoming.

Geographic range: Oregon and California; Montana and Wyoming.

California records:

El Dorado Co.: Strawberry Valley, female, VIII-5-12 (E. C. Van Dyke, C. A. S.).

Fresno Co.: S. Fk. Kings R. Canyon, 5,000 ft., male, VII-6-10 (E. C. Van Dyke, C. A. S.).

Lassen Co.: Blue L., Warner Mts., male, VII-19-20-47 (C. I. S.).

Los Angeles Co.: Cam p Baldy, 2 females, VII-8-50 (W. C. Bentinck, C. I. S.).

Plumas Co.: female, VII-1911 (J.C. Huguenin, C. A. S.).

101. *Acroneuria (Hesperoperla) pacifica* Banks (Fig. 39, *a, f*)

Acroneuria pacifica Banks, 1900, Trans. Amer. Ent. Soc., 26:242.

Acroneuria pumila Banks, 1906, Can. Ent., 38:335.

Acroneuria pacifica Needham and Claassen, 1925, Monog. Plecop., pp. 187-188; male genitalia, pl. 4, figs. 11 and 12; wings, pl. 16, fig. 3; male and female genitalia, pl. 29, figs. 7, 9, and 10; egg, pl. 30, fig. 3.

Acroneuria pumila Needham and Claassen, 1925, *ibid.*, p. 188, desc. and figs. of male and female genitalia.

Acroneuria pacifica Claassen, 1931, Plecop. Nymphs Amer., pp. 88-89, desc. of nymph; nymphal mouth parts, pl. 5, figs. 71-76; nymph, pl. 25, fig. 204 and pl. 32, fig. 224.

Acroneuria delta Claassen, 1937, Jour. Kans. Ent. Soc., 10:42, female.

Acroneuria pacifica Frison, 1942, Pan-Pac. Ent., 18:72-73, synonymized *pumila* Banks and *delta* Claassen.

Type locality: Washington. British Columbia to California.

Geographic range: British Columbia to California; Montana to Colorado.

California records:

El Dorado, Humboldt, Lake, Lassen, Marin, Mariposa, Mendocino, Napa, Nevada, Plumas, San Bernardino, Shasta, Sierra, and Tuolumne counties. April-July.

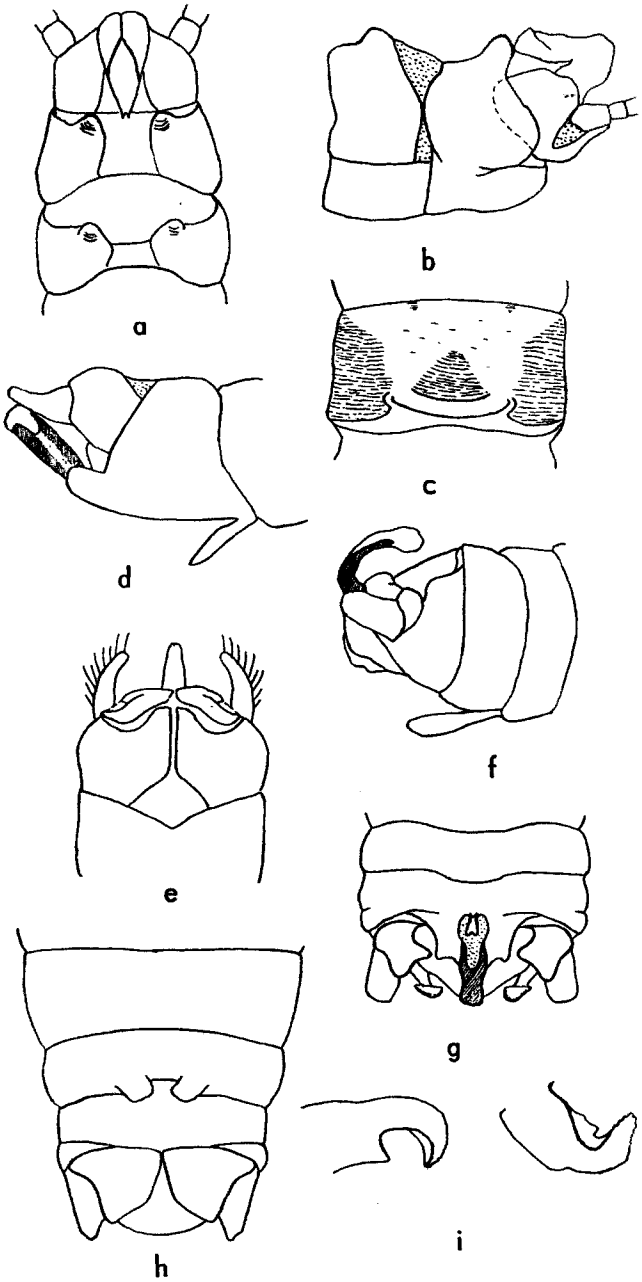

Fig. 41. *a, Capnia quadrituberosa* male genitalia, dorsal; *b, Capnia quadrituberosa* male genitalia lateral; *c, Capnia quadrituberosa* female eighth sternite, ventral; *d, Leuctra divisa* male genitalia, lateral; *e, Leuctra divisa* male genitalia, dorsal; *f, Nemoura marionae* male genitalia; dorsal; *h, Nemoura marionae* female sternites; *i, Nemoura marionae* subanal lobes of male paratypes. (Hitchcock, 1958.)

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TABLE

County Records of

California Stoneflies

County Records of California Stoneflies

	Peltoperla thyra	Peltoperla quadrispinula	Peltoperla brevis	Peltoperla cora	Nemoura spiniloba	Nemoura biloba	Nemoura californica	Nemoura depressa	Nemoura marionae	Nemoura delicatula	Nemoura besametsa	Nemoura n. nevadensis	Nemoura producta	Nemoura cataractae	Nemoura cinctipes	Nemoura columbiana	Nemoura frigida	Nemoura haysi	Nemoura oregonensis	Leuctra augusta	Leuctra infuscata	Leuctra divisa	Leuctra occidentalis	Leuctra forcipata	Leuctra sara	Perlomyia collaris	Capnia bakeri	Capnia barberi	Capnia californica	Capnia columbiana	Capnia elongata	Capnia excavata	Capnia glabra	Capnia gracilaria	Capnia lineata	Capnia maculata	Capnia porrecta	Capnia projecta	Capnia promota	Capnia spinulosa	Capnia teresa	Capnia tumida	Capnia umpqua	Capnia quadrituberosa	Eucapnopsis brevicauda	Isocapnia abbreviata	Isocapnia grandis	Isocapnia spenceri thujae	Brachyptera occidentalis	Brachyptera californica	Brachyptera grinnelli
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Alpine												×																																							
Amador																																																			
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Calaveras																																																			
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Ventura																																																				
Yolo																																																				
Yuba																																																				

County Records of California Stoneflies

Brachyptera nigripennis	Brachyptera pacifica	Brachyptera pallida	Brachyptera raynoria	Brachyptera vanduzeei	Taenipteryx maura	Pteronarcella regularis	Pteronarcys californica	Pteronarcys princeps	Arcynopteryx yosemite	Arcynopteryx barbara	Arcynopteryx aurea	Arcynopteryx curvata	Arcynopteryx parallela	Isogenus sorptus	Isogenus erratus	Isogenus tostonus	Isogenus alameda	Isogenus nonus	Isogenus yakimae	Isoperla denningi	Isoperla ebria	Isoperla fulva	Isoperla marmorata	Isoperla mormona	Isoperla patricia	Isoperla pinta	Isoperla sordida	Isoperla trictura	Calliperla luctuosa	Rickera venusta	Kathroperla perdita	Paraperla frontalis	Alloperla chandleri	Alloperla delicata	Alloperla pallidula	Alloperla borealis	Alloperla coloradensis	Alloperla continua	Alloperla fidelis	Alloperla fratema	Alloperla pacifica	Alloperla tamalpa	Alloperla towuesi	Alloperla diversa	Alloperla pintada	Hastaperla chilnualna	Acroneuria californica	Acroneuria theodora	Acroneuria pacifica	
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INDEX TO THE GENERA AND SPECIES OF

STONEFLIES OF CALIFORNIA

(Synonyms are in parentheses. Principal page references are in italic type.)