

NEW GENERA OF MAYFLIES FROM CALIFORNIA

(Ephemeroptera)

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In September of 1953 Charles Warren, then a graduate student at the University of California, brought to me for identification a number of tiny mayfly nymphs which he had collected with a bottom sampler in the course of conducting a pollution study of the lower Tuolumne River. The most curious of these was a species of Baetinae having bowed tarsi with distal truncate, spatula-like appendages armed with one large and eight or nine lesser claws.

Searching for this unique species during 1954, the writer and his wife, Helen L. Day, made numerous trips to the Tuolumne River, collecting some ten miles above and below Modesto. The spatula-clawed Baetinae nymph has been reared and found to be an aberrant form of the genus *Baetis*. It is apparently identical with the nymph described by Dr. Traver in 1944 as Baetine No. 1, from Brazil.

Two additional forms of Baetine nymphs were reared from the 1954 collecting on the Tuolumne River which, in the author's opinion, cannot be included in any known genus of the Ephemeroptera. The male adults of both are inseparable from *Pseudocloeon* and from each other, yet the three-tailed nymphs are quite dissimilar from the two-tailed nymphs of *Pseudocloeon*, and from each other. It is the purpose of this paper to propose the new genus *Paracloeodes* based on the type species *P. abditus* and the new genus *Apobaetis* based on the type species *A. indeprensus*, and to name and describe the nymphs as the holotypes of the type species.

Paracloeodes Day, new genus

Adult: Very small mayflies, the male adult with body about 3.5, forewing 3.5, foreleg 3.0 and tails (2) 5.5 mm. long. Female with body averaging 4.5, forewing 4.5, foreleg 2.0 and tails (2) 5.0 mm. long. Hindwings absent. Turbinate eyes of male not contiguous, very large and set on stalks about .25 mm. in height when measured up the outer sides. Eyes of female widely separated, 1.7 times the distance apart as their longest axis. Posterior margin of head of female definitely emarginate. Foreleg of male with tibia and tarsus subequal, each one-half longer than femur; proportionate lengths of tarsal segments 1 to 5 being respectively 1, 15, 12, 6 and 4. Hindleg of male with tibia and femur subequal and tarsus one-half this length; proportionate lengths of tarsal segments 1 to 4 being respectively 4, 3, 2, and 5. Proportionate

tions of tarsal segments of hindleg of female as in male. Tibio-tarsal joint in male and female strongly fused but marked by diminished thickness of tarsus. All leg segments beset with numerous minute, hair-like spinules. Marginal intercalaries of forewing paired, of medium length, and well developed in both male and female, at least from costa through radial sector. Venation of forewing as in figure 24. In the female, the apical margin of sternite 9 is very slightly produced. Genitalia of male adult with first segment of forceps extremely long, second and third joints fused, and length of fourth segment about four times its thickness; broad, domed penes cover present in type species. Two tails.

Nymph: Slender, streamlined. Length of body of male averages 3.75, legs, all of equal length, 1.75 and tails (3) 1.5 mm. Length of antennae 50% longer than head. Antero-lateral portion of head deeply cut away, exposing mouthparts; posterior margin straight. Each mandible with canines fine and rounded at tips, of moderate length and divided to base into two groups: protheca asymmetrical; without spines or hairs between canines and molars. Right mandible (fig. 9) with large tooth at center of molars. Left mandible (fig. 10) with single large tooth above molars. Maxilla (fig. 11) notably light and slender with robust, two-jointed palp extending almost half its length beyond tip of galea-lacinia. Labial palp (fig. 12) two-jointed and of distinctive and unusual form, with outer apical margin terminating in a sharp point and inner apical margin forming a large, smoothly rounded lobe. Pronotum three times as wide as long; anterior margin straight and posterior margin widely excavated. Anterior margin of first tergite with wide, deep median slot into which fits the mesonotal scutellum. Tergites with short, fine spinules on posterior margins; postero-lateral corners without spines. Legs (fig. 26) with tibia 60% the length of femur and tarsus slightly shorter than tibia. Claws slightly curved and hooked at ends, over half as long as tarsi, and with 18-20 fine, straight denticles on inner margin of basal portion. Gills single, ovate, hyaline white, and with strongly marked dark central trachea with a few short branches (fig. 8). Three tails, the middle tail 96% as long as outer tails and equally stout. Short hairs on each side of middle tail and on inner sides of laterals.

Type of the genus, *Paracloeodes abditus* Day, new species

Paracloeodes abitus Day, new species

(Figures 7-12 and 19-24)

The morphological details of this species, the type species of the new genus *Paracloeodes*, have been given above. Details that might be expected to be of a specific nature are as follows.

Adult: Entire upper surface of head yellowish white, ocelli narrowly ringed at bases with smoky gray and stalks of male eyes also so ringed. Facets of upper compound eyes of male light golden yellow, lower eyes black. Antennae with scape and pedicle pale, filaments light smoky; two faintly darkened "V" shaped marks between bases. Pronotum pale smoky, anterior margin finely dark. Mesonotum and metanotum yellowish white, faintly outlined in smoky gray; median suture of mesonotum marked lightly with gray. Wings hyaline, colorless, veins white. Abdomen yellowish white,

tergites 1-5 with lateral areas light smoky. Pleural fold intermittently marked with fine, gray geminate lines. Segments 9 and 10 wholly white. Golden eggs of female seen through body wall in complete detail. All legs transparent white; trochanters, tarsal joinings and claws finely outlined in black. Penes cover, second and third segments of male forceps faintly washed with smoky; other segments of forceps white. Tails transparent white.

Male nymph: Length of body 3.7, legs 1.7 and tails 1.5 mm. The morphological features of the holotype nymph have been given in the generic description. In *P. abditus* the coloration is basically white with markings in black washes which are never quite opaque. Vertex of head white with faint, broad black wash in area of genae. Anterior and lateral margins of labrum outlined in black. Canines of mandibles and teeth at tips of galea-lacinia black. Scape and pedicle of antenna smoky and each section of flagellum with narrow black margins. Upper and lower portions of eyes distinctly seen, the former yellowish and the latter black. Pronotum white with wide median, submedian and lateral dark stripes from anterior to posterior margins. Mesonotum and metanotum yellowish, margined in black; mesonotum vaguely marbled and speckled in black, and a broad wash of black in antero-lateral corners; a broad wash of black across basal portion of wing-pads. Very wide, strong dark semi-circular stripes over each trochanter. A strong black stripe under middle and hindlegs. Tergite 1 white; 4, 5, 7 and 8 white with dark median and submedian spots on anterior margins; larger and less intense black spots in lateral corners. Tergites 2, 3, 6 and 9 washed with black except for small median white area on posterior margin and wide white band above pleural fold; a strong, large dark spot in median area. Anterior and posterior margins of all tergites finely black. Denticles along all posterior margins black. Sternites white, 1-8 with anterior margins black. Sternite 9 washed and finely outlined in black and with wide dark stripe across anterior portion. Legs with femora white, tibiae, tarsi and claws light smoky and darker at joinings; a prominent dark spot at distal ends of femora. Gills hyaline white, each with a single dark central trachea; branches not darkened. Three white tails of about equal length, dorsal surfaces and all joinings faintly darkened; short white hairs on each side of middle tail and on inner sides of lateral tails.

Holotype: Male nymph mature; collected by Helen L. Day and W. C. Day on TUOLUMNE RIVER, STANISLAUS COUNTY, CALIFORNIA, ABOUT THREE MILES EAST OF SHILOH BRIDGE, August 7, 1954; in collection of California Academy of Sciences. Topotypical paratype nymphs together with reared male and female adults have been sent to Canadian National collection, to Cornell University, and to G. F. Edmunds, Jr. Twenty-five topotypical paratype nymphs, ten males, ten females, thirty-five nymphal cases and numerous slides in author's collection.

Edmunds and Travers (1954) in their reclassification of the world Ephemeroptera list thirteen valid genera of the subfamily

Baetinae. Of these, but three genera have dipterous male adults with paired intercalaries in the forewing, these three being *Baetiella* Ueno, *Cloeodes* Traver and *Pseudocloeon* Klapalek. As pointed out by Dr. Traver in her paper on the mayflies of Puerto Rico, 1938, the nymph of *Pseudocloeon* has not been reared in the Java type locality for positive association with holotype of the type species of the genus, but nymphs are known to exist in the same faunal region which are similar to those North American nymphs which produce adults that appear identical with the adults of the type species of *Pseudocloeon*. Traver stated in this connection that until the type species has been reared, she proposed to consider the nymphs described from the Nearctic region as representatives of the true *Pseudocloeon*.

The nymph of *Pseudocloeon* has two tails, canines of mandibles blunt and strongly consolidated, and fused into a single unit as in *Baetis*, glossae narrow and tapering as in *Baetis*, and distal segments of the labial palpi rounded, as in Fig. 25. In the specimens that I have examined, I would judge the labial palpi to be three-jointed.

The adults of the genus *Baetiella* from Japan are apparently identical with those of *Pseudocloeon* while the nymphs of the former differ from those of the latter by the bearing of a long hair near the tip of the claw.

The adults of *Cloeodes*, from Puerto Rico, characterized from the type species *C. maculipes*, can be distinguished from other two-winged mayflies of the subfamily Baetinae that have paired intercalaries in the forewing by the very long basal segment of the tarsi of middle and hindlegs. The three-tailed nymph of *C. maculipes* has two-jointed maxillary palpi, canines blunt and strongly consolidated and fused into a single unit, and three-jointed labial palpi, similar in number of segments and quite similar in form to these same parts in *Pseudocloeon*.

Dr. Traver remarked at the time she established the genus *Cloeodes* and selected *C. maculipes* as the type species that other species placed in this new genus (*C. porticensis*, *consignatus* and *sp.*) do not agree with the type as to the unusual length of the basal tarsal joint on the middle and hindlegs, but conform rather to the type of *Pseudocloeon* in this respect. She also wondered if *C. consignatus* and *C. sp.* represented still another genus and what the status of *porticensis* might be.

Through the kindness of Dr. Henry Dietrich of Cornell University, I have dissected and mounted a paratype of *C. portoricensis* and Puerto Rican nymphs collected by Dr. Needham that are identical with those that reared the holotype of this species. The adults of *C. portoricensis* can be separated from those of *C. maculipes* through the proportions of the middle and hindleg tarsal segments; the nymphs of the two species have labial palpi that are completely different in form of the apical segment, and also differ in the number of segments making up these palpi. The maxillary palpi of *C. portoricensis* bear numerous fine hairs or spines while those of *C. maculipes* have none. The nymphal claws of *C. maculipes* are without denticles while those of *C. portoricensis*, described as being without denticles, actually bear 18-20 very fine spines on the basal halves.

The very long first tarsal segment in the middle and hind leg of the type species of *Cloeodes* is the single means by which this genus can be separated from *Pseudocloeon* in the adults, yet this feature does not exist in *C. portoricensis* so that the latter cannot be distinguished from *Pseudocloeon*. The labial palp of the type species of *Cloeodes* is quite similar in form to that of *Pseudocloeon* and that of *C. portoricensis* is entirely different from any dipterous member of the Baetinae. The degree of these nymphal differences indicates a considerable genetic separation and, from the taxonomist's standpoint, only a portion of the genus *Cloeodes* can be keyed to make a separation from *Pseudocloeon* in the adult stage.

Dr. Traver suspected at the time of making the original description, that *Cloeodes portoricensis* should not be considered as belonging to the same genus as *C. maculipes*. It is my conclusion that this is true.

In August of 1954, my wife and I collected on the lower Tuolumne River, nymphs that appear to be identical with the nymphs of *C. portoricensis*; a number of these nymphs were reared and the reared adults show only specific differences from the adults of *C. portoricensis*, these differences being in maculation and form of the penes cover.

On the above basis, I propose the new genus *Paracloeodes*, this genus to presently include the type species, *P. abditus* Day from California and the Puerto Rican species *P. portoricensis* Traver, the latter transferred from *Cloeodes*. Inasmuch as the

adults of *Paracloeodes* cannot be separated from those of *Pseudocloeon*, the nymph of the type species is selected as the holotype.

Remarks on the condition of the lower Tuolumne River will be made in the discussion of the new genus *Apobaetis*, to be described in this paper. Nymphs of *Paracloeodes abditus* were collected on August 7th, 1954 in water of 82° F. and, despite careful search prior to this time, no specimens were taken until this date, when the nymphs were found to be almost or entirely mature. It is probable that the nymphs remain in the deeper and cooler portions of the river until approaching maturity brings them into the depths of four to six inches near the streamside where they were taken. The nymphs are highly selective in their habitat, being found in only a few widely scattered locations in good current and resting on very fine sand.

In the aquarium, emergence of the nymph occurs from about 8:00 to 9:00 P.M., the subimaginal skin is shed during the night, and the mature imago is found alive at dawn. One hour after emergence in the darkened room of the aquarium, a strong light produced no effect on the movements of the subimagos.

Apobaetis Day, new genus

Adult: Very small, male with body 4.0, forewing 4.0, foreleg 4.0 and tails (2) 6.25 mm. long. Female with body 4.75, forewing 4.5, foreleg 2.25 and tails (2) 6.00 mm. long. Hindwings absent. Eyes of male very large, especially long and narrow, 60% longer than wide; contiguous at bases in posterior portions, widely separated in anterior portions; .3 mm. in height when measured up the outer side. Eyes of female one-fourth further apart than their longest axis. Posterior margin of female head slightly produced. Foreleg of male with tibia 1.5 length of femur and tarsus 1.3 length of femur; proportionate lengths of tarsal segments 1 to 5 respectively 1, 14, 10, 6 and 4. Hindleg of male with femur and tibia subequal and tarsus one-half this length; proportionate lengths of tarsal segments 1 to 4 being respectively 4, 3, 2 and 3. Tibio-tarsal joints of male and female entirely fused. All leg segments beset with fine spinules, not to be seen under magnifications of 250-300 ×. Venation of forewing as in figure 18; marginal intercalaries paired. Apical margin of sternite 9 of the female very slightly produced. First segment of male penes large, second and third fused. In the type species, a prominent penes cover as in figure 13.

Nymph: Length of body of male about 4.0, legs 2.0, and tails (3) 1.6 mm. Length of antennae 1.75 length of head. Antero-lateral portions of head deeply cut away, exposing mouthparts; posterior margin straight. Mandibles with canines notably long, sharp-pointed, strongly divided to base into two groups; an extremely large tooth situated above molars on left mandible as in figure 4; area between canines and molars bare; prostheca heavy, divided

at tips and symmetrical. Labrum with straight, unmodified anterior margin as in figure 2, this condition being unique in the entire subfamily Baetinae. Maxillary with body of galea-lacinia unusually light, narrow and graceful; palpi definitely three-jointed, one-half their length extending beyond the tip of the galea-lacinia as shown in figure 5. Labial palpi two-jointed and as shown in figure 6 with distal margin squarely truncate and set with stiff, fine spines; a sharp and deep "V"-shaped slot on inner apical margin. Pronotum three and one-half times as wide as long; posterior margin excavated. Anterior margin of first tergite slotted on anterior margin to receive scutellum of metanotum. Margins of abdominal segments expanded into flat lateral extensions of moderate width. Legs as in figure 27. Tibia and tarsus of equal length, about half that of femur. Claws of all legs very long and fine, fully as long as tarsi, almost straight and without denticles. Gills ovate and single, hyaline white, tracheae dark gray. Three tails of equal diameter, the center tail often as long as laterals; heavily margined with fine hairs of medium length on each side of middle tail and inner sides of laterals.

Type of the genus, *Apobaetis indepressus* Day, new species

***Apobaetis indepressus* Day, new species**

(Figures 1-6 and 13-18)

The morphological details of this species, the type species of the new genus *Apobaetis*, have been give above Features that might be expected to be of a specific nature are as follows:

Male adult: Front, vertex and genae of the head palest brown strongly marked with fuscous. A wide band of fuscous rings the white pit of antennal sclerite. Ocelli set on rather high, fuscous stalks; a band of fuscous between lateral ocelli and a pair of long, ovate fuscous spots on vertex. Scape, pedicle and basal portion of filaments of antennae washed with fuscous. Eyes ringed with narrow stripe of fuscous basally; a short, fuscous stripe half-way up anterior face of each stalk; lower halves of stalk washed with brown. Pronotum dark brown, posterior margin widely pale. Scutum dark brown, sutures black; a small white area on median anterior margin; antecosta fuscous, prescutum white. Scutellum and post-scutellum dark brown with postero-lateral margins pale. A large white area mesad of the scutellum with a pair of small black oval rings in posterior portion. Metanotum dark brown outlined in black, with median and pair of small, pale submedian spots on scutellum. Pleural sclerites small and dark brown, membranous areas white and very wide. Sclerites of venter dark brown, widely outlined in white; fuscisternum and post-fuscisternum entirely white. Trochanter of each leg set in large white area. Abdominal segments 2-6 hyaline white; 1 and 7-10 pale brown. Wings hyaline, veins white; a prominent large brown spot at base. Legs, tails and forceps milky white, translucent. *Female*: Brownish markings much lighter in color, similar in maculation.

Male nymph: Length of body 4.0, legs 2.0, tails (3) 1.6 mm. The morphological features of the holotype nymph have been given in the generic description. The nymph of *Apobaetis indepressus* is dirty whitish in color, touched with but limited areas of dark brown. Entire head white except lateral margins of the labrum which are finely black. Upper portion of develop-

ing adults eyes clearly seen in mature nymph as pale yellow with circles of gray on perimeters. Pronotum white with submedian dark dots near median of anterior margin; short dark stripes on antero-lateral margins; a dark triangular spot in postero-lateral corners. Mesonotum white with dark brown areas in antero-lateral portions; faint brown stripes along anterior margin except in median portion, and on postero-lateral margins. Margins of metanotum widely darkened. A prominent dark brown area above middle and hind trochanters. Venter white. Tergites 1, 4, 5, 7, and 8 white; 2, 3 and 6 washed with dark brown; 9 and 10 palest brown. Tergites 1-4 with fine dark margins along median portion of anterior margins. Fine, dark spinules along all posterior margins. Anterior margin of tergite 1 rather widely and lightly darkened, clearly delineating the wide and deep median slot in this margin. Tergite 2 darkened in median portion; a rounded, large white spot at median on anterior margin, with strong semi-circle of dark smoky around this pale spot; a very dark median stripe extends caudad from dark semi-circle along median line almost to posterior margin. Tergite 3 darkened in median area with darker wide, short submedian stripes on anterior margin. Tergites 4 and 5, 8 and 9 with short dark submedian dashes from anterior margins, and small dark spots laterad of the stripes and on anterior margins, Tergite 6 dark with large very dark spot at median near anterior margin. Pleural fold hyaline white, the spiracle of each segment marked with a large, prominent dark spot. Sternites white, anterior margins of 8 and 9 widely and slightly darkened. Legs white, each femur with tiny dark spot on anterior surface two-thirds distant from base. Claws very long, nearly straight and without denticles. Three white tails of equal length, strongly banded with brown from base to tip on notal surfaces only; in each four tail joints, three contiguous joints are dark marked and the fourth is white.

Holotype: Male nymph, mature; collected by Helen L. Day and W. C. Day on the TUOLUMNE RIVER, STANISLAUS COUNTY, CALIFORNIA, ABOUT SIX MILES east of Modesto, August 14, 1954; in collection of California Academy of Sciences. Topotypical paratype nymphs, together with male and female adults reared from same to California Academy of Sciences, Canadian National Collection, Cornell University and G. F. Edmunds, Jr. Thirty-five topotypical nymphs, fifteen males, fifteen females, forty nymphal cases and numerous slides, in author's collection.

The writer is aware of the taxonomic difficulties occasioned by establishing new genera of Baetinae based on the nymphal forms of the type species, yet there appears to be no practical alternate in properly placing the nymphs of *Apobaetis* and *Paracloeodes*, and I believe it to be of value to make them known to other workers. In the subfamily Baetinae, the specializations and simplifications of the adults are marked by such distinct features as loss of hindwings, loss of wing veins and basal attachments, and loss of

external penes in the male. Absence of such important taxonomic characters might well be expected to make the separation of the adult components of the subfamily more difficult. Baetine nymphs show such simplifications as fusion of the canines and/or labial palpi, two-jointed condition of the maxillary palpi, and total loss or reduced length of the center tail, these simplifications appearing in different combinations in some, but not all genera.

Because of the loss of certain adult characters, it seems to the writer that consideration of the total aggregate of adult and nymphal characters is more than ordinarily necessary in classification of the Baetinae. The work of Traver (1937:75) points up a similar conclusion though based perhaps on other factors. She states that further study of the specialized Baetine group, Neotropical and Palearctic as well as Nearctic, has convinced her that many genera are involved, and that it may not be possible in all cases to be certain of the genus unless both the nymphs and imago are known.

Edmunds and Travers (1954:236) in their recent reclassification of the Ephemeroptera list thirteen valid genera of the subfamily Baetinae, show that seven generic synonymies had been made through 1953, and effected one new synonym. In addition to these, Dr. Edmunds has indicated to me that, in his opinion, three further synonymies are probable in this subfamily. Without the latter three, twenty-one named genera have been reduced by over one-third, which would indicate considerable taxonomic insecurity during the history of the subfamily.

By 1933_A Herman T. Spieth had reached the conclusion that neither the genus *Acentrella* nor *Heterocloeon* were good genera but should be treated as elements of the genus *Baetis*, and this is where they are now placed in the 1954 reclassification by Edmunds and Traver. Dr. Spieth (1933:338-339) comments on the genus *Pseudocloeon* may well foreshadow further changes in the generic classification of the Baetinae, and emphasizes the importance of nymphal characters in the classification of the genera of the Baetinae. He remarked that the genus *Pseudocloeon* is like *Baetis* in every item of nymphal and adult structure that he considered, except that the adult lacks hind wings and the nymph has only two caudal setae.

Dr. Spieth's pertinent comments are as follows: "Considering wing characters alone, a graded series can be found which extends from the condition found in *Baetis parvus* to that found in *Pseudo-*

cloeon . . . It is possible that even *Pseudocloeon* should be considered part of the genus *Baetis*, comparable with the short winged forms known among *Drosophila*, leaf hoppers, beetles, parasitic hymenoptera, gall wasps, etc. (See Kinsey, 1930). Each of the types of reduced wings in these mayfly groups may have arisen by direct and independent mutation from a form such as *B. parvus*. It is not necessary that there has been a gradual decrease in the size of the hind wing. The *pseudocloeon* species may be more closely related to a species of *Baetis* than are two species which are now unquestionably regarded as members of that genus. A thorough and careful working of the whole group with large series from wide localities, plus the correct association of the nymphs with the adults, may throw some light upon the question of relationships and the relative positions of the various species in the evolutionary scheme. Until that time it is necessary to admit that our classification may be and probably is an artificial one, and that it cannot be said with certainty that it represents a picture of the phylogenetic history of the group."

Consideration of the similarity of the morphological details of the nymphs could have played an important part in the synonymy of *Heterocloeon* with *Baetis* by Edmunds and Traver (1954). While the hindwings of the former have not actually disappeared, they are so greatly reduced in size as to appear as tiny threads. It would seem to the writer that *Heterocloeon* could have as logically been included in *Pseudocloeon* as in *Baetis*. In either case, the nymphal evidence of close similarity offsets the difference of the development of the adult hindwings.

In *Apobaetis* and *Paracloeodes* we encounter a reversal of the above situation in that the adult similarities to known genera are not followed by nymphal similarities but by considerable differences; the similarities of the adult are, in fact, denied by the nymphal form. Both adult and nymph of *Paracloeodes* can be separated from the type species of *Cloeodes* but, while the differences of the nymphs are great, I have been unable to find morphological features that will separate the male adults of *Paracloeodes* from *Pseudocloeon*. The most important differences between the nymphs of *Paracloeodes* and *Pseudocloeon* are seen in the number of tails of the nymph, three, not two; relative length of claw to tarsus, 60%, not 35%; type of denticles of the claw, 18-20 fine and hairlike, not 7-8 long and heavy; form of the canines, fine and entirely separ-

ated into two groups, not heavy, blunt and fused into a single mass; prosthema, fine and hair-like, not wide and heavy; shape of galea-lacinia, light and graceful, not heavy, wide and blunt; and the form of the distal segment of the labial palpi, deeply divided into a sharp outer point and rounded inner lobe, not simply rounded.

The male adult of *Apobaetis* cannot be separated from either *Paracloeodes* or *Pseudocloeon*, but the nymph has little morphological resemblance to either. In *Apobaetis* the straight anterior margin of the labrum, with no slightest indication of a median notch, is unique among all genera of the Baetinae. The form of the canines, long and toothless claws, as well as the segments of the maxillary palpi are more like those of the nymphs of *Centroptilum* than any other of the Baetinae.

A chart of the Baetine nymphs (except *Baetiella* which is here regarded as *Pseudocloeon*) that have dipterous male adults with paired intercalaries of the forewing appears as follows:

Nymphs of two-winged mayflies with paired intercalaries of forewing

	tails	claws		canines	max. palp joints	labial palp	
		lgt*	denticles			joints	form †
<i>Pseudocloeon</i>	2	1/3	7-8 heavy, long	fused, blunt	2	3	rounded semi-fused
<i>Cloeodes</i>	3	1/3	none	fused, blunt	2	3	rounded
<i>Paracloeodes</i>	3	6/10	18-20 hair-fine	separated fine, rounded	2	2	divided, point and lobe
<i>Apobaetis</i> ‡	3	equal	none	separated fine, pointed	3	2	square, notched

* relative length, claw to tarsus

† form of distal margin, apical segment

‡ no median notch, anterior margin of labrum

I have no hesitancy in proposing the new genus *Apobaetis* on the single species *A. indeprensus* as it would seem most likely that further collecting with the requisite equipment should yield additional species. We now have *Paracloeodes* from California and Puerto Rico and Traver's *Baetine* No. 1 from California and Brazil, and it seems reasonable to assume that these forms are to be found somewhere in between these distant points. However, if only the

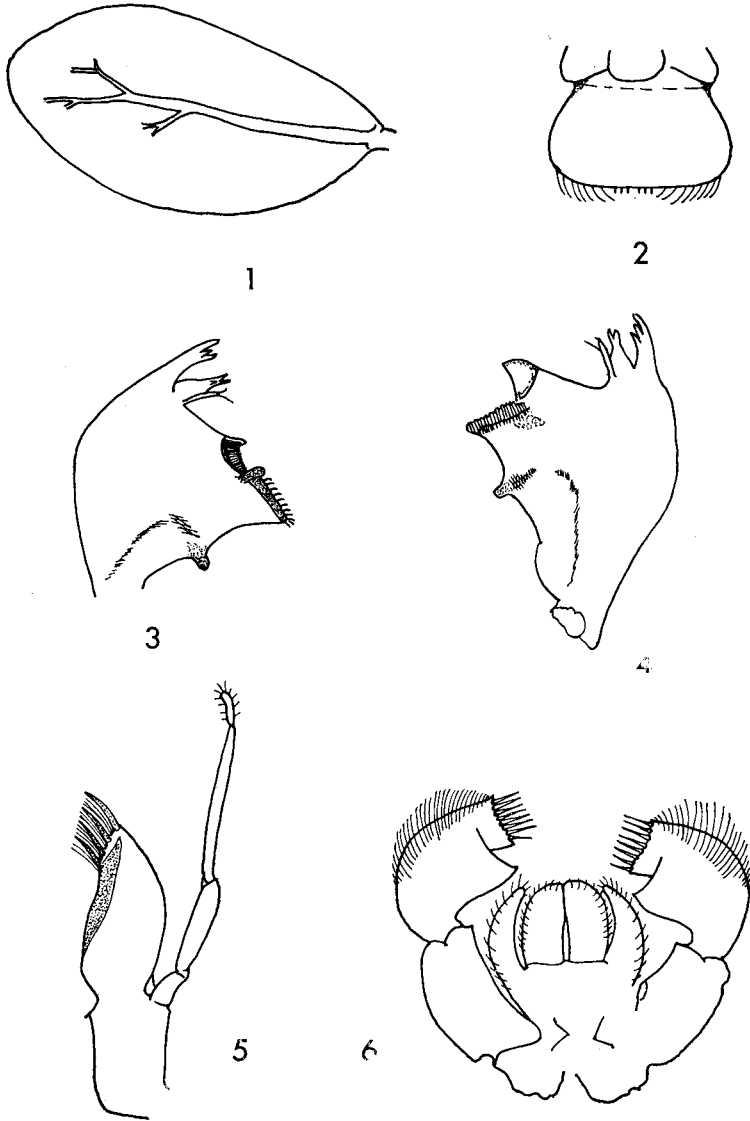
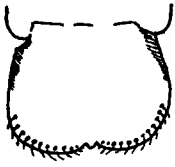
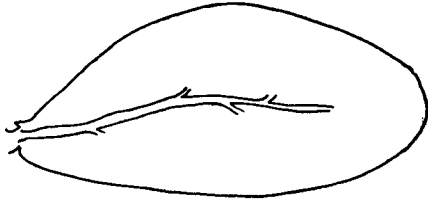


PLATE I

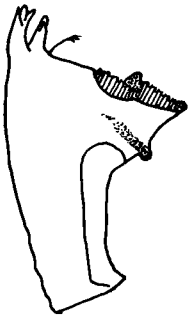
Figures 1-6, *Apobaetis indepressus*, paratype nymph. Fig. 1, Third gill. Fig. 2, Labrum. Fig. 3, Right mandible. Fig. 4, Left mandible. Fig. 5, Right maxilla. Fig. 6, Labium.



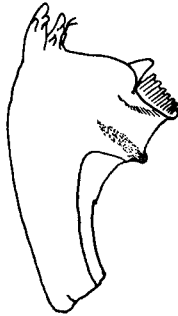
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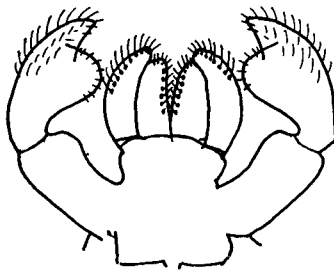
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PLATE II

Figures 7-12, *Paracloeodes abditus*, paratype nymph. Fig. 7, Labrum. Fig. 8, Third gill. Fig. 9, Right manible. Fig. 10, Left manible. Fig. 11, Left maxilla. Fig. 12, Labium.

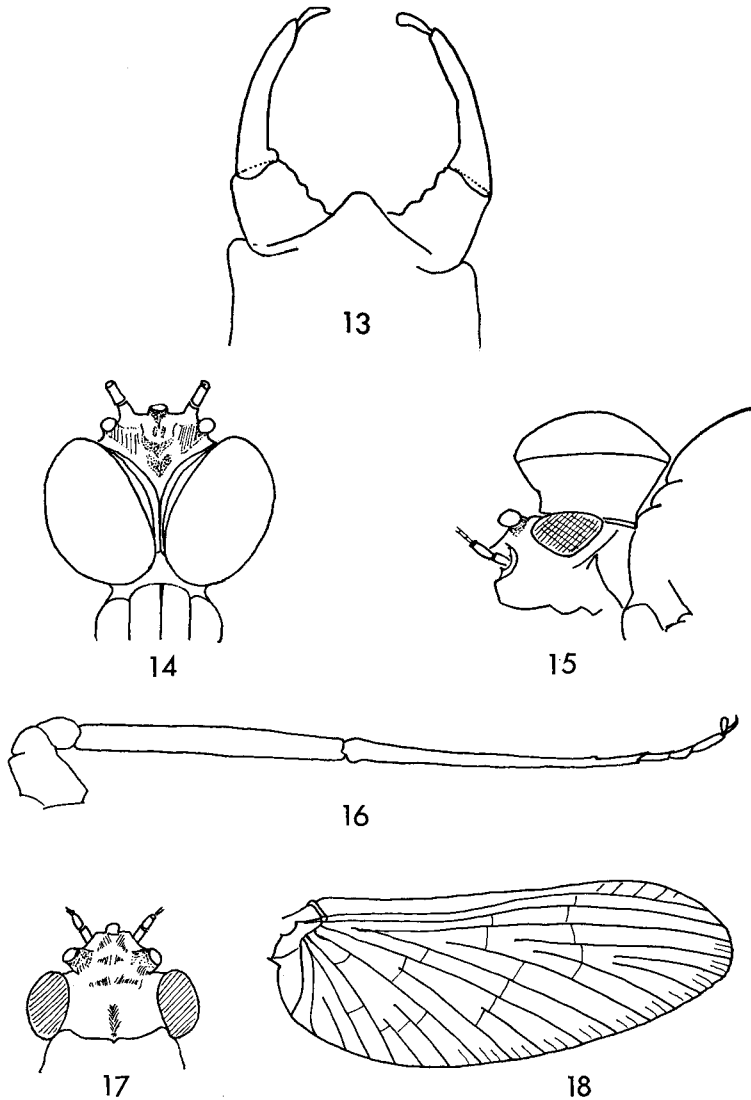


PLATE III

Figures 13-18, *Apobaetis indeprensus*, adult. Fig. 13, Male genitalia, ventral aspect. Fig. 14, Male head, dorsal aspect. Fig. 15, Male head, lateral aspect. Fig. 16, Male hindleg. Fig. 17, Female head, dorsal aspect. Fig. 18, Male wing.

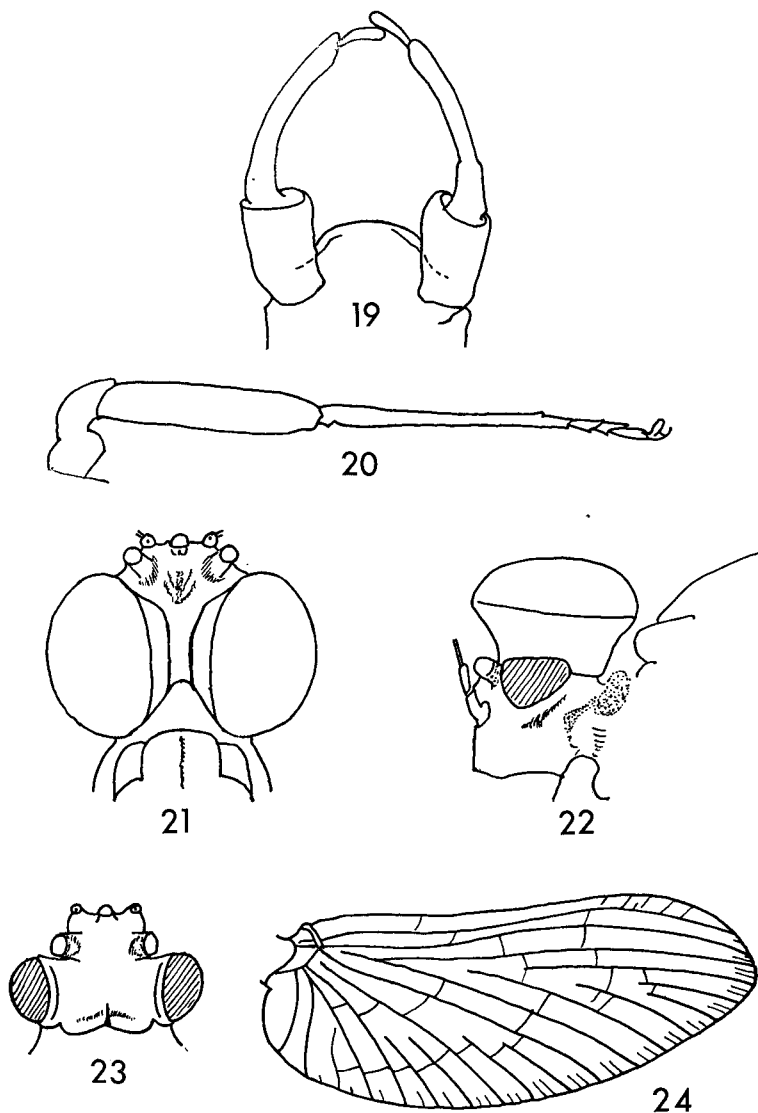


PLATE IV

Figures 19-24, *Paracloeodes abditus*, adult. Fig. 19, Male genitalia, ventral aspect. Fig. 20, Male hindleg. Fig. 21, Male head, dorsal aspect. Fig. 22, Male head, lateral aspect. Fig. 23, Female head, dorsal aspect. Fig. 24, Male wing.

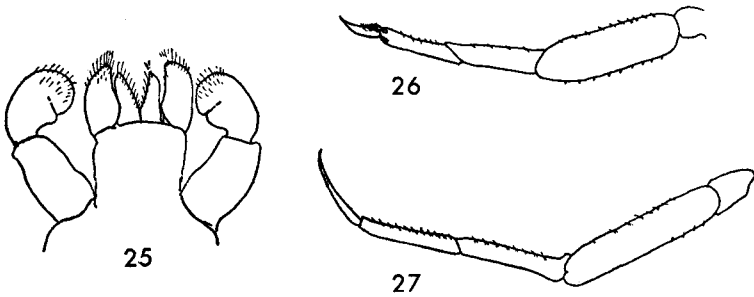


PLATE V

Fig. 25, Nymphal labium, *Pseudocloeon carolina*. Fig. 26, Nymphal foreleg, *Paracloeodus abditus*. Fig. 27, Nymphal foreleg, *Apobaetis indeprensus*.

adults of *Apobaetis* or *Paracloeodes* were taken, they would undoubtedly be labeled as *Pseudocloeon*; if only the adults of *Baetina* No. 1 were taken, they would be classified as an ordinary species of *Baetis*. It is quite possible that nymphs of *Apobaetis* and *Paracloeodes* have not been previously collected because the ordinary equipment used for taking nymphs is unsuitable for collecting these tiny specimens.

The nymphs of *Apobaetis* and *Paracloeodes* are small and elusive as well as pale and most difficult to find on the collecting screen. To take these nymphs we found it necessary to employ a 26 mesh screen of small enough area that the whole screen could be partly immersed in a large white enameled pan half-filled with water. Here the nymphs can be located only by their movements.

The nymphs of *Paracloeodes abditus* and *Apobaetis indeprensus* are warm water species showing remarkable ability to survive under highly marginal conditions. The lower Tuolumne River has been dredged, diverted and dammed, and has suffered pollution from irrigation run-off, crop-dusting, sewage and industry. In early June of 1954 water temperatures had risen to 75° F, in July 80° F., and in August 82° F.; very few mayfly genera were encountered apart from the Baetinae, and representatives of these were found in very small numbers.

Less damaged streams of similar origin and type of location in California are rich in mayfly species and other aquatic fauna. From all indications the lower Tualumne River was at one time heavily populated with a wide diversity of mayfly species, and the remaining Baetinae represent the forms whose specializations have

been successful in permitting continued existence in the adverse situation now encountered.

Apobaetis nymphs, like those of *Paracloeodes*, were found in small groups over widely scattered areas, the former at depths of 18-24 inches in rather fast runs of water over fine sand, and the latter in much more shallow water.

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