

A REVISION OF THE BAETIDAE WITH SPATULATE-CLAWED NYMPHS (Ephemeroptera)^{1,2}

By Jay R. Traver and George F. Edmunds, Jr.³

Abstract: The Baetidae whose nymphs have spatulate claws are revised and considered as representing 3 genera, one of which is left unnamed. The following are described: *Camelobaetidius mantis* from Brazil, *Dactylobaetis* (n. g.) *warreni* and *D. cepheus* from western United States; *D. arriaga*, *D. chiapis*, *D. jenseni*, *D. mexicanus*, and *D. musseri* from Mexico; *D. zenobia* from Honduras; *D. anubis*, *D. phaedrus* and *D. serapis* from Brazil; *D. cayumba* from Peru; and *D. penai* from Argentina. Details of the nymphal structures are compared with the genus *Baetis* (s. l.) and a classification and terminology of mouth parts are presented that could have broad application in Baetidae. Keys are given for known male imagos and nymphs of the species.

The Baetidae of the Americas are more diverse than can be realized from published reports. Among these are 3 types of nymphs with peculiar flattened or spatulate claws whose special function is unknown. The spatulate claws are of 2 types representing 2 separate phyletic lines. This paper is primarily concerned with 1 assemblage of species that is clearly monophyletic as attested by numerous nymphal characters, especially of the mouth parts and the claws. This group is known from one fairly large and widespread cluster of species for which we propose the generic name *Dactylobaetis*, in allusion to the finger-like denticles on the claws of the nymphs, and a smaller apomorphic sister-group with a more restricted range for which Demoulin (1967) has recently proposed the name *Camelobaetidius*.

Genus *Dactylobaetis* Traver and Edmunds, new genus

Baetine No. 1 Traver, 1944, Bol. Mus. Nac. n.s. Brasil, Zoologica 22: 24

1. The research on which this paper is based was supported by a grant from the National Science Foundation.
2. This paper was submitted for publication before the genus *Camelobaetidius* was described by Demoulin (1967, Dec. 31), and by April 1968, when we learned of the Demoulin paper, the editor had sent our paper to the printer. We had considered all of the new species described herein as belonging to a single genus, although one of them, *mantis*, was regarded as highly distinct from all of the others. The genus *Camelobaetidius* Demoulin has as its type, and only species, a species closely related to *mantis*. We have concluded that two genera should be recognized and have made such revision as is necessary with the consideration of keeping typesetting changes to a minimum. This has necessitated the rewriting of several paragraphs, modification of others, and addition of a discussion of *Camelobaetidius*. This approach has left the paper relatively intact and, hopefully, not outdated by the description of *Camelobaetidius*. Nevertheless, there are some irregularities which we hope will not detract from the paper.
3. Respectively, Emeritus Professor of Zoology, University of Massachusetts, Amherst, and Professor of Zoology and Entomology, University of Utah, Salt Lake City.

Baetis sp. Day, 1955, Pan-Pacif. Ent. **31** (3): 121. - Edmunds & Musser, 1960, Univ. of Utah Anthropol. Pap. No. **48**: 118. - Illies, 1964, Verh. Internat. Verein Limn. **15**: 1079, 1081.

Genus nr. *Baetis* sp. Roback, 1966, Monogr. Acad. Nat. Sci. Phila. **14**: 136, 166-67, fig. 70-75.

Imago: Stalks of the turbinate eyes are short to medium in height. Fore wings with paired marginal intercalaries, except none in subcostal spaces; opaque and granular in apical costal and subcostal spaces; stigmatic cross veins simple, slanting and few in number. Hind wings with 2 veins only; costal projection acute and broadly based; anterior margin of projection beyond apex more or less undulate. Genital forceps of ♂ quite broadly separated basally.

Nymph: Generally similar to *Baetis*. Mouthparts somewhat *Baetis*-like as discussed in detail below. Legs usually short and stout. Short thread-like gills may be present on thorax near base of fore legs. Fore legs usually longer than other pairs. Tarsi distinctly bowed. Claws flattened, with 5 to 40 or more apical denticles. Simple obovate gills borne on abdominal segments 1-7, the 1st and last pairs smaller. Three caudal filaments present; the median terminal filament 3/4 to almost as long as cerci and fully as stout as cerci in most species.

Type species: *Dactylobaetis warreni* Traver & Edmunds, n. sp.

Dactylobaetis (as Baetine No. 1) was first characterized by Traver from a single immature nymph taken by Dr H. Kleerekoper from a brook in the State of Minas Gerais, Brazil. "The legs short, rather stocky; tarsus somewhat bowed. Claw very peculiar; appears flattened and truncate at tip, shaped like tip of a spatula, the truncate portion set with fine spines." However, these odd claws are more similar to a fan-shaped garden rake or to a comb than to the tip of a spatula. In 1954, the late W.C. Day and his wife collected from the Tuolumne River near Modesto, California some odd baetine nymphs "having bowed tarsi with distal truncate, spatula-like appendages armed with one large and eight or nine lesser claws." Day (1955) states that 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". Although Day had not published a description of this species before his death, he had designated it by the manuscript name of '*Baetis warreni*', honoring Charles Warren who had been of great assistance to the Days in their collections of specimens from the Tuolumne River, California. For this reason we are naming this species in honor of Mr Warren, as we believe Mr Day would have approved, and designating it as the type species of *Dactylobaetis*.

Edmunds & Musser (1960) reported (as *Baetis* sp.) nymphs "of an apparently undescribed species having peculiar flattened claws with a truncate comb-like distal margin;" these nymphs as well as adults believed to be of the same species were taken in the Green River at Hideout Springs Forest Camp in Utah. These authors report similar nymphs from the Colorado and Virgin Rivers in Utah and from the Green River in Sweetwater Co., Wyoming. Illies (1964) figured a nymph of *Dactylobaetis* (as "unknown Baetid genus") from the Rio Huallaga at Tingo Maria, Peru. This may perhaps be *D. cayumba* or an allied species. In 1964, another species of *Dactylobaetis* from Honduras was reared by J.S. Packer, a graduate student at the University of Utah. Roback (1966) figured portions of a nymph of *Dactylobaetis* (as "genus nr. *Baetis* sp") from the Rondos and Huallaga Rivers, Peru. Mexican comb-clawed nymphs and some adults of the same genus were collected in 1939 and 1940 by Dr Lewis Berner of the University of Florida,

and presented to one of us (JRT) for study. In addition, we have had available for study many other specimens of nymphs in the collection of the University of Utah, likewise a large series of adult males from Idaho, three such series from Chiapas Province, Mexico, collected by P. J. Spangler, and many nymphs and reared imagos from Argentina, collected by Luis Peña. Collections where specimens are deposited are indicated by the following abbreviations: University of Utah (UU); U.S. National Museum (USNM); California Academy of Science (CAS); University of Idaho (UI); personal collection of Lewis Berner (LB); personal collection of Jay R. Traver (JRT).

This genus occurs only in the Western Hemisphere from Central Oregon, Central Idaho and Southern Wyoming south to Uruguay, SE Brazil and Central Argentina. The known intermediate distribution includes diverse localities in California, Utah, Costa Rica, Guatemala, Honduras, Mexico, Canal Zone and Peru. The known nymphal habitats are diverse, but all known collections are from rocky streams; these streams are usually somewhat silty, at least during part of the year. In the Western United States all the streams where the nymphs occur are silted and reach relatively high summer temperatures with daytime samples ranging from 15.5°C (60° F) to 29.5°C (85°F). The streams have "warm water" fish fauna, with none of them being trout streams. Increased silt loads are causative of higher stream temperatures, and the northward extension of *Dactylobaetis* may be limited to silted streams because they do reach suitably high temperatures. It is of interest to note that the genus is uncommon in collections we have examined from the lower elevations of the Amazon basin, and that where it occurs, accompanying ecological notes indicate the presence of rocks or waterfalls.

In addition to the type species, 10 others are known in the adult stage. Imagos of 7 species are named and described herein; 2 groups are considered briefly as probable allies of named species, the remaining 2 groups are described but designated only as sp. A and sp. B respectively. It is deemed best *not* to name either of the last group at the present time, for these reasons. Adults of sp. A were taken at the same time and place as the nymphs designated as *D. mexicanus* n. sp.; adults of sp. B were also collected at the same time and place as nymphs described as *D. musseri* n. sp. It is conceivable therefore that rearing studies may prove them to be, respectively, adults of the 2 species known from nymphs. Nymphs of 10 species are described in this paper, 4 of these being the immature stages of *D. warreni*, *D. zenobia* and *D. penai*, plus the presumed nymph of *D. cepheus*; the remaining 6 species are known at present only in the nymphal stages. Many nymphs other than those described have been studied. In several instances these are commented upon and briefly characterized as probable allies of one of the named species. Again, several which seemed allied to one another but not to any described species are dealt with as members of a group, designated as Groups A, B, C or D.

Generic concepts in the family Baetidae are unsatisfactory in the present state of our knowledge. Before any fundamentally sound natural classification can be arrived at, it will be necessary to study many more reared species of Baetidae and to make careful search for additional useful characters in the adults and the nymphs. It is evident even in our present state of knowledge that several of the currently recognized "genera" (based on adult characters) have 2 or more distinct types of nymphs. Some of these types of nymphs are so extremely distinctive that generic rank for the group seems essential for an orderly and natural classification arrangement. There is also the problem that some of

the genera which differ largely in the presence or absence of hind wings have similar nymphs. One of us (Edmunds) has seen 2 species where hind wings were present in only 1 sex.

Such problems of classification are particularly evident in the *Baetis-Pseudocloeon* complex. Day (1955) established the genera *Paracloeodes* and *Apobaetis* because of the morphological distinctiveness of the nymphs, even though the adult would appear to be typical members of *Pseudocloeon*. The nymphs of the genus *Dactylobaetis* similarly are very distinctive, but the adults closely resemble typical members of *Baetis*. Since the nymphs appear to have good morphological features which allow them to be separated into apparently distinct species and the adults are relatively less known and sparsely available in collections much as in the large and diverse genus *Ephemerella* (Ephemerellidae), it seems permissible to name and describe certain groups of *Dactylobaetis* as new species, even though only the nymphal stages of such groups are known. This has been done only if (1) a considerable number of nymphs having similar structural features and an over-all likeness in abdominal patterns has been available for study, or if (2) in some small sample only, certain morphological characters set this group apart from others. It is quite probable that still other species are represented by as yet unnamed groups of nymphs which are here mentioned briefly but not described as new species.

CHARACTERS OF DACTYLOBAETIS, WITH NOTES ON BAETIS (S. 1)

The imago

Generic features are drawn from the reared specimens of *Dactylobaetis warreni*, *D. zenobia*, *D. penai*, and from adults taken in Idaho and Mexico but not associated as yet with the nymphal stage. Turbinate eyes of the male imago are large in some species, of small to medium size in others, set on stalks of short to medium height; these stalks almost contiguous at base, but in some species diverging dorsally so that the eyes appear well separated. In dorsal aspect, the eyes may appear either ellipsoidal or hemispheroidal in shape. Two pairs of wings present. The fore wings are opaque and granulated in the apical and subcostal spaces. Stigmatic cross veins are generally simple, slanting and few in number. No intercalary present in the 1st (subcostal) interspace; paired intercalaries in the other interspaces along the outer margin (fig. 1). Hind wing 2-veined; faint indications of a few cross veins are evident in some specimens. Costal angulation present, rather acute, and broadly based; followed distally in many but not all specimens by a slight depression, and this by a 'humped' area which in turn precedes a slightly depressed area; angulation and hump may appear granular. About opposite the costal angulation is a concave area on the posterior margin. Hind wings of males are generally rather blunt to rounded at the apex; those of females are relatively narrower and longer than in males. Fore wings of females are longer and more pointed at the apex. Hind wings of 9 species are figured (44-47, 49, 51-53, 71).

Fore legs of males are approximately 1 mm shorter than the fore wings. Femora of all legs of both sexes shorter than the tibiae. Tibia I twice or more the length of the femur in male, ca. 1/3 longer than femur in female; tarsus ca. half as long as tibia in both sexes. Leg II slightly longer than leg III in both sexes; femora longer than tarsi; tibiae slightly longer than femora. In leg III in both sexes: tibia equal to or slightly longer than femur, tarsus ca. half as long as tibia. Tarsal segments of leg I of male, in decreasing order: 2, 3, 4, 5, 1; or 2, 3, 5, 4, 1; in female, 5, 2, 3, 4, 1. Tarsal segments of legs II and III in both sexes, in decreasing

order: 4, 1, 2, 3. Basal tarsal segments of legs II and III in both sexes are so completely fused with the apex of the tibia that it is often difficult to determine the exact line of contact, which appears as a slight narrowing of the tibia. This line of demarcation is thus much less clearly defined in *Dactylobaetis* than in *Baetis*, *Callibaetis* and *Centroptilum*.

The forceps of the male are quite widely separated basally. The proximal segment, rather short in most species, bears a blunt projection at the inner apical margin. The longer 2nd segment which follows is more or less swollen basally, then narrows for a distance, only to become wider toward the apex; the distal segment is moderately long. The forceps seem to be intermediate between the so-called *moffati* and *intercalaris* types as these terms have sometimes been employed for the genus *Baetis*. Three membranes extending between the proximal segments of the forceps are evident in most species. The most ventral of these is convex apically, chitinized and set with fine spines; it passes dorsad of the proximal segments to its attachment near the outer margins of these segments; it represents the 'penis cover'. The other 2 membranes, both of which lie dorsad to the 'penis cover', are non-chitinous and attached respectively to the inner margins of the proximal segments. That membrane lying nearest to the 'penis cover' is normally concave on the apical margin; the most dorsad membrane is slightly convex apically but with a slight depression at the mid-line. The "penes" are quite prominent, their tips oriented toward the mid-line between the proximal segments of the forceps. Sperm ducts somewhat convoluted in shape, push up apically along the inner margins of the "penes", seeming to lie alongside but not within them (fig. 74). When sperms are discharged, the "penes" are pushed apicad by the sperm masses, forcing the 2 non-chitinous membranes before them, but the relative position of the 'penis cover' is not changed (fig. 72). Sperms can be seen to extrude near the mid-line of the inner non-chitinous membrane; no opening is visible at the tips of the "penes", which therefore are "penes" only by conventional terms. Grandi (1960) summarized the condition of the "penes" and genital ducts in the Baetidae, as compared with these features in several other families of Ephemeroptera. Figures of the genitalia of 8 species of *Dactylobaetis* are presented, showing these 3 membranes, the "penes" and the sperm ducts (fig. 4-5, 59-60, 62-63 66-68).

Although the adults of *Dactylobaetis* are similar in general to those of *Baetis*, the shape of the costal projection of the hind wing and the relatively broad basal separation of the forceps seem to distinguish this genus from those species of *Baetis* with only 2 veins in the hind wings. Until a larger number of species of *Dactylobaetis* have been accurately associated in the nymphal and adult stages, this cannot be determined with a reasonably high degree of probability.

The nymph

Body stream-lined, of the typical *Baetis* type. Head hypognathous; mouthparts rather typically baetine. Details of the structural features of the principal mouthparts are here discussed at some length, and illustrated by many figures, as indicated. In comparisons made between *Dactylobaetis* and members of the genus *Baetis* (s. l), the latter genus is considered in its widest sense, including *Acentrella* and *Heterocloeon* which have been placed by most workers in synonymy with *Baetis*. The terminology used in this paper to designate various forms of modification of the incisors of the mandibles (called canine region in many publications on Ephemeroptera), the maxillary palpi, the labrum and the labium are probably applicable not only to *Dactylobaetis* and *Baetis*, but likewise to all members of the family Baetidae, although only those of the *Baetis-Dactylobaetis* complex are considered here. The nymphs of many species of *Baetis* have been described from many parts of the world and details of nymphal structures well illustrated. For purposes of comparison and as illustrations of the modifications of

mouthparts in particular, only a few papers are cited here, out of the many that might have been chosen. Reference is made to the following papers: Berner (1953); Burks (1953); Demoulin (1956 and 1965); Eaton (1885); Esben-Petersen (1912); Grandi (1949 and 1960); Harker (1954); Ide (1937); Kapur & Kripalani (1963); Kimmins (1938 and 1955); Macan (1961); Needham & Murphy (1924); Ulmer (1939).

Details of the labrum: Along the apical margin of the dorsal surface is a fringe of long slender hairs set close together. A short distance back from this margin and often more or less parallel to it are several to many much longer and stouter spines; groups of very small spines are scattered here and there in the central and subcentral portions and near the basal margin; laterally, marginal and submarginal spines occur, these also usually long and stout. Macan (1961) shows how the pattern of spines on the dorsal surface of this organ serves to differentiate 4 different English species of *Baetis*. Taking his work as a cue, it is possible to place most of the known *Dactylobaetis* and many species of *Baetis* in the following categories, for this purpose utilizing mainly the large spines set back from the apical margin. The large spine near and somewhat below the mid-apical indentation is here designated the *central* spine; laterad of this are the *laterals*, variable in number and arrangement. Between the central and the laterals and at a somewhat lower level, a smaller spine is often present, termed the *intermediary*. To facilitate the descriptions, several groups and subgroups of arrangements of spines on the labrum have been distinguished. The descriptions of number and arrangement of spines refer to those on 1 side of the mid-line of this dorsal surface. In Group I: 1 central and 2 to several laterals are present. I A: spines quite evenly spaced, with no considerable distance between the central and the nearest lateral; no intermediary present. I A (1): central forming with the 1st 3 or more laterals a relatively straight line, as in *Baetis sogeriensis* Harker (Harker 1954: 262, fig. 75), in which 3-4 laterals only are present (fig. 31, modified from Harker). In *Dactylobaetis phaedrus* 5 laterals are in line with the central, 3 others in a curved line near the margin (fig. 36.) I A (2): central and laterals together are arranged in a curved line: *B. peruvianus* Ulmer (Needham & Murphy 1924: fig. 174, pl. XIII), 3 laterals present; *B. chandra* Kapur & Kripalani (1963: fig. 9a), in which ca. 12 laterals are shown; and Demoulin (1965), *Baetis* sp. No. 1, with 17-18 laterals (p. 95, fig. 1b). Here seems to belong a single specimen of *Dactylobaetis* from Lago Santa Clara, Brazil, having 8-10 laterals (fig. 30). Group I B: a relatively wide space occurs between the central and the nearest lateral; intermediary spine may be present or absent. Laterals may be arranged in a straight line, but are more often in an irregular staggered line, or a distinctly curved and/or oblique arrangement. I B (1): laterals are *not* set on a ridge. Many *Baetis* are of this type, including *B. rhodani* (Pict.) as shown by Macan (1961, p. 38, fig. 23e); *B. pavidus* Grandi as *parva* (Grandi, 1949: p. 293, fig. VI 7); *B. maurus* Kimmins (Kimmins 1938: p. 304, fig. C); 4 nymphs described by Demoulin (1965) as *Baetis* sp. No. 2-5, p. 96, 98-100, fig. 2b-5b. Most *Dactylobaetis* are of this type; fig. 39 shows the intermediary absent, while in fig. 32 an intermediary is present. The numbers of laterals vary as much as their arrangement, hence this division lends itself to further subdivision. I B (2): as in I B(1), except that the laterals seem to be set on a ridge or fold; *Dactylobaetis musseri* from Central America has this arrangement (fig. 34). In Group II: no central spine is present; several to many laterals, usually in a curved row, *not* set on a ridge or fold. *Baetis simplex* Kapur & Kripalani (1963: 208, fig. 12a) has this type, reproduced in fig. 40; likewise 3 nymphs described by Demoulin (1956) as *Acentrella* sp., *Baetis* sp. A and *Baetis* sp. B (p. 6, 8 and 10; fig. 2f, 3f, and 4f). Still other modifications which do not conform to any of the above categories occur in some species of *Baetis* and *Dactylobaetis*. (a) Two or 3 intermediary spines may be present between the central and the nearest lateral, as in *Baetis pumilus* (Burm.), figured by Macan (1961, p. 38, fig. 23b). (b) Instead of a single central spine, a pair of these are set close together, as in some *Dactylobaetis*. (c) The condition shown by Macan (1961: 38, fig. 23d) for *Baetis atrebatinus* Etn., in which no true central spine is present; laterad of its position if

present, 1 short and 1 longer spine serve as intermediaries, and laterad of these 2 a closely-set group of longer spines arising from a ridge or fold, seeming to be connected basally. Probably other arrangements of spines not listed will be found.

Details of the mandibles: In both *Dactylobaetis* and *Baetis* (s. 1) the incisor region of the mandibles shows a distinct tendency toward the compaction of the inner and outer incisors into a single lobe which may still show faint indication of its original elements. The *basic* condition in certain other genera of the family Baetidae shows the inner incisor separated completely from the outer, each arising independently, with at least a minute space intervening basally between them. This condition is well illustrated by Eaton (1885) for *Centropilum*, pl. 46, and for *Callibaetis*, pl. 48 (see fig. 56 for this condition in *Callibaetis*). In some species of *Baetis*, separation of the inner and outer incisors is partial only, the inner appearing to arise from the same base as the outer, although separated at least in part from the outer in its upper portions. This condition we have termed *pseudobasic* (fig. 57). Eaton shows this for *B. rhodani* (1885: pl. 44); see also the right mandible of *Baetis* sp. A (Kimmins 1955: p. 869, fig. 4c). Incisors of 1 mandible may be in the *pseudobasic* condition, whilst incisors on the other mandible of the same nymph may show partial compaction. Both of the references cited above show this to some extent. We have seen no specimens of *Dactylobaetis* that exhibit either the *basic* or the *pseudobasic* condition; in all of these, the incisors exhibit some degree of compaction. Many species of *Baetis* likewise exhibit various grades of compaction of the incisor region similar to conditions found in *Dactylobaetis*. In any grade of compaction, in either of these two genera, the apical portions of the incisors may appear truncated; may be pushed upward into a conical structure; or still further modified into a pyramidal form.

In what we term Grade I of compaction, the outer and inner incisors are fused together. The line of fusion may still be apparent, but becomes increasingly more difficult to ascertain as compaction is more complete. The visible number of denticles, 8 in the early phases, is reduced to 7 and finally to 6. One denticle near the center, or 1 on the inner margin, may be much reduced in size or appear partially fused with its neighboring denticle. The fusion of denticles appears to be more complete in the outer incisor; here also the outermost denticle may be "set back", to use Macan's expression (fig. 84). Many *Dactylobaetis* exhibit various phases of Grade I compaction. Species of *Baetis* which show 1 or both mandibles of Grade I are illustrated in many articles: *B. rhodani*, left mandible (Eaton 1885: pl. 44., fig. 8); *B. atrebatinus*, *B. niger* (L.), *B. pumilus*, *B. scambus* Etn. and *B. rhodani* (Macan 1961: 40, fig. a-e); *Baetis* sp. B (Demoulin 1956: fig. g and h); *Baetis* sp. (Esben Petersen 1912: 342, fig. 13c); *B. sogeriensis* (Harker 1954: 262, fig. 77); and *B. maurus* (Kimmins 1938: 304, fig. A). In Grade II, the fusion of denticles of the outer incisor is complete or nearly so, while those of the inner incisor are still distinct, at least at the tips. Some species of *Dactylobaetis* exhibit this grade; fig. 87 shows the beginning of fusion. Illustrations of *Baetis* with incisors of Grade II include: *Acentrella* sp. A and *Baetis* sp. A (Kimmins 1955: 869, fig. b and p. 870, fig. b); and *B. pavidus* as *B. parva* (Grandi 1949: 293, fig. 2). Denticles of the incisors of Grade III are completely fused except that the innermost denticle of the inner incisor may still be free at the tip. A few *Dactylobaetis* have incisors of this type (fig. 43). Some species of *Baetis* which exhibit this grade are: *B. chandra* and *B. simplex* (Kapur & Kripalani 1963: 304, fig. c, d, f and g; and p. 208, fig. b, c, d and e); *B. maurus* (Kimmins 1938: 304, fig. B); and *B. pavidus* as *B. parva* (Grandi 1949: 293, fig. 1). Among nymphs of *Baetis* now in the personal collection of Traver from the Himalayas are 3 species which show this total compaction. These were listed (Traver 1939) as "specimens of the genus *Baetis*" but no figures of any of them were published. In some species which have incisors in Grade III there is still an indication, though frequently very faint, of the numbers of denticles entering into this stage of fusion. In others, not a trace of this can be seen, fusion is total.

A second line of modification of the mandibles occurs in some members of *Dactylobaetis* and *Baetis*. The molar surface of the left mandible tends to assume a position more nearly parallel

to the apical margin than is customary, so that in this respect it comes to look rather like the right mandible (fig. 43). While this condition is seen quite frequently in species having advanced Grade II or Grade III compaction of the incisors, there may be no actual correlation between these 2 conditions. The thumb-like process basad of the molar region on the left mandible varies from short and thick in some species, to long and slender in others (fig. 43). The prostheca (or lacinia) is well developed on both mandibles in *Dactylobaetis*, differing somewhat on the 2 but seems never to be so markedly reduced in size as in some species of *Baetis*, in which this structure on 1 of the mandibles may be represented only by a single slender process which may have a number of very short spines at its tip (Harker 1954: 262, fig. 78), or again by a few long hairs only (Macan 1961: 40, fig. 24d).

Hypopharynx as in fig. 8.

Details of the maxilla. The body of the maxilla varies in different species of *Dactylobaetis* in terms of relative lengths of upper and lower portions. The distance from the tip of the crown, or a point directly opposite it, to the proximal end of the galea adjacent to the upper edge of the palpifer as measured along the outer margin, is here called the upper region. The distance from this latter point to the base of the stipes at its union with the cardo is designated as the lower region. In most species of this genus, the upper and lower regions are approximately equal in length (subequal type, fig. 55). In a few species only, the upper may exceed the lower in length (long type, fig. 58). For purposes of measurements, the maxilla must lie flat on the slide. In all specimens of *Dactylobaetis* that we have seen the maxillary palpi are 2-segmented beyond the short palpifer; the same appears to be the case in the majority of species of *Baetis*, although a few may have 3-segmented palpi. It seems possible to recognize 2 main types of maxillary palpi, each with several to many variations. Palpi of the first type are of relatively even width throughout (fig. 58); many species of *Baetis* have this type, and also a few *Dactylobaetis*. In palpi of the second type, the basal segment is distinctly wider than the distal and often appears twisted or curved (fig. 35, 27 and 55); this segment may be uniformly wide or wider in 1 portion only. Palpi of this type are the usual ones among species of *Dactylobaetis*. In either type, the palpi may be slender or stocky; the distal segment may be equal to, shorter or longer than the basal. Examples of many of the variations of these types of palpi in the genus *Baetis* will be found in the articles cited under discussions of the labrum and mandible.

Details of the labium: Glossae and paraglossae are quite variable in actual width and length and in the relative dimensions of each of these parts to the other. In both *Baetis* and *Dactylobaetis*, some species have long glossae and paraglossae with equivalently long palpi (fig. 42); in others, these structures appear short and robust (fig. 33, 41). On the dorsal surfaces of the paraglossae near the apex, a row of spines occurs. The ventral surfaces of the glossae have a few scattered spines. The labial palpi are 3-segmented, the distal segment usually short, often incompletely separated from and narrower than the 2nd or penultimate one. The shape of the dilation which is generally present on the inner apical margin of this 2nd segment has been used extensively as a specific character in the Baetidae. Illustrations of the above features in various species of *Baetis* are given in the several references listed in discussion of the labrum and mandible. For still other figures of the distal portion of the palpi see: *Baetis javanica* Ulmer (Ulmer 1939: fig. 352); *Baetis spinosus* McDunnough and *B. intercalaris* McD. (Berner 1953: 50, fig. 58 and 59); 4 species of *Baetis* (Burks 1953: 115, fig. 258, 259, 261 and 262); and 13 species of this genus (Ide 1937: pl. 8-10). Figures of the labium in part or in whole are given herein for the principal types which occur in *Dactylobaetis* (fig. 33, 41 and 42); variations of the labial palpus are shown in fig. 54, 76, 77, 81, 82 and 85.

Thorax: In most species the legs are relatively short and stout; in only a few of them are the legs slender and rather long in proportion to the body length. Leg I is longer than leg III in the majority of species. The femur is longer than the tibia on legs I and III, in most spe-

cies; in a few others, the tibia may be subequal to or slightly longer than the femur, usually on leg I, rarely on leg III. The tarsus is considerably shorter than the tibia; tarsus I is usually longer than tarsus III. A rather close-set fringe of long spines seems always to be present along the posterior margins of the femora. The articulation area at or near the apex of the femur is very well developed. Short spines may be present on or near the anterior margin; others may be scattered over the dorsal surface. On the tibia, widely spaced short stout spines occur along the anterior margin, and often in 1 or more rows set back from this margin; 2, 3 or several long strong spines are present at the apex in many species, often with groups of delicate curved hairs interspersed between them; there is often a fringe of long delicate hairs on the posterior margin, sometimes interspersed with short spines. Several to many spines are found on the concave margin of the tarsus, including 1 very long spine at the extreme tip, projecting toward the flattened or cupped undersurface of the claw; some of the marginal spines may be quite long. A few short spines are present on the convex margin. The tarsus is *always distinctly bowed* and diverges from the axis of the tibia. The *arrangement* of the short spines on the surface of the femur, the *number* and arrangement of long spines at the tip of the tibia and spines along the concave margin of the tarsus appear to be of value in species differentiation, as in many species of *Baetis* and *Dactylobaetis*. Good figures of the legs of several species of *Baetis* may be found in Macan 1961, and Kapur & Kripalani, 1963. Legs I and III of *D. warreni* and *D. phaedrus* are shown here as fig. 13, 25, 48, 50, 75 and 91.

The flattened claw bears a series of denticles or slender finger-like processes which from certain aspects gives the entire claw a comb-like appearance. Each denticle bears a slight projection on the anterior side not far from its base, these projections seeming to be connected each to the others by a slender thread or membrane. Only in certain lateral views can these details of their structure be seen. At the outer end of the series appears what is probably the true tip of the claw. In species possessing many denticles it is difficult to know which is the true tip. The relationship of these denticles to the tip of the claw seems very unlike that of the usual arrangement of tip-of-claw-to-denticle, but it is highly probable that these structures are modified denticles rather than *de novo* features. As yet, however, comparisons with the claws of *Baetis* and other Baetidae have not provided a completely adequate basis for clarifying the nature of these structures.

Inside the claw is a unique deltoid tendon-like fibrous structure that extends from the base of the row of denticles along the lower surface of the claw and converges at a hyaline juncture with the unguitactor plate, which in turn is fastened as usual to the levator muscles via a long tendon-like extension (fig. 78, 79). The homologue of this deltoid tendon-like structure is not visible in *Baetis* or *Callibaetis*, nor have we been able to see it with phase-contrast microscopy on living specimens while the claw is being raised and lowered. Nevertheless there must be some tendon-like connection to the unguitactor plates in *Baetis* and *Callibaetis* because as the claw is lifted up the unguitactor plate slides outward as if it were being pulled by a structure attached in the apical half of the claw. To date, sectioning of the claws has not aided in determining more about the internal structure of the claws of Baetidae and in ascertaining whether or not the comb-like structures are truly the denticles. A single Baetid nymph from Peru of unknown affinities in the collection of the University of Utah is interesting in that it represents the only other mayfly possessing claws of this general type. This nymph shows none of the distinctive features of *Dactylobaetis* and is clearly not a *Dactylobaetis*. The flat comb differs in structure and appears to have evolved independently of that of *Dactylobaetis*. The claw is shown in fig. 88, 89. The tip of the claw appears to be central in the series and there are denticles in an arc on either side. This nymph probably represents a form derived from a baetid with a double row of denticles (similar to *Callibaetis*) while *Dactylobaetis* seems to be derived from a *Baetis*-like ancestor which had a single row of denticles. A deltoid tendon is present in the claws of this peculiar nymph, but it inserts into the central apex of the claw and along the

denticles only on *one* side of the flattened claw,

That the peculiar claws of *Dactylobaetis* may be a neotenic feature is suggested by Ide's studies (1935) of the postembryonic development of the tarsal claws of 2 species of the family Heptageniidae (p. 46-461, 464; fig. 10,-9-11). This study presents an interesting analogy between the tarsal claws of *Dactylobaetis* and those of early instar nymphs of these 2 heptageniids. In 1st instar nymphs of *Epeorus humeralis* Morgan (now placed as *E. vitrea* Walker), Ide found that each tarsal claw had on its apical margin "about 15 curved hooks of nearly equal size", plus 1 stouter hook; as development proceeded, the stouter hook became "the tarsal claw proper"; the original 15 smaller hooks were reduced in number and became "the pectinations along one side of the main claw" (Ide). In *Iron pleuralis* Banks (now placed as a subgenus of *Epeorus*), "the most strongly developed claw is near the middle of the series of claws rather than at one end" (Ide). Ide states: "Curiously enough the abrupt transformation of the tarsal claws" occurs at the same time that the nymphal gills have grown long enough to anchor the nymph to "the stone on which the nymph is resting". At this time also, nymphs "tend to drop out of the rapids into the somewhat quieter water below."

The adaptive significance or function of the flat comb-claw type is unknown. We have not made detailed observations on living *Dactylobaetis* nymphs, but their general habitat of rocky bottomed, silted rivers is shared by other mayflies with rather typical claws. None of the earlier instars of nymphs of this genus are known but known first instar nymphs of *Baetis* do not have *Dactylobaetis*-type claws.

Within certain narrow limits, the number of denticles in *Dactylobaetis* is constant for each individual nymph, and seems also to be fairly constant in a given group of nymphs which resemble one another as to color pattern, structure of mouthparts and similarity in position and number of spines on the legs, and would appear to represent a definite species. The numbers of denticles vary from 5, 6 or 7 in some species to more than 40 in others. To study the claws and count the denticles it is usually necessary to separate the claw from the tarsus, preferably after the structure has been placed in the mounting medium but before this medium has 'set'.

Thoracic gills. The presence in some species of short thread-like thoracic gills attached ventrally near the base of leg I only, seems to be 1 of the unique features of *Dactylobaetis* nymphs. Such gills are present in all specimens we have examined from Southeastern Brazil and Uruguay, and in some from the Canal Zone; in nymphs from other localities these gills are apparently absent. A similar situation is found in the genus *Baetodes*, where such gills may be absent, single or double at the bases of all 3 pairs of legs.

Color pattern of the thorax. Markings on the pronotum and mesonotum, and to a limited extent the sternal markings, may aid in species differentiation. Dark crescentic markings on the pleura around the leg bases are present as in many other nymphs of the family Baetidae.

Abdomen: Minute spines are present along the posterior margins of all terga, except for a narrow strip on each side adjoining the pleural fold. Adjacent to the posterolateral corner of terga 2-7 a single minute spine is usually present; at and adjoining this corner on 8-10, a cluster of small spines. Markings on the abdominal terga are usually quite similar to the patterns shown in fig. 11, 12, 24. Essentially those on the middle abdominal terga consist of: short oblique submedian dashes each side of the mid-line from the anterior margin, often with a small dark dot near the end of each dash; on each side a longer arched streak arising at the anterior margin just laterad of the oblique dashes and extending backward toward the posterolateral corner; the anterior or posterior margins, or both, may be narrowly darkened; posterolateral corner darkened on the margin; a wide pale area laterad of the arched streak, within which is a dark dot toward the anterior margin. Often one or more of the terga may be darker than the adjoining ones, especially 3 and 6, while tergum 8 is frequently paler. The anterior portion of the mid-

dorsal space between the oblique submedian dashes is generally pale. Ventrally, a longitudinal line of dark marks is often present on some or all of the sterna, adjacent to the pleural fold; the anterior or posterior margins of the sterna may be darkened in some specimens. Other markings, if present, are indicated in the descriptions of the species. A few species have quite unique patterns, some of which are shown in fig. 61, 65.

Abdominal gills. The intermediate gills are rather straight on the outer (anterior) margin, convex posteriorly on the side toward the body. Fine spines are present along the basal half of the convex margin and along the apical half of the straight margin, while slender short hairs clothe the apical margin, in part at least. In some species 1 or both of the lateral margins may be somewhat sclerotized and darker in color; the apical margin is so thin and delicate that it is sometimes difficult to determine its exact shape. Gills on segments 1 and 7 are smaller than the intermediates, and usually more symmetrical; gills on segment 1 may be slightly smaller than those on 7. Of the intermediates, gills on segments 3-5 are large; usually largest on 4. The main trachea is usually visible in gills of segments 2-6, sometimes also in 7, rarely in 1; if pigmented lateral branches are present from this main trachea, these are principally on the inner side toward the convex margin. Fig. 6, 11, 12, 24, 28 present the usual aspect of the gills of this genus. In fig. 11, 12 a line seeming to parallel the outer margin represents a slight fold in the gill.

Caudal filaments. As previously noted, the median terminal filament is usually fully as stout as the cerci and frequently almost as long. This is well shown in fig. 9 and 18, depicting details of these structures in the nymph of *Dactylobaetis warreni*. In this respect, *Dactylobaetis* nymphs generally resemble those of several other genera of the family Baetidae (*Cloeon*, *Centropitulum*, *Callibaetis*) rather than *Baetis*; yet in a few of the described species of *Baetis* the median terminal filament is equally well developed and fully as long as cerci (see *B. frondalis* McD., as figured by Ide 1937: 228, pl. 10, fig. 10a-c).

The following key should serve to differentiate the male imagos of the named species of *Dactylobaetis* as well as the 2 as yet unnamed groups. No attempt is made to provide a key to the female imagos.

KEY TO MALE IMAGOS

1. Abdominal terga darker in color than sterna 2
 Abdominal terga and sterna similar in color..... 5
2. Abdominal segments 2-6 semi-opaque; tracheae along pleural fold of abdomen faintly or not at all darkened..... 3
 Abdominal segments 2-6 semi-hyaline; tracheae along pleural fold distinctly darkened 4
3. Terga 2-6 dark olive brown with grayish tinge, tiny red dots on 2-3 and 5-6; turbinate eyes small to moderate, widely divergent dorsally; tracheae very faintly darkened. Genitalia as in fig. 63 — Honduras. **zenobia**
 Terga 2-6 yellowish brown, no such red dots; turbinate eyes large, contiguous dorsally; tracheae not darkened. Genitalia similar to fig. 5 — Mexico. sp. B
4. Basal segment of forceps quite long, ca. 1/2 length of long 2nd segment; dark longitudinal streak along thoracic pleura, ventrad of it a yellow streak, prominent black markings on thoracic sterna; metanotum not brighter in color than mesonotum. Genitalia as in fig. 59. — Argentina **penai**
 Basal segment of forceps shorter, considerably less than 1/2 the long 2nd segment; such markings on thoracic pleura absent or very indistinct, those on thoracic sterna paler, reddish brown; metanotum brighter in color than mesonotum. Genitalia as in fig. 67.

- Idaho **cepheus**
5. Purplish-red triangular markings on terga 2-3 and 5-6; turbinate eyes almost contiguous dorsally, hemispheroidal; fore wing 4 mm. Genitalia as in fig. 62. — Mexico **jenseni**
 Tiny reddish dots may occur on terga 2-3, but no such triangular markings as above; turbinate eyes variable; fore wing 4.0-5.5 mm.6
6. *Posterior* margins of terga 1-3 and 6 purplish black in *dorsal* area only, widest at mid-line on 6; turbinate eyes contiguous dorsally, ellipsoidal; fore wing 5mm. Genitalia as in fig. 60. Basal segment of forceps quite long. — Mexico **arriaga**
 Abdominal terga not as above; turbinate eyes divergent dorsally, hemispheroidal; fore wing 4.0-5.5 mm. Basal segment of forceps much shorter 7
7. Thorax pale reddish brown; no markings on abdominal terga; tracheae along pleural fold of abdomen not darkened; fore wing 5.5 mm. Genitalia as in figs. 5, 66. — Mexico...sp. A
 Thorax and abdomen variable; tracheae distinctly darkened 8
8. Thorax yellowish, metanotum concolorous with mesonotum; indistinct reddish-purple dots may occur on terga 2-3; *anterior* margins of terga 2-6 brown-shaded laterally; head yellow, no reddish-brown shading; fore wing 4 mm. Genitalia as in fig. 68. — Mexico
 **chiapas**
 Thorax reddish brown, metanotum darker than mesonotum; no such dots on terga 2-3; anterior margins of terga 2-6 not as above; head shaded with reddish brown; fore wing 5 mm. Genitalia as in fig. 4. — California **warreni**

SUMMARY: CHARACTERS OF NYMPHAL MOUTHPARTS

The following resume of characters used in the keying and description of nymphal mouthparts will save time and effort of having to go back over the more detailed discussions of the characters employed here.

Labrum

Group I. One central and 2 to several lateral spines.

I A.: Spines quite evenly spaced, with no considerable distance between central and nearest lateral; usually no intermediary spine present.

I A (1): Central forming with the 1st 3 or more laterals a relatively straight line (fig. 36).

I A (2): Central and laterals together are arranged in a curved line (fig. 30).

I B.: A relatively wide space between the central and the nearest lateral; intermediary present or absent.

I B (1): Laterals are *not* set on a ridge or fold, hence do not appear connected basally (fig. 39).

I B (2): As in I B (1), except that the laterals *are* set on a ridge or fold (fig. 34).

Group II. No central spine present; several to many laterals, *not* set on a ridge or fold (fig. 40).

Mandibles

Basic. Inner and outer incisors arise independent of one another (fig. 56).

Pseudobasic. Separation of inner and outer incisors partial only, inner appears to arise from base of outer (fig. 57).

Compacted. Outer and inner incisors fused together.

- Grade I. Line of fusion still apparent; 8, 7 or 6 denticles discernible in each incisor (fig. 15, 16, 84, 90)
- Grade II. Denticles of outer incisor almost or wholly fused, those of inner incisor still distinct at tips (fig. 87).
- Grade III. Denticles of both incisors completely fused, except that the innermost denticle of the inner incisor may still be free at tip (fig. 43).

Maxillae

Length of body

- Long type. Distance from tip of crown to outer edge of palpifer greater than from latter point to base of stipes (fig. 58).
- Subequal type. Distance from tip of crown to upper edge of palpifer approximately equal to distance from latter point to base of stipes (fig. 55).

Palpi

- Type I. Of relatively even width throughout (fig. 58).
- Type II. Basal segment distinctly wider than distal (fig. 55).

KEY TO NAMED SPECIES OF DACTYLOBAETIS AND CAMELOBAETIDIUS NYMPHS

1. Terminal filament shorter than the 10th abdominal segment (fig. 38); a prominent blunt projection near base of femur I on anterior margin (fig. 48.) **Camelobaetidius**, 11
 Terminal filament at least 3/4 as long as cerci; no such projection on femur 1 **Dactylobaetis**, 2
2. Claws with relatively few denticles, 5-17; dilation at inner apical margin of 2nd segment of labial palpus rounded or pseudo-pointed (fig. 76, 85) 3
 Claws with 20-40 denticles; dilation at inner apical margin of 2nd segment of labial palpus sharp-pointed or truncate (fig. 81, 82)..... 8
3. Claws with 5-6 denticles; 8-14 tarsal spines; abdomen reddish to yellowish brown; gills seldom show darkened tracheae. — Mexico **mexicanus**
 Claws with 7-17 denticles; tarsal spines, gills and abdomen variable 4
4. Claws with 7-11 denticles; body 4.5-7.0 mm in length; inner margin of 2nd segment of labial palpus rounded; tarsal spines and color patterns variable.....5
 Claws with 15-17 denticles; body 3.0-3.5 mm in length; inner margin of 2nd segment of labial palpus pseudopointed; thorax without longitudinal markings but with numerous lateral and anterolateral pale areas; reddish lines and shading on mesothorax and abdominal terga. — Peru **cayumba**
5. Ten-12 spines at apex of tibia I (fig. 80); 8-14 tarsal spines; 7-11 denticles; labrum of Group IA (1) (fig. 36); incisor area of mandibles elongated, pyramidal (fig. 29); labial palpi with very short distal segment, palpi, glossae and paraglossae unusually long (fig. 42, 54); maxillary palpus of Type I (fig. 58); dorsum of abdomen as in fig. 65. —Southeastern Brazil **phaedrus**
 Four-6 spines at tip of tibia I; 7-13 tarsal spines; labrum of Group IB (1); mandibular incisors not pyramidal, of Grade I or II; labium not elongated as above, inner margin of 2nd segment of palpus rounded; maxillary palpus of Type II 6
6. Claws with 7-8 denticles; mandibular incisors of Grade I late or early Grade II; 5-6 paraglossal spines, 7-10 tarsal spines; dorsum of thorax and abdomen grayed yellowish

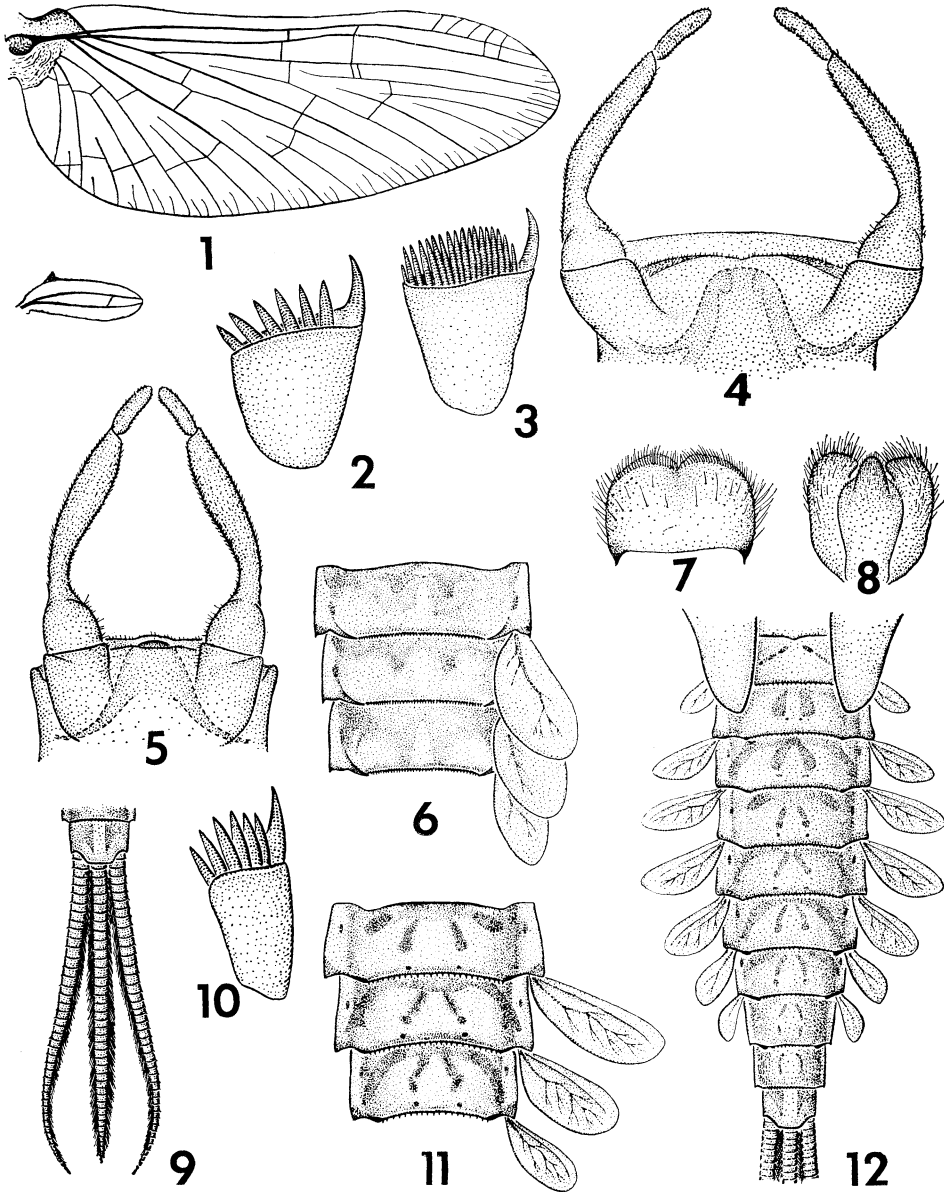
- olive brown, markings on mesonotum not sharply defined; posterior margins of terga strongly darkened laterally. — Honduras..... **zenobia**
- Claws with 8-9, occasionally 10 denticles; mandibular incisors of Grade I; 3-6 paraglossal spines, 7-13 tarsal spines; 3-6 spines at tip of tibia I; dorsum of thorax and abdomen variable..... 7
7. Eleven-13 tarsal spines; 4-6 paraglossal spines; body stout, thoracic notum light reddish brown, sternum yellowish; abdominal terga bright reddish brown, markings distinct. —California **warreni**
- Seven-9 tarsal spines; 3-4 paraglossal spines; body slender, thoracic nota and sterna dark reddish brown, abdominal terga grayed reddish brown, markings faint, rather indistinct. — Idaho. (presumed nymph of). **cephus**
8. Thoracic gill present near base of leg I; dilation at inner apical margin of 2nd segment of labial palpus sharp-pointed; labrum of Group IB (1); mandibular incisors of Grade I. 9
- No such thoracic gill present; dilation at inner apical margin of labial palpus variable; labrum of Group I B (2); mandibular incisors of Grade II or III..... 10
9. Claws with 20-27 denticles; body 6.5-10.0 mm in length, dark reddish brown dorsally; tergal pattern much as in fig. 11, 12. — Southeastern Brazil. **anubis**
- Claws with 30-40 denticles; body 4.25-5.0 mm in length, body yellowish to pale reddish brown with yellowish tinge, tergal pattern as in fig. 61. — Southeastern Brazil **serapis**
10. Claws with 29-30 denticles; body 6.0-7.0 mm in length, grayish olive to reddish brown dorsally; tergal pattern much as in fig. 11, 12; dilation at inner apical margin of 2nd segment of labial palpus sharp-pointed; 3 lateral spines on labrum.— Argentina. **penai**
- Claws with ca. 35 denticles; body 5.75-8.0 mm in length, dark brown markings dorsally on yellow background, tergal pattern as in fig. 6; dilation at inner apical margin of 2nd segment of labial palpus truncate; 3-6 lateral spines on labrum.—Mexico, Guatemala ... **musseri**
11. Claws with ca. 25 denticles; gills with at least median trachea pigmented.—Brazil, Amazonia **mantis**
- Claws with ca. 9 denticles; gills without pigmented trachea.—Surinam **leentvaari**

All descriptions of imagos and nymphs are drawn from specimens preserved in alcohol, unless otherwise indicated.

Dactylobaetis warreni Traver and Edmunds, new species Fig. 1, 4, 7-9, 11-13, 15-20, 23, 25, 27, 32, 41, 44, 76, 86, 90.

Represented by ♂ and ♀ imagos and nymphs. Turbinate eyes orange in life, yellowish in alcohol; moderate in size, on short stalks almost contiguous dorsally, hemispheroidal. Abdomen pale yellowish white, segments 2-5 partially semi-hyaline to semi-opaque; no definite contrast between dorsum and venter. Tracheae along pleural fold distinctly black-outlined and with lateral branches.

♂ *imago*: Body 5.5-6.5 mm; fore wing 5 mm. Head distinctly red-tinged in fresh specimens, except for narrow pale frontal margin and a spot each side at base of lower eyes; turbinate eyes bright orange. In alcohol orange color fades to yellow, red tinge on head less evident. Scape and pedicel of antennae narrowly brown at apical margins, filament faintly dusky. Pronotum yellowish; reddish-brown oblique submedian streaks, also line above leg base. Mesothorax reddish brown; mesonotal shield varying from pale reddish brown to flesh color, midline and inner parapsidal furrows dark reddish brown; mesoscutellum pale at tip, brown areas on each side and beneath ridge; a brown submedian spot on each side preceding tip, extensions from this spot antieriad along outer parapsidal furrows. Mid-line of metanotum - wider



All figures are of the genus *Dactylobaetis* unless otherwise noted. In figures of nymphal claws, denticles are shown as seen from several aspects. Fig. 1-12. 1, *D. warreni*: wings of ♂ imago. 2, *D. mexicanus*: claw of nymph. 3, *Dactylobaetis* sp. from Uruguay: claw of nymph. 4, *D. warreni*: genitalia of ♂ imago, ventral view; membranes between bases of forceps widely expanded. 5, *Dactylobaetis* sp. A: genitalia of ♂ imago, ventral view; membranes between bases of forceps of contracted. 6, *D. musseri*: abdominal terga 4-6 of nymph. 7-9, *D. warreni*: 7, labrum of nymph, showing all marginal spines as well as those on dorsal surface. 8, hypopharynx of nymph. 9, caudal filaments of nymph. 10, *D. mexicanus*: claw of nymph. 11-12, *D. warreni*: 11, abdominal terga of nymph, enlarged. 12, abdominal terga 1-10 of nymph.

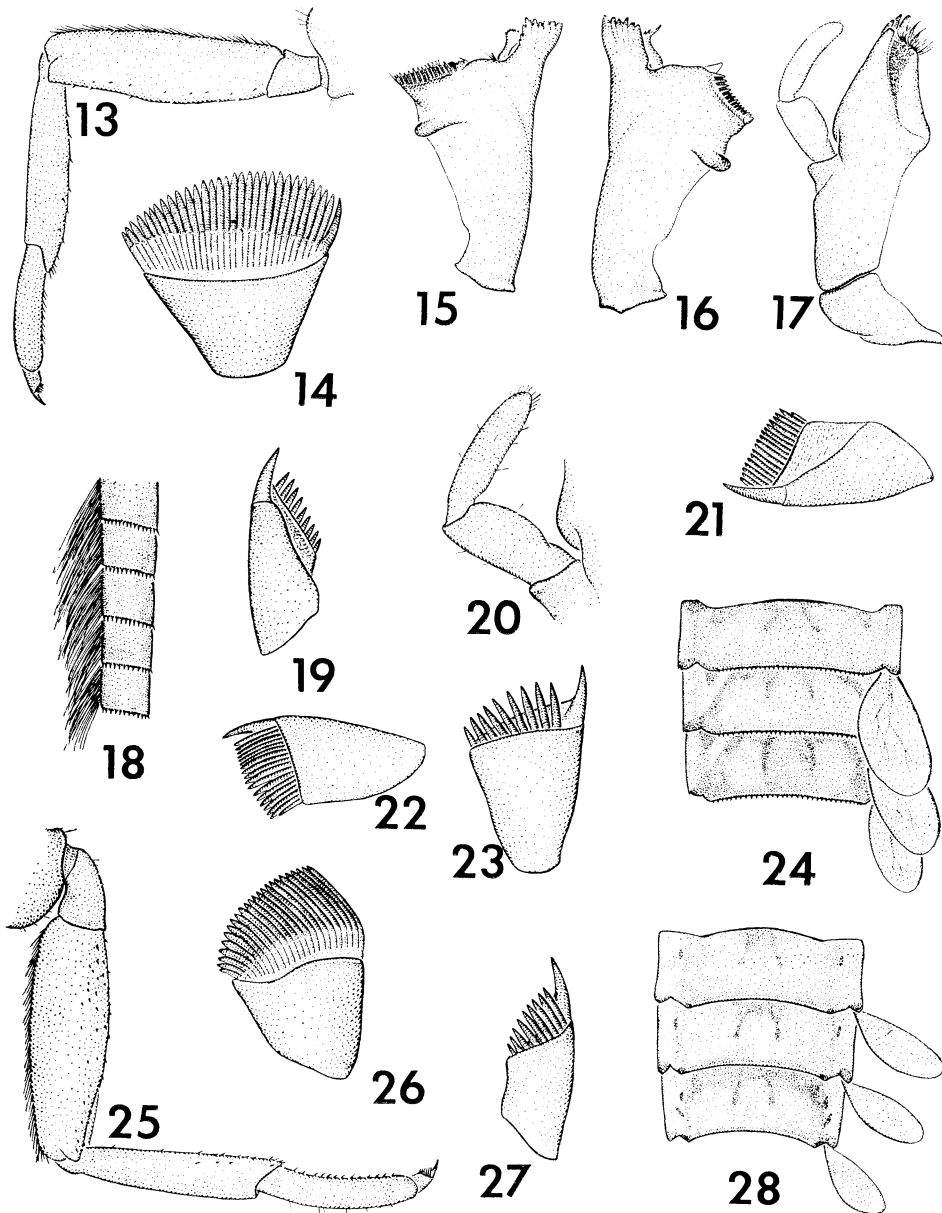


Fig. 13-28. *Dactylobaetis*: nymphal structures. 13, *D. warreni*: leg III of nymph. 14, *D. musseri*: claw of nymph. 15-20, *D. warreni*: 15, Right mandible of nymph. 16, Left mandible of nymph (Figs. 15 and 16 represent Grade I of compaction of incisor regions). 17, Maxilla with palpus; represents subequal body type and Type II of palpus. 18, Details of portion of cercus of nymph. 19, Claw of nymph. 20, Maxillary palpus enlarged. 21, *Dactylobaetis* sp. from Uruguay: claw of nymph. 22, *D.* sp. from Uruguay: claw of nymph. 23, *D. warreni*: claw of nymph. 24, *D. mexicanus*:

anteriorly, - and anterior margins, yellowish; remainder on many but not all specimens *bright reddish brown, brighter than mesothorax*. Pleura pale red-brown, dark lines preceding and above leg bases. Prosternum yellowish; margins and joinings of sclerites narrowly dark brown. Meso- and metasterna pale reddish brown, narrow dark transverse markings. Legs yellowish white; claws pale reddish brown. Wings hyaline, whitish; costal and subcostal spaces of fore wing and area of costal angulation in hind wing somewhat granulated, semi-opaque; venation hyaline, Sc and R₁ of fore wing faintly yellowish in basal area. In stigmatic area of fore wing, 4-6 simple slanting cross veins. Faint traces of 1 or 2 cross veins are faintly indicated in some but not all hind wings. Abdominal segments 1-6 pale yellowish white, no contrast in color between dorsum and venter. Segments 2-5 partially semi-hyaline in many specimens, semi-opaque in others. Segments 7-10, often also apical half of 6, opaque, distinctly pink-tinged, sterna very faintly paler than terga. Tracheal trunk along pleural fold distinctly outlined in black, with lateral branches in each segment extending on to terga and sterna. Caudal filaments yellowish white, not darkened at joinings. Genitalia yellowish white (fig. 4).

♀ *imago*. Body 5.5-6.5 mm. Fore wing 5 mm. Entire body of freshly killed specimen orange to pale reddish brown, last 3 abdominal segments paler. In alcohol body yellowish white. Dusky areas each side on vertex of head, between eyes; red spot in head above middle ocellus, faded in alcohol. Faint brownish submedian patches on pronotum. Mesonotal shield margined as in ♂, faint lines on pleura around leg bases. Masses of pink ova often present in thorax. Abdomen pink-tinged, segments 1-7, in those ♀♀ containing ova. Tracheal trunk along pleural fold, if darkened at all, less distinctly so than in ♂. Legs, wings and caudal filaments essentially as in ♂.

Nymph. Diagnosis. Claws with 8-9 denticles. Labrum of Group I B (1); intermediary present, 2-3 lateral spines. Incisors of mandibles of Grade I; thumb-like process of left mandible stout, blunt, rather short. Body of maxilla subequal; palpi of Type II. Dilation of 2nd segment of labial palpus rounded; 4-6 spines on dorsal surface of paraglossae. Gills generally with darkened tracheae. Body yellow to light reddish brown; tergal markings as in fig. 11, 12.

Body of nymph: 5.0-6.5 mm. Head in front of eyes yellow in ♀, red-tinged in ♂; turbinate eyes of ♂ bright orange; vertex in ♀ reddish brown, mid-line pale. Dark brown markings along margin of clypeus; each side base of labrum; tips of mandibles and maxillae. Dorsum of thorax and abdomen in nymphs with darkened wing pads, chestnut brown in ♀, brighter red-brown in ♂; midlines narrowly pale; yellowish mottling laterally on pronotum, the posterior margin dark brown. All sclerites of thoracic notum, pleura and tip of mesonotal scutellum margined in dark brown; 2 dark brown submedian spots at anterior margin of metanotum. Crescentic dark brown areas on pleura, above and around leg bases, most prominent on ♂ where these extend down on to sternum. Thoracic sternum yellowish; meso- and metasterna narrowly brown at anterolateral margins. Femora pale reddish brown with faint transverse median band; tibiae and tarsi yellowish; femoro-tibial articulation dark brown; outer margins of femora and tarsi and tips of tarsi narrowly brown; tibiae dark only at extreme bases and near apices; claws pale brown, paler at bases. A few short stout spines arranged irregularly on surfaces of femora adjoining the anterior margins, most of these in basal 1/2 of segment; all appear to be conical. At tip of tibia, 3-5 spines (fig. 86). Eleven-13 stout spines along concave margin of tarsus I; 9-10 each on tarsi II and III. Both anterior and posterior margins of terga dark brown, darkest on anterior and at posterolateral angles on 1-7. Dark reddish brown tergal markings: submedian oblique streaks on 1-7, replaced on 8-10 by narrow streak parallel to mid-

abdominal terga 4-6 of nymph. 25, *D. warreni*: leg I of nymph. 26, *D. musseri*:
claw of nymph. 27, *D. warreni*: claw of nymph 28, *Dactylobaetis* sp. from Uruguay:
abdominal terga 4-6 of nymph.

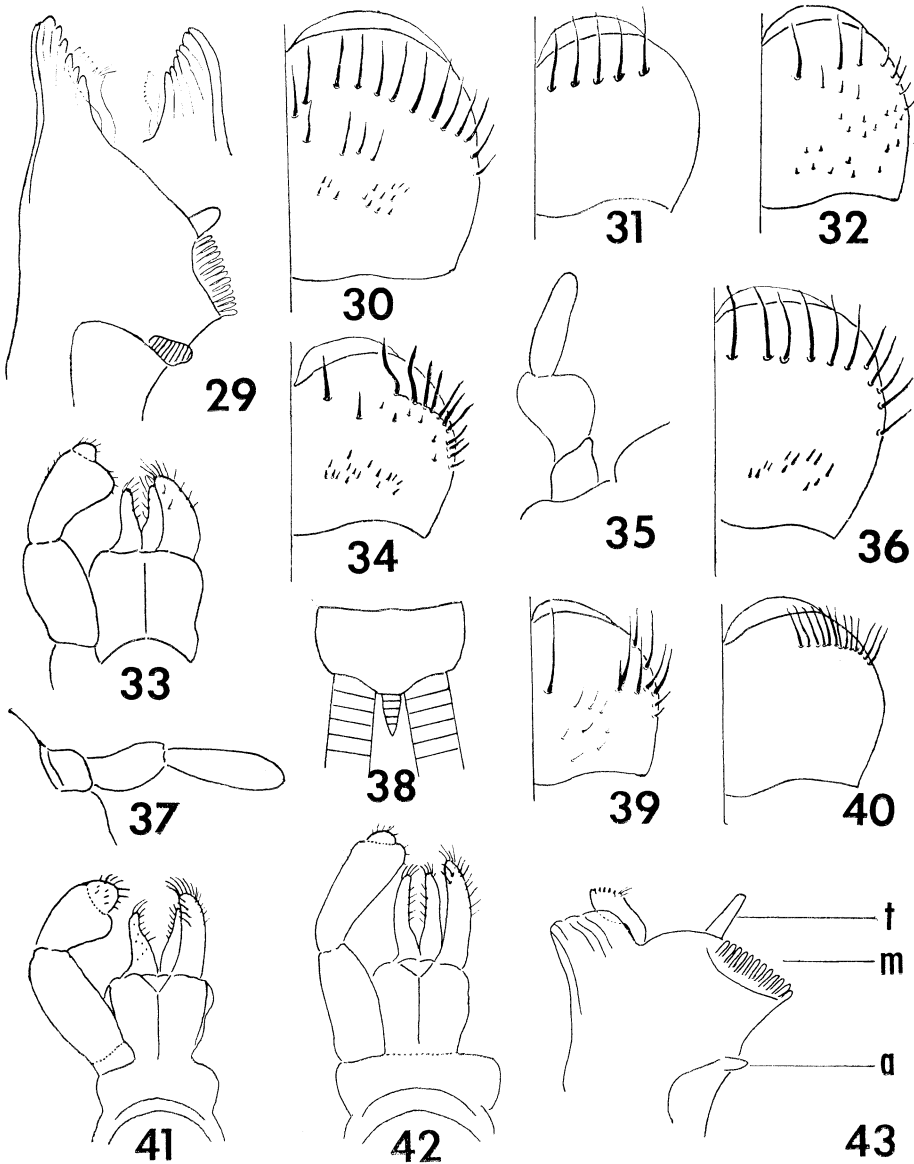


Fig. 29-43, *Dactylobaetis*, *Camelobaetidius* and *Baetis*: nymphal structures. (Marginal spines omitted from all drawings of labrum. Labial paraglossae shown from dorsal (inner) aspect, other portions of drawing of labium from ventral (outer) aspect). 29, *D. phaedrus*: left mandible in part, and incisor region of right mandible; represents Grade I of compaction and pyramidal incisor region. 30-32, labrum of 3 species: 30, *Dactylobaetis* sp., ally of *D. phaedrus*: represents Group I A(2). 31, Type of *Baetis sogeriensis* Harker, modified from Harker (1954, Fig. 75): represents Group I A (1). 32, *D. warreni*: represents Group I B (1), intermediary spine present. 33, *Camelobaetidius mantis*: labium. 34, *Dactylobaetis musseri*: labrum; represents Group I B (2). 35, *anubis*: maxillary palpus, represents Type II. 36, *D. phaedrus*: labrum,

line; lateral oblique streaks from anterior margin each side of mid-line extending toward posterolateral corners on 1-7, absent from 8-10 (see fig. 11, 12). In ♂ nymphs, tracheal trunk along pleural fold darkened, showing through on to sterna. Abdominal sterna yellowish, faintly pink-tinged in ♀; anterior margins of 6-10 or 1-10 narrowly dark brown. Caudal filaments pale reddish brown, not darkened at joinings (fig. 9, 18). Gills whitish; on most nymphs main trachea and a few lateral branches on inner side are darkened; occasionally only the main trunk is very faintly darker.

Holotype. ♂ imago. Tuolumne River, California. Dairy Ranch 5 km (3 mi.) E of Shiloh; 24.VII.54. Reared from nymph by the Days. In collection of the California Academy of Science. Allotype ♀ imago, same data as given for holotype (CAS). Paratypes. 11 ♂ and 24 ♀ imagos, same data as holotype; 1 ♂, 2 ♀♀ and 3 nymphs, same locality, 31.VII.54 (JRT); 13 ♂ and 9 ♀ imagos, and 34 nymphs, same locality, 11. VI. 55 (CAS, UU). Many of the adult paratypes reared by the Days.

From field notes taken by the Days, which H. B. Leech of the California Academy of Science has kindly sent to us, we include the following information regarding the habitat of these nymphs. "July 24, 1954. Tuolumne River; Dairy Ranch 3 miles upstream from Shiloh Bridge; water at 80° F, at 3 p.m. Really found the comb-claws (*Dactylobaetis*) and took home over 100; reared perhaps 30 of them. Found in a shallow, fast riffle about 1" to 4" deep made of small stones 1/2" to 1" in diameter, mixed with and resting on sand; riffle at foot of a long quiet stretch 1/3 mile long. Nymphs very mature. Hatched July 24 and 25." "July 31, 1954. [Same location as above.] Not quite so many comb-claws (*Dactylobaetis*), so believe that July 24 is height for these nymphs." August 7, 1954 (Same location) "Some comb-claws left." The following year, May 7, 1955, same location. "...on a cold rainy day with water at 65° F at noon some immature comb-claws."

Of general conditions of the river at this time, Day (1955) wrote: "The lower Tuolumne River has been dredged, diverted and dammed, and has suffered pollution from irrigation run-off, cropdusting, sewage and industry. In early June of 1954 water temperature 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." "From all indications the lower Tuolumne 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."

Imagos of *Dactylobaetis warreni* seem most closely related to *D. chiapas* and to *Dactylobaetis* sp. A; all 3 have pale semi-hyaline abdominal segments 2-5; no color contrast between dorsum and venter; no distinguishing tergal markings. *Dactylobaetis* sp. A lacks

represents Group I A (1). 37-38, *Camelobaetidius mantis*: maxillary palpus, represents Type II. 38, Abdominal segment 10, bases of cerci and short terminal filament. 39, *Dactylobaetis* sp. from Rio Chillon, Peru: labrum, represents Group I B (1), intermediary spine absent. 40, *Baetis simplex* Kapur & Kripalani: labrum (after K. & K. 1963, Fig. 9a), represents Group II. 41, *D. warreni*: labium. 42, *D. phaedrus*: labium. 43, *D. musseri*: left mandible in part, represents Grade III of compaction, with long thumb and truncated incisor region: m=molar region; t=thumb; a=anterior articulatory process.

the darkened tracheal trunk along the pleural fold which is present in the other 2 species. The bright dark brown metanotum and the paler red-brown mesothorax should differentiate *D. warreni* from *D. chiapas*, the latter species smaller and with wholly yellow thorax. Nymphs of *D. warreni* are very similar to those presumed to represent *D. cepheus*, but have stouter bodies and much better defined dark markings on thorax and abdomen.

Dactylobaetis cepheus Traver and Edmunds, new species Fig. 46, 64, 67, 69.

Only the ♂ imagos of this species are known. Turbinate eyes quite large, yellowish orange, well separated dorsally, hemispheroidal. Dorsum of abdomen yellowish olive brown, contrasting with the yellowish venter; segments 2-6 semi-hyaline. Tracheae of pleural fold black-outlined.

♂ *imago*. Body 5 mm; fore wing 5 mm. Head pale reddish brown; dark line from lower part of eyes to lateral ocelli. Scape and pedicel of antennae very narrowly darker at apex. Turbinate eyes yellowish orange, quite large, well separated dorsally, hemispheroidal; eye stalks quite heavily shaded with dark brown except in lateral areas, short to moderate in height (fig. 64, 69). Pronotum reddish brown, lateral margins dark brown. Mesonotal shield pale yellowish to bright reddish brown, with or without a dark midstripe; mid-anterior margin pale; darker spot anterior to scutellum on each side; dark lines extend anteriorly from these spots along wing bases; tip of scutellum pale. Metanotum bright reddish brown; mid-line yellowish; scutellum black-margined. Pleura pale reddish brown, sclerites margined with dark brown. Prothoracic pleura yellowish white above leg bases; meso- and metapleura yellowish brown with narrow dark reddish brown markings. Prothoracic sternum yellowish, narrowly outlined in black; mid-area of mesosternum and oblique area extending from this to base of leg III quite bright reddish brown; metasternum paler red-brown. Legs yellowish. Faint reddish brown streak near base of femur I; incomplete reddish brown band anterior to apex of tibia I; tarsal segments narrowly reddish brown at joinings; all claws reddish brown. Venation hyaline; longitudinal veins of costal margin pale yellowish near base. Four-7 slanting stigmatic cross veins in fore wing, occasionally a cross vein may be forked near costa. Hind wing as in fig. 46. Abdominal terga 2-10 pale yellowish to dark olive brown; *anterior* margins of terga very narrowly darkened; segments 2-5 or 2-6 semihyaline; 6 or 7-10 opaque, may have a distinctly pinkish tinge. Main tracheae and branches along pleural fold outlined in black. Sterna contrastingly paler than terga, pale yellowish, basal and apical sterna faintly shaded with pale olive, anterior margins of basal sterna darker. Caudal filaments yellowish white, not darker at joinings. Genitalia as in fig. 67.

Holotype. ♂ imago. Canyon County, Idaho; Snake River at junction of U. S. Highways 20-26, 13 km (8 mi.) NW of Parma; 29. VIII. 58; G. F. Edmunds, Jr. & R. K. Allen, collectors. In collection of University of Utah. Paratypes: 40 ♂ imagos; same data as holotype (UU, IU, JRT). The adults were swarming at edge of road late in evening.

Imagos of *Dactylobaetis cepheus* most closely resemble *D. penai* from Argentina; thorax of *D. cepheus* paler, lacks prominent blackish and yellowish stripes on pleura, but metanotum brighter in color and markings of thoracic sternum less prominent; basal segment of forceps shorter, being considerably less than 1/2 the length of the long 2nd segment. From *Dactylobaetis* sp. B from Mexico and *D. zenobia* from Honduras, in which species dorsum and venter of abdomen differ in color as in *D. cepheus*, the latter differs by reason of the semihyaline mid-abdominal segments.

Presumed nymph of Dactylobaetis cepheus

S. L. Jensen collected several *Dactylobaetis* nymphs from the Bruneau River, Owyhee County, Idaho, near the town of Bruneau, but was not able to rear them. The site of collection of these nymphs is not far from the area in which the imagos of *D. cepheus* were taken by Edmunds and Allen: Canyon County, Idaho, Snake River, 13 km (8 mi.) NE of Parma. We feel confident that eventual rearing of nymphs from this locality will prove them to be the immature stages of *D. cepheus*. Nymphs have same color pattern as those of *D. warreni* but are much more slender.

Diagnosis. Claws with 8-9 denticles. Labrum of Group I B (1); intermediary present; 2-3 lateral spines. Mandibular incisors of Grade I; thumb-like process on left mandible rather stout, short. Maxillary body subequal; palpi of Type II. Dilation of 2nd segment of labial palpus rounded; 3-4 spines on dorsal surface of paraglossae. Gills with darkened tracheae. Abdomen olive to reddish brown dorsally.

♀ *nymph.* Body 6 mm. Head pale reddish brown. Thoracic notum rather dark reddish brown; mid-line of pro- and mesonota very narrowly pale; black markings laterally on pronotum; mesonotal shield outlined anteriorly and laterally with black, sclerites darkened at joinings; pale mottlings on mesonotum laterally anterior to wing bases; sternum paler reddish brown, dark shading laterally on mesosternum. Legs yellowish; femoro-tibial articulation, tips of tarsi and claws blackish brown; 8-9 spines along concave margins of tarsi; 4-6 spines at tip of tibia. Abdomen olive to reddish brown dorsally, paler ventrally. Anterior margins of terga blackish, posterior margins black laterally; pale mid-streak between brownish oblique submedian dashes; oblique lateral streaks rather indistinct; lateral areas yellowish, mottled with narrow dark pencilings. Anterior margins of sterna 6-9 narrowly darkened. Gills pale; main tracheae and branches darkened. Caudal filaments yellowish brown.

Idaho: Owyhee County, Bruneau River at Jct. of Idaho Highway 51, 1.6 km (1mi.) W of Bruneau; 23. IX. 63; same as above, but 1.6 km (1 mi.) S of Bruneau; 30. VIII. 65; S. L. Jensen, collector. In collection of University of Utah.

A single nymph from the Malheur River, Oregon, taken 8 km (5mi.) E of Harper; 25. VI. 54; G. F. Edmunds, Jr., collector, may be of the same species as the Idaho nymphs.

Field notes by the collector give the following information as to the habitat of these nymphs. Land elevation 738 m (2460 ft); stream flow slow to moderate, bottom of rocks and gravel; daytime temperature of water 22°C (72° F); nymphs taken among the gravel in water about 30 cm in depth.

Allies of D. cepheus. Nymphs from several localities in the Colorado River drainage of Wyoming, Colorado and Utah seem to be allied to *D. cepheus*. Six of these collections are from the Green River, from R. M. 339¹ (Sweetwater County, Wyoming) to R. M. 182, Split Mtn., Uintah County, Utah. As is the case with the Idaho specimens, these nymphs are much more slender than those of *D. warreni*. The tergal patterns of all of these nymphs are quite similar to the Idaho specimens, although often less distinct; some nymphs are smaller; the legs less well marked; tracheae of gills may not be darkened. Claws

1. R. M. is abbreviation for river mile: "indicates the distance in miles from Greenriver, Utah, as given in U. S. G. S. Plan and Profile Maps of Green River" (Edmunds & Musser, 1960, University of Utah Anthropol. Pap. 48).

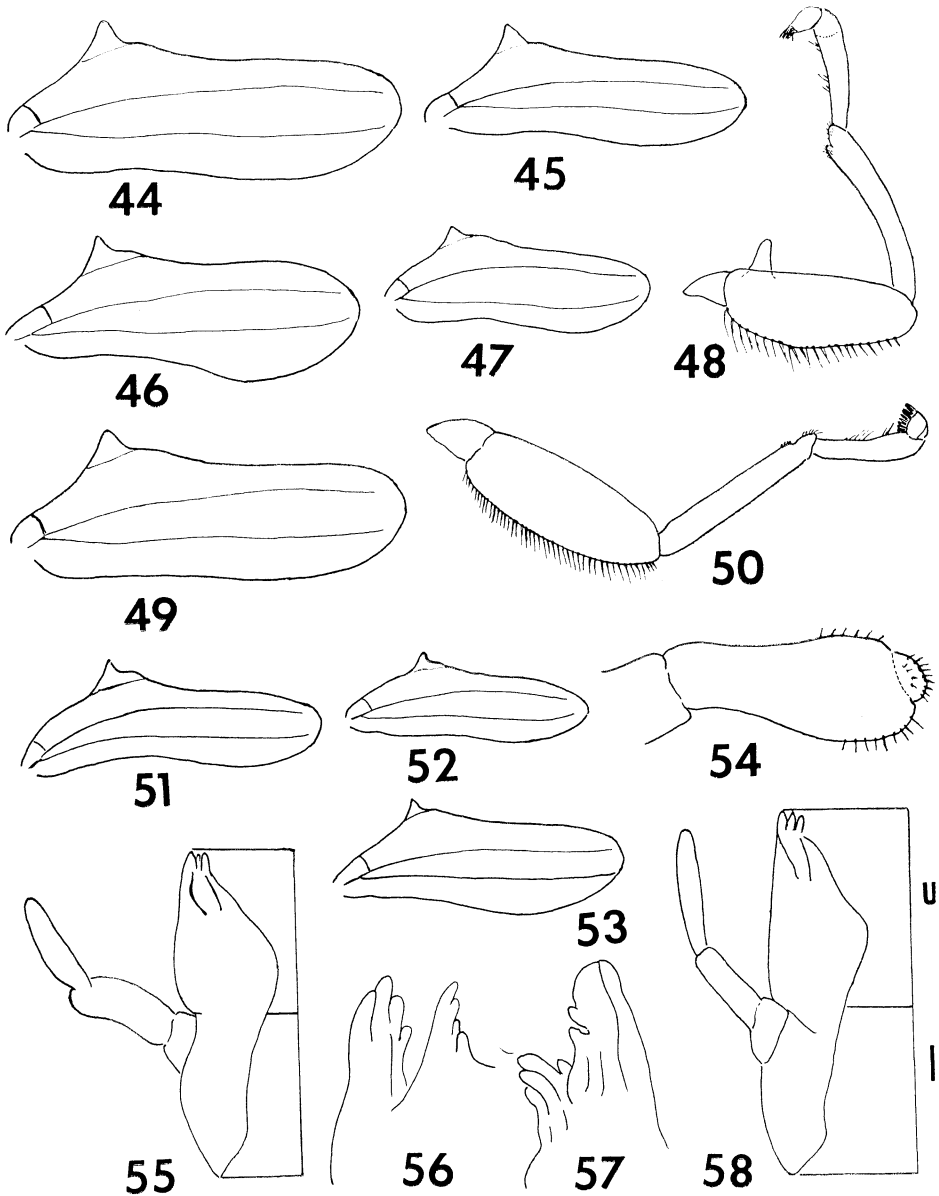


Fig. 44-56. *Dactylobaetis*, *Camelobaetidius*, *Callibaetis* and *Baetis*. (All hind wings of *Dactylobaetis* drawn at same magnification). 44-47, Hind wings of ♂ imagoes of *Dactylobaetis*: 44, *D. warreni*. 45, *D. chiapas*. 46, *D. cepheus*. 47, *D. arriaga*. 48, *Camelobaetidius mantis*: leg I of nymph. 49, *Dactylobaetis* sp. B: hind wing of ♂ imago. 50, *D. mantis*: leg III of nymph. 51-53. Hind wings of ♂ imagoes, *Dactylobaetis*: 51, *D. zenobia*. 52, *D. jenseni*. 53, *Dactylobaetis* sp. A. 54, *D. phaedrus*: labial palpus of nymph. 55, *Dactylobaetis* sp. from Peru: maxilla of nymph, represents subequal body and palpus of Type II. 56, *Callibaetis* sp. from Veracruz, Mexico: incisor region

of most of these nymphs have 8-9 denticles, 9-10 in one specimen; structural details of mouthparts very similar to those of the Idaho nymphs. In 2 instances, imagos of *Dactylobaetis* were taken in flight over the same area from which the nymphs were collected. Unpublished field notes by Edmunds, 1950, describing the imagos taken as Hideout Canyon correspond well to features of the imagos from Idaho. These specimens from Northeastern Utah may prove to be identical with those from Idaho when fresh material is available and when nymphs from both Idaho and Utah have been reared.

A few *Dactylobaetis* nymphs from the Virgin River, Washington County, Utah, do not correspond as well with the Idaho specimens as do those referred to above; we list them tentatively as possible allies of *D. cepheus*.

Dactylobaetis zenobia Traver and Edmunds, new species Fig. 51, 63.

Represented by ♂ imago and nymphs. Turbinate eyes orange, of small to moderate size, widely divergent dorsally, on stalks of moderate height, hemispheroidal. Abdominal terga dark olive brown with gray overcast, very little difference in color between 2-6 and 7-10; sterna paler than terga. Small red submedian and lateral dots on several terga, reddish triangle on tergum 10; main tracheae of pleural fold very narrowly outlined in black. Abdominal segments semi-opaque.

♂ *imago*. Body 5.5 mm; fore wing 5.5 mm. Head pale olive brown; dark longitudinal streak on mid-vertex; white longitudinal streak at middle of apical margin and around bases of antennae; scape and pedicel of antennae pale grayish brown, slightly darker at joinings, filaments grayish. Turbinate eyes orange, of moderate size; widely divergent dorsally; hemispheroidal. Pronotum rather dark brown, dark spot at anterior margin each side of mid-line; median line, inner and outer parapsidal furrows, dark. Scutellum pale, narrowly outlined in black; small pale triangle precedes scutellum, dark brown areas extend anteriorly from this area along wing bases; below and on each side of scutellum, other dark areas. Metanotum very dark olive brown; pale mid-dorsal triangle adjacent to mesonotum. Pleura pale olive brown with dark brown markings. Prosternum pale brown, margined with darker brown, meso- and metasterna largely dark olive brown except for pale median crescent anteriorly on metasternum and large pale oblique strips anterior to leg bases. Legs pale yellowish, claws slightly darkened; tarsi very narrowly darker at joinings. In fore wing, veins C, Sc and R₁ dark brown at extreme base, very pale brown for entire length, some other longitudinals faintly brown-tinged. Six stigmatic cross veins, very slanted, all simple. Costal angulation of hind wing and hump apical to it appear granular; apex slightly pointed (fig. 51).

Abdominal terga dark olive brown with gray overcast, very little difference in color between 2-6 and 7-10; apical terga faintly rose-tinged; *anterior* margins very narrowly darkened; *posterior* margins of 1-7 very narrowly dark red in lateral areas. On tergum 2, a small red submedian spot each side of mid-line near but not on posterior margin, another laterally on each side halfway from mid-line to pleural fold. Red spots also on tergum 3, but the lateral spot is connected to the posterior margin, and the submedian has a slight forward-directed process. Very faint lateral reddish spots on 5 and 6, as on 3; on 6, submedian spots somewhat as on 3, but each with 2 anteriorly directed processes. Faint reddish triangle on 10, based on posterior

of left mandible of nymph, represents basic condition of incisors. 57, *Baetis* sp. from Boqueron Abda, Peru: incisor region of right mandible, represents pseudobasic condition of incisors. 58, *Dactylobaetis phaedrus*: maxilla of nymph, represents long body and palpus of Type I; u=upper region, l=lower region of maxillary body.

margin. These red spots can be seen only in freshly-preserved specimens. Abdominal sterna paler brown, yellowish adjacent to pleural fold. Intersegmental areas of all segments pale. Main tracheae along pleural fold faintly dark-outlined, a single darkened branch extends into each tergum and sternum. Tiny black stigmatic dots on segments 2-6, faint on 5 and 6. Anterior margins of sterna very narrowly darkened. Caudal filaments yellow, very faintly darkened at joinings. Genitalia as in fig. 63; pale brown in color.

Nymph. Diagnosis. Claws with 7-8 denticles. Labrum: I B (1); intermediary present; 3 laterals. Right mandibular incisor of Grade I, advanced; left, Grade II, early. Maxillary body sub-equal; palpi rather delicate, Type II. Dilation of 2nd segment of labial palpus rounded. Five-6 spines in row on dorsal surface of paraglossae. Tracheae in gills distinctly darkened. Body dorsally grayed yellowish olive brown.

Body of nymph 5.5-7.0 mm. Head of ♂ yellow; mid-line on vertex and occiput yellow, developing eyes bright reddish orange; antennae yellow. Pronotum yellowish olive brown; no distinct markings, except faint darker submedian spots near anterior margin; anterior and lateral margins narrowly dark brown. Mesonotum somewhat darker olive brown, distinctly grayed. Mid-line very narrowly pale; indistinct darker line margins this, beyond this a very indistinct paler longitudinal streak. Along base of wing pads, a pale streak. Anteriorly and laterally to base of wing pad, a pale area containing 1 small dark dot. Metanotum dark, reddish brown; mid-line very narrowly pale; anterior and posterior margins black. Thoracic pleura mainly yellowish, very few dark markings. Sternal area pale yellowish; indistinct grayish-brown patches anterior to leg bases on meso- and metasterna. Legs yellowish. Longitudinal dark streak on femora; both margins and femoro-tibial articulation darkened. Tibiae brown-shaded at each end. Tarsi mainly brown, except yellowish in middle of concave side. Seven-10 tarsal spines; 4-5 spines at tip of tibia. Abdominal terga grayed yellowish olive brown. Type of markings as in fig. 11, 12, of abdomen of *D. warreni* but details of pattern not clear-cut. Pale between submedian oblique dashes on terga except 3 and 6, which are slightly darker; pale spots each side of submedian dashes on terga 2-6; dark spot in pale area near anterolateral angle diffuse, small. Tergum 8 not paler than others. Both anterior and posterior margins of all terga dark, posterior widest near lateral margins. Abdomen yellow ventrally; anterior margins of sterna darkened; outlines of main tracheae along pleural fold show through dimly, from these darkened branches extend transversely into each sternum. Gills seem more asymmetrical than usual, darkened along basal half of convex margin; main tracheae and numerous branches black, distinct. Caudal filaments broken except at extreme base; yellow in this portion. One ♀ is even darker than the ♂, markings of both thorax and abdomen more distinct; others are much paler than ♂, markings even less well defined. Mid-line of vertex of head pale, remainder of vertex and occiput brown. Longitudinal streak on femora very weak, poorly defined, even in the darker female. Nymphal skin of ♂ nymph from which the imago was reared agrees well with the above description of the ♂ nymph.

Holotype. ♂ imago, reared from nymph. Honduras, Dept. Francisco; Morazon, 16 km (10 mi.) E of Guaimaca on Highway #3; small stream, 6. XI. 64; J.S. Packer, collector. In collection of University of Utah. Paratypes. 1 ♂ and 3 ♀♀ nymphs, all nearly mature. Same data as for holotype (UU).

Twenty-three other nymphs taken by Mr Packer in Honduras appear to be of the same species as those designated as types. Denticles and mouthparts are as in the holotype nymph slough and paratype nymphs with the exception of 4 nymphs from Dept. El Paraiso, in which the mandibular incisors are of Grade III with truncate apical margins. The same specimens from El Paraiso that differ in mandibular structure show a different arrangement of spines on the labrum: central, intermediary, then a long space, 1st lateral,

another long space, beyond this 3-4 other laterals. These 23 nymphs are from the following localities. Dept. El Paraiso : stream approximately 8 km E of Danli, another 3 km E of Danli, 29.VIII.64; tributary of Rio Guayambre at junction of Highway #4, 50 km E of Danli, 3.IX.64; near Santa Maria, small stream, 3.IX.64 (UU). From Dept. Olancho, 2.5 km (1.6 mi.) W of Campamento Galera turn-off at bridge on Highway #3, 7.IX.64 (UU). From Dept. Comayagua, at bridge near Comayagua on Highway #1, Rio Selguapa, 17.X.64; El Rosario, Rio Humuya, 30.X.64 (UU). From Dept. Choluteca, small stream at junction of Highway #2 and Marcouia Road, 10.X.64 (UU).

Imagos of *Dactylobaetis zenobia* differ from *Dactylobaetis* sp. B, the only other species of the genus having semi-opaque mid-abdominal segments, because of the much darker terga 2-6, the narrowly darkened tracheal trunk, and the more widely divergent turbinate eyes. The semi-opacity and the darker olive brown color of segments 1-6 distinguish it from *D. cepheus* and *D. penai*. Nymphs of *D. zenobia* differ from those of *D. warreni* and the presumed nymph of *D. cepheus* thus: the grayed yellowish olive brown of thorax and abdomen dorsally; markings of mesonotum not well defined; mandibular incisors rather more compacted.

Allies of D. zenobia: A single ♂ imago from Chiapas Province, Mexico, bears some resemblance to *D. zenobia*, but differs from it in other respects.

♂ imago. Body 4 mm; fore wing 4 mm. Head yellowish anteriorly, pale brown between eyes; antennae yellowish, filament faintly dusky. Turbinate eyes yellowish, ellipsoidal, only slightly divergent dorsally. Thorax dark reddish brown. Pronotum rather paler than meso- and metanota, darker along lateral margins. Mid-line of mesonotum narrowly darker, as are areas above wing bases anterior to scutellum and depressed areas laterad of scutellum; pleura paler than notum, some dark lines above leg bases. Leg I missing; legs II and III pale yellowish white; narrow blackish penciling longitudinally along surfaces of femora; claws reddish brown. Abdominal segments 1-6 semi-hyaline; dorsum darker than venter. Terga 2-6 pale grayish brown with faint olive tinge, paler adjoining pleural fold; *posterior* margins narrowly darker, darkest on 1-5; no reddish dots visible. Terga 7-9 reddish brown, distinctly darker than 2-6; tergum 10 paler than 7-9; *posterior* margins of 7-10 very faintly darkened. Tracheae along pleural fold outlined in black. Abdominal sterna yellowish, no dark markings. Caudal filaments whitish, not darkened at joinings. Genitalia differ from *D. zenobia* by reason of a longer basal segment of the forceps, which segment is almost 1/2 the length of the long 2nd segment, much as in *D. arriaga*.

This Mexican ♂ differs thus from *D. zenobia*. Smaller size; turbinate eyes ellipsoidal, less divergent dorsally; abdominal segments 2-6 semi-hyaline, pale grayish brown, definitely paler than 7-9; no reddish dots on any terga; terga narrowly darker on *posterior* margins. When more specimens of both *D. zenobia* and this ♂ from Mexico are available, the Mexican ♂ may prove to represent a new species. Until such time we hold it as an ally of *D. zenobia*.

A single ♂ nymph from Chiapas Province, Mexico, same locality as the ♂ imago described above, may prove to be the immature stage of that imago. Body 4.5 mm. Claws with 7-8 denticles. Labrum I B (1); with intermediary and 2 lateral spines; incisors of mandibles of Grade I; thumb on left mandible large, stout, blunt at tip; body of maxilla subequal; palpi of Type II; labium as in *D. zenobia* nymphs. Head and developing turbinate eyes yellow. Thorax grayed olive brown; pronotum paler than mesonotum, mottled laterally with yellowish; mesonotum darker along anterior margin and anteriorly before wing bases, dark lines each side of pale mid-line in anterior portion; metanotum darker brown than mesonotum, very dark submedian areas at anterior margin; pleura and sternum yellowish; dark crescentic markings around leg bases; anterior

1/3 of mesosternum brown-shaded. Legs yellowish white; femoro-tibial articulation, tips of tarsi and claws brown-shaded; no gill evident near base of leg I. Near apex of tibia III, 5-6 spines in a cluster, 2 of these at apex; 6-7 tarsal spines. Abdomen yellowish ventrally, dorsum with reddish-brown markings characteristic of the genus: submedian dashes and oblique lateral streaks prominent. Terga 1 and 8 largely yellow; 2, 3 and 6 darker than adjoining terga, but 2 paler laterally and along anterior margin; basal 1/2 of 7 brown; pale mid-line on terga 4-5 and 9-10; *anterior* margins of terga narrowly darkened. Sterna narrowly darkened on anterior margins, 8 and 9 faintly brown-shaded. Caudal filaments yellowish, brown band across central area. Mexico, Chiapas Province, Arriaga; 22.VIII.65; P. J. Spangler, coll. (UU).

Twelve nymphs from the Canal Zone are similar enough to those of *Dactylobaetis zenobia* so that they are here considered as allies of that species. Bodies 4-5 mm in length. In most, the dorsum of thorax and abdomen is yellowish to olive brown, not grayed as in *D. zenobia*; a few others, however, resemble the latter species quite closely. A short ventral thoracic gill near the base of leg I is present in several of the Canal Zone specimens, but does not seem to be present in *D. zenobia*. Specimens from the Canal Zone resemble nymphs of *D. zenobia* in these features: numbers of denticles; structural features of labrum, maxilla and labial palpus. Paraglossal spines 4-5 in number; mandibular incisors of nymphs from Rio Guanabana are of Grade III, in all others of Grade I; 3-4 spines at tip of tibia, 6-9 tarsal spines. Gills appear similar to those of *D. zenobia*. Canal Zone specimens were collected by W. L. Peters and C. M. Keenan from the following localities: Rio Guanabano, 5 km (3 mi.) N of Ft. Clayton on Chiva Road, 9.IX.63; Rio Camaron, N edge of Ft. Clayton on Chiva Road, 9.IX.63; Rio Venado, Ft. Kobbe, 10.IX.63; Rio Pedro Miquel, George Green Park on Madden Road; 10.IX.63 (UU).

We are tentatively placing 2 other nymphs as possible allies of *D. zenobia*, principally because of the number of denticles, 7-8 in each instance. Both are rather small specimens, 4.0-4.5 mm in length. From Mexico a single nymph. Thorax reddish brown, central area of mesonotal shield rather grayed. Abdomen yellowish brown with reddish-brown tergal markings quite similar to fig. 11, 12; *anterior* margins of all terga narrowly black in dorsal area, posterior margins reddish brown. On terga 3-6, dark markings give the appearance of brown triangles on each side, bounded by submedian oblique dashes and lateral arched lines enclosing a yellow spot; yellow also between submedian dashes. Main trachea of gill darkened in basal half; a few dark lateral branches. Legs pale reddish brown; indistinct femoral streak. Labrum of Group I B (1); intermediary and 2 laterals present; mandibular incisors of Grade I; body of maxilla subequal, palpi of Type I; dilation of apical margin of 2nd segment of labial palpus rounded; 5-6 paraglossal spines; 7-9 tarsal spines. Ocosingo Valley, Chiapas Province, Mexico; Finca Monte Libano in tributary of Rio Santa Cruz; 1/7.VII.50; Goodnight and Stannard, collectors (UU).

From Guatemala, a single nymph. Dorsum of thorax very dark brown, pale median and lateral markings. Abdomen pale reddish brown dorsally, tergal markings much as in Mexican specimen. Gills larger, main trachea and lateral branches more distinct; convex margin blackish, much as in *D. zenobia*. Labrum, mandibles, maxillae and labial palpi as in *D. zenobia*; 4 paraglossal spines; 8-10 tarsal spines. Caudal filaments pale yellowish brown. Solola Pona Fachel, Guatemala; 31.VIII.62; G. G. Musser, coll. (UU).

Dactylobaetis penai Traver and Edmunds, new species Fig. 59, 71.

Represented by ♂ and ♀ imagos and nymphs. This species is named in honor of S. Luis Peña, the collector, who reared many of the nymphs to imagos. Turbinate eyes cinnamon brown to bright orange, moderate in size, on short to medium stalks, not contiguous dorsally; hemispheroidal. Abdomen dark reddish olive brown, 2-5 semi-hyaline, terga darker than sterna.

Tracheae along pleural fold narrowly black-outlined.

♂ *imago*. Body 5-6 mm; fore wing 5-6 mm. Frontal portion of head pale brown, yellow spot below each antenna; dark brown stripe from below lower eye to lateral ocellus, narrower stripe upward at right angles from this alongside ocellus. Vertex yellowish, narrow dark mid-line; inner basal margin of stalk of turbinate eye dark brown. Turbinate eyes ranging in color from reddish cinnamon brown to bright orange; moderate in size; not contiguous dorsally; on short to moderate stalks; hemispheroidal. Dorsum of thorax dark reddish to blackish brown, pronotum slightly paler than mesonotum. Lateral margins of pronotum blackish; yellowish mottling laterally; small yellowish submedian spot may be present each side of mid-line. Mesonotum with mid-line and both inner and outer parapsidal furrows narrowly black; creamy triangular area at anterolateral angle enclosing 2 oblique black lines; often a small red spot on anterior margin laterally. Creamy spot anterior to mesonotal scutellum; in some specimens small red spots in same area; scutellum pale, narrowly black-margined, black below lateral crests; blackish-brown areas each side anterior of scutellum along bases of wings. Metanotum dull dark blackish brown; margins, submedian lines and tip of scutellum blackish; pale spots each side above leg bases and submedially on anterior margin. Pleura reddish brown; black longitudinal streak above and around bases of legs; ventrad of this a wide creamy yellow streak surrounding leg bases. Prosternum yellowish, posterior margin dark brown. Prominent black butterfly-shaped area, enclosing 2 small pale dots, occupies most of meso- and metasterna, the 'hind wings' darker than 'fore wings' of this figure. Legs yellowish. Femur I, tip of tibia I and tarsus I faintly brown-shaded; claws blackish. Femora II and III with less brown shading; tarsal joinings and 1 claw on legs II and III narrowly darkened. Wings hyaline, whitish. Longitudinal veins along costal margin of fore wing pale yellowish, very narrowly brown-tinged at extreme base; costal margin in stigmatic area narrowly darkened; other veins pale; 5-7 simple slanting stigmatic cross veins, 2 of which may be slightly anastomosed. Hind wing as in fig. 71.

Abdominal segments 2-6 semi-hyaline, terga darker than sterna. Terga rather dark olive brown with reddish tinge; *posterior* margins faintly red-tinged in dorsal area; *anterior* margins narrowly darkened, principally in lateral areas. On terga 2-6: narrow dusky mid-line; faint submedian oblique dashes from anterior margin; tiny submedian dots, 1 at end of each submedian dash. Sterna 2-6 paler olive brown than terga. Segments 7-10 opaque. Both terga and sterna may be largely creamy with distinct pinkish tinge; in other specimens, terga pale reddish brown, sterna creamy to yellowish. Dark line along pleural fold on tergum 9; terga 7-10 often with creamy lateral margins adjoining pleural fold. Tracheal trunk along pleural fold narrowly black; an occasional short lateral branch from main trunk; usually 2 small stigmatic dots per segment. Both anterior and posterior margins of all sterna narrowly darkened; a brownish longitudinal streak often present, paralleling pleural fold; on sterna 7-10, narrow submedian streaks may parallel the mid-ventral line. Caudal filaments pale yellowish. On many but not all specimens, apical joinings of the first 4 or 5 segments are reddish. Genitalia pale brown; basal segment of forceps rather long (fig. 59).

♀ *imago*. Body 4.5-6.5 mm; fore wing 5.0-6.5 mm. Head pale reddish brown; faint dark markings below eye and above antennae; vertex creamy in some specimens; dusky submedian streaks on vertex. Antennae pale reddish brown, scape and pedicel narrowly darker apically. Thorax reddish brown. Pronotum dark on lateral margins; V-shaped brown areas on each side, outlined in dark brown. Sclerites of mesonotum narrowly dark-margined; creamy area and small red spot anterolaterally may be present or absent. Mesonotal scutellum and adjacent areas, also metanotum, much as in ♂ but often paler. Pleura as in ♂ but longitudinal streak less well defined, paler. Thoracic sternum largely reddish brown; slightly darker brown shading anteriorly on mesosternum; dark butterfly-shaped area present in some specimens only. Legs as in ♂. All veins in fore wing of some specimens very pale yellowish brown; 5-7 complete and 1-2 incomplete stigmatic cross veins, 2 of which may show slight anastomosis. Abdomen

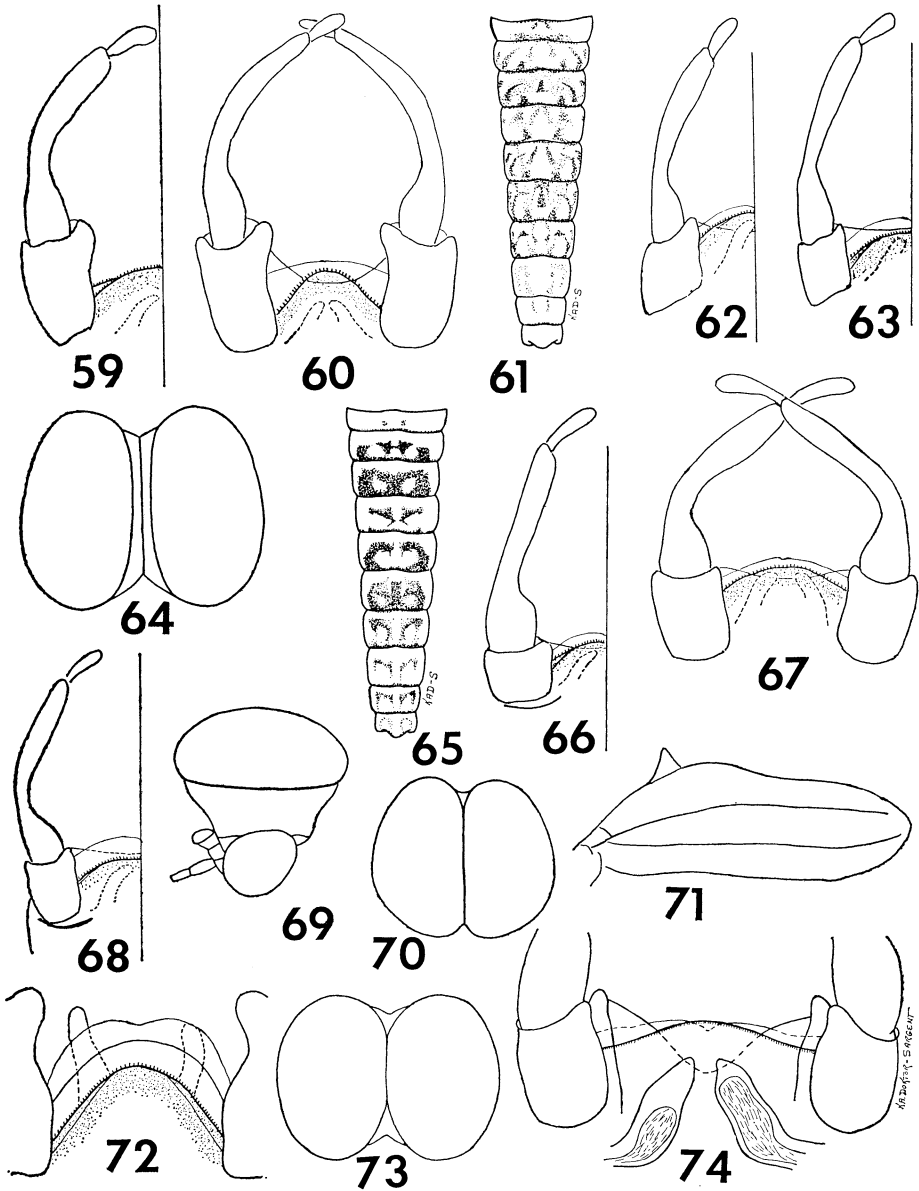


Fig. 59-74. *Dactylobaetis*: imagos, nymphs. 59, *D. penai*: genitalia of ♂ imago, ventral view. 60, *D. arriaga*: genitalia of ♂ imago, ventral view. 61, *D. serapis*: tergal pattern of nymph. 62, *D. jenseni*: genitalia of ♂ imago, ventral view. 63, *D. zenobia*: genitalia of ♂ imago, ventral view. 64, *D. cepheus*: turbinate eyes of ♂ imago, dorsal view. 65, *D. phaedrus*: tergal pattern of nymph. 66, *Dactylobaetis* sp. A: genitalia of ♂ imago, ventral view. 67, *D. cepheus*: genitalia of ♂ imago, ventral view. 68, *D. chiapas*: genitalia of ♂ imago, ventral view. 69, *D. cepheus*: turbinate eyes of ♂ imago, lateral view. 70, *Dactylobaetis* sp. B: turbinate eyes of ♂

pale reddish to orange brown, darker dorsally; opaque when ova are present. Tergal markings essentially as in male but much less distinct except for anterior and posterior margins. Terga 7-10 tinged with pale olive brown; irregular creamy areas may be present along anterior margins. Abdominal sterna paler than terga, slightly yellow-tinged; little or no distinction in color between 1-6 and 7-9. Caudal filaments pale yellowish; not darkened at joinings.

Nymph. Diagnosis. Claws with 29-30 denticles, 30 the usual number. Labrum of Group I B (2); intermediary absent, 3 laterals. Mandibular incisors of Grade II or early Grade III; thumb-like process on left mandible moderately long, rather stout at base. Body of maxilla subequal; palpi of Type II. Dilation of 2nd segment of labial palpus sharp-pointed; 3-4 spines on dorsal surface of paraglossae. Abdominal gills with darkened tracheae; no thoracic gill. Body pale yellowish ventrally, grayish olive to reddish brown dorsally; tergal markings essentially as in *D. warreni* (see fig. 11, 12).

Body 6-7 mm. Head yellowish anterior to ocelli; narrow dark streak laterally below eyes, from outer margin to anterior margin of lateral ocellus; small brown spot between ocelli. Vertex narrowly pale at mid-line; dark grayish brown laterally in ♀; turbinate eyes of ♂ dark reddish brown. Antennae yellowish; apical portion of filament dusky. Pronotum dark reddish brown in nymphs with blackened wing-pads, grayish brown in others; small black submedian spot at anterior margin; mid-area paler than lateral areas, mid-line narrowly pale, becoming V-shaped near posterior margin; posterolateral corners narrowly dark-margined. Mesonotum grayed olive brown to dark reddish brown; mid-line and inner parapsidal furrows narrowly pale; yellowish mottling anterior to wing roots. Scutellum and lateral areas anterior to it blackish. Black submedian spots on metanotum at anterior margin. Pleura yellowish to pale reddish brown, with black markings; grayish-brown crescentic areas around leg bases. Sternum yellow; anterior portion of mesosternum outlined in black, may be brown-shaded. Legs yellowish. Femora with transverse gray bands, posterior margins narrowly dark brown, femur I may be brown-shaded; femoro-tibial articulation blackish brown. Tibiae and tarsi brown-shaded. *No thoracic gill* near base of leg I. Abdominal terga grayish olive to dusky reddish brown. Terga 2-7: darker submedian oblique dashes from anterior margin, at end of each dash a dark dot; lateral dark bands from anterior margin extending toward posterolateral corners. Anterolateral areas of terga 2-6 pale yellowish, a dark dot each side above pleural fold. On terga 8-10, submedian dashes only, these parallel to mid-line; tergum 8 in some specimens pale yellowish white without markings. Both anterior and posterior margins of terga narrowly blackish brown. Abdominal sterna yellowish; anterior margins narrowly darkened; brownish longitudinal stripe adjacent to pleura fold on sterna 3-9, faint on 3 and 4, distinct on 5-9; dark brown mark at end of each stripe, somewhat oblique on 5 and 6. On some specimens, faint traces of submedian oblique dashes on sterna 6-8. Gills pale yellowish white, narrowly darkened along inner margins; main trachea and a few lateral branches on inner side darkened. Caudal filaments yellowish to yellowish brown; tips dark brown to black; indistinct dark band halfway between base and tip.

All known specimens of this species are from Cordoba Province, Argentina.

Holotype ♂ imago, reared from nymph by L. Peña. Los Condores (ca. 25 km NE of Villa Cura Brochero); 14. IV. 67. In collection of University of Utah. Allotype ♀ imago, reared from nymph by L. Peña. Same data as holotype (UU). Paratypes. 2 ♂ and 2 ♀

imago, dorsal view. 71, *D. penai*: hind wing of ♂ imago (Drawn at same magnification as Fig. 44-47 and 51-53). 72, *D. arriaga*: portion of genitalia of ♂ imago, showing position of membranes between bases of forceps with "penes" thrust apicad. 73, *D. arriaga*: turbinate eyes of ♂ imago, dorsal view. 74, *Dactylobaetis* sp. A: portion of genitalia of ♂ imago, showing "penes" below level of 'penis cover', sperm ducts with sperms extending alongside but not within the "penes".

imago, reared from nymphs by L. Peña: Copina (ca. 25 km WNW of Alta Gracia), elev. 1650 m; 11/14.IV.67 (UU). 1 ♀ imago, reared from nymph by L. Peña: Rio Poche (25 km WSW of Salsacate), elev. 1100 m; 15/17.IV.67. (UU). 40 ♂ imagos: Rio Poche (25 km WSW of Salsacate); 15/17.IV.67: L. Peña, coll. (UU). Forty nymphs, 20 of each sex: Copina (ca. 25 km WNW of Alta Gracia), elev. 1965 m; 11/14.IV.67; L. Peña, collector (UU). 3 ♂ and 2 ♀ nymphs: Los Condores; 14.IV.67; L. Peña, collector (UU). One ♂ and 1 ♀ nymph: Rio Poche; 15/17.IV.67; L. Peña, collector (UU).

Other specimens of this species not included among the types: 1 ♀ subimago: Los Condores (ca. 25 km NE of Villa Cura Brochero); 14.IV.67; reared from nymph by L. Peña (UU). 2 ♂ subimagos, reared from nymphs by L. Peña: Copina; 11/14.IV.67 (UU). One ♂ and 3 ♀ imagos: Rio Anzicate at Highway #36 (ca. 7 km SSE of Alta Gracia): 9/11.IV.67; L. Peña, collector (UU).

Imagos of *D. penai* seem most closely related to *D. cepheus*, both species having semi-hyaline abdominal segments 2-5, with dorsum of abdomen distinctly darker than venter. More creamy markings occur on the thorax of *D. penai*; the dark longitudinal streak on the pleura with the yellow streak ventrad to it are much more distinct; metanotum not brighter in color than mesonotum; dark markings on thoracic sternum much more evident; basal segment of forceps longer, almost 1/2 the length of the 2nd segment. Nymphs of *D. penai* bear some resemblance to those of *D. anubis* from Brazil, but differ in certain details of labrum and mandibular incisors and in the absence of a thoracic gill.

Dactylobaetis arriaga Traver and Edmunds, new species Fig. 47, 60, 72, 73.

Known from ♂ and ♀ imagos. Turbinate eyes large, orange, contiguous dorsally; ellipsoidal (fig. 73). Thorax yellowish with black pencilings. Abdominal segments 1-6 whitish. Posterior margins of terga 1-3, 6 and 10 purplish black dorsally, widest on 6 at mid-line. Tracheae along pleural fold not darkened.

♂ *imago*. Body 5 mm; fore wing 5 mm. Head yellowish. Scape and pedicel of antennae each narrowly dark brown at apex, filament faintly dusky. Turbinate eyes orange, quite large in size, in most specimens contiguous dorsally, ellipsoidal, set on rather short stalks. Thorax yellowish to pale yellowish brown. Pronotum paler than mesonotum; brownish penciling laterally following course of tracheae; mid-area pale. Anterior 1/2 of mesonotum narrowly margined laterally with dark brown; mid-line narrowly darker in central area only; tip of scutellum pale, but dark along lateral margins and on line extending forward above wing bases; black pencilings along anterolateral margin and on pleura above bases of legs. Metanotal scutellum narrowly dark brown at tip and on lateral margins, posterior margin brownish. Thoracic sternum pale, unmarked. Little or no distinction in color between thoracic notum and pleura.

Legs pale yellowish white, claws dark-tinged. Venation hyaline; S_c and R_1 of fore wing faintly yellowish in basal portion. Four complete stigmatic cross veins and 2 others incomplete on Sc . Area of costal angulation of hind wing slightly granulated; angulation rather sharp-tipped (fig. 47). Abdominal segments 1-6 whitish, semi-hyaline. Posterior margins of terga 1-3 and 6 purplish black dorsally, this border widest on 6 at mid-line; terga 4-5 wholly pale. Tiny stigmatic dots may be present on terga 4-6. Tergum 7 yellowish brown dorsally, anterolateral triangles paler; black longitudinal line parallel to pleural fold. Segments 8-10 and sternum of 7 pale yellow, opaque; posterior margin of tergum 10 blackish. Caudal filaments pale yellowish white, not darkened at joinings. Genitalia as in fig. 60, 72.

♀ *imago*. As in ♂ but fewer dark pencilings on thorax; abdomen semi-opaque. Minute stigmatic dots on terga 4-6.

♂ *subimago*. Turbinate eyes slightly smaller than in imago. Thorax darker brown; black transverse line on mesonotal pleura posterior to base of leg I; black longitudinal line on metanotal pleura above leg base. Abdomen yellow, opaque; same tergal markings as in imago.

Holotype ♂ imago. Mexico; Arriaga, Chiapas Prov.; 22. VIII. 65; P. J. Spangler, coll. In collection of University of Utah. Allotype ♀ imago. Same data as holotype (UU). Paratypes 4 ♂ imagos. Same data as holotype (UU).

The whitish semi-hyaline segments 1-6, the purplish-black *posterior* margins of terga 1-3, 6 and 10, the absence of black pencilings along the tracheae of the abdominal pleura, the yellow thorax and the large orange contiguous turbinate eyes: these characters taken together distinguish this species from all others of the genus.

Dactylobaetis chiapas Traver and Edmunds, new species Fig. 45, 68.

Known from ♂ and ♀ imagos. Turbinate eyes yellow, of moderate size, not contiguous dorsally; hemispheroidal. Abdominal segments 1-6 yellowish white, semi-hyaline, *anterior* margins of terga 2-6 very narrowly dark-shaded in *lateral* portions only; pleural fold distinctly outlined in black.

♂ *imago*. Body 4.5 mm.; fore wing 4 mm. Head yellowish; pedicel of antennae red-tinged at apex, filament faintly dusky. Turbinate eyes of moderate size, yellow, not contiguous dorsally, hemispheroidal; on stalks of medium height. Thorax yellow. Pronotum brown-shaded except in mid-area, lateral margins darker brown. Mesonotum rather deeper in color than pleura; metanotum not darker than mesonotum; traces of dark pencilings above leg bases and along anterolateral margins of notum. Thoracic sterna concolorous with pleura, no dark markings. Legs pale yellowish white; tarsal joinings very narrowly brown, claws brown-shaded. Venation hyaline; 3-6 stigmatic cross veins in fore wing, simple, slanting, occasionally 1 or more may be incomplete at Sc. Hind wing as in fig. 45. Abdominal segments 1-6 semi-hyaline, yellowish white. *Anterior* margins of terga 2-6, very faintly brown shaded in *lateral* areas only, above pleural fold; mid-dorsal areas of these terga usually pale although in a few specimens *very indistinct* reddish to purplish-brown submedian dots may occur on 2 and 3. Segments 7-10 opaque yellow; tergum 10 narrowly darkened on posterior margin. Tracheae along pleural fold outlined distinctly in double black line. All sterna unmarked. Caudal filaments whitish, joinings opaque but not darkened. Genitalia as in fig. 68.

♀ *imago*. Body 4.0-4.5 mm; fore wing 4 mm. As in ♂, but black markings on thorax even less distinct. Prominent darkened branches from tracheae of pleural fold extend dorsad on terga 2-4 or 2-5; stigmatic dots present.

Holotype ♂ imago. Mexico; Arriaga, Chiapas Prov.; 22. VIII. 65; P. J. Spangler, coll. In collection of University of Utah. Allotype ♀ imago. Same data as holotype (UU). Paratypes. 11 ♂ and 13 ♀ imagos, same data as holotype (UU and USNM).

A combination of the following features should differentiate *D. chiapas* from other species in this genus: turbinate eyes yellow, not contiguous dorsally; thorax *yellow*, mesonotum slightly deeper in color than pleura and sterna; abdominal segments 1-6 white, semi-hyaline, terga with brownish shading at *anterior* margins in *lateral* area; well-marked tracheae on pleural fold.

Dactylobaetis jenseni Traver and Edmunds, new species Fig. 52, 62.

Known only from ♂ imagos. Turbinate eyes quite large, orange, almost contiguous dorsally, hemispheroidal. Abdominal segments 1-6 whitish, semi-hyaline, posterior margins narrowly reddish black; purplish red triangular markings laterally on terga 2-3 and 5-6, fainter markings of same color each side of mid-line on 2-3. Tracheae along pleural fold distinctly darkened.

♂ *imago*. Body 4.0-4.5 mm; fore wing 4 mm. Head yellowish; brown shading laterally between eyes and lateral ocelli. Scape and pedicel of antennae and apical 1/2 of filament faintly red tinged. Turbinate eyes quite large, orange, on rather short stalks; almost contiguous dorsally at mid-area, well separated anteriorly. Pronotum rather dark brown laterally; narrowly black on lateral margins and on posterior margin each side of paler mid-line. Mesonotum pale yellowish brown; dark brown pencilings along anterolateral margins and laterally between notum and pleura; scutellum pale yellowish. Pleura yellowish. Metanotum yellowish brown. Thoracic sternum yellow, unmarked.

Legs yellowish white; tarsal joinings very narrowly darkened; claws dusky at bases. Venation hyaline. Hind wing as in fig. 52. Abdominal segments white, semi-hyaline. *Posterior* margins of terga 1-6 narrowly reddish black, most heavily marked on 2-3 and 5. Purplish red triangular markings, bases on posterior margins, laterally on terga 2-3 and 5-6 above pleural fold, tips of triangles extending to or beyond middle of terga. In addition, paler purplish triangles on 2 and 3, dorsolateral in position, tips extending almost to middle of terga; narrow stripe of same color borders midline; similar markings very faintly indicated also on tergum 6. Segments 7-10 opaque, yellowish; posterior margins very narrowly darkened. Tracheae along pleural fold strongly black-outlined on segments 2-6, more faintly on 7 and 8. Abdominal sterna unmarked. Caudal filaments whitish, not darkened at joinings. Genitalia as in fig. 62.

♀. Unknown.

We take pleasure in naming this species for Mr Steven L. Jensen, our artist, who has recently made a comprehensive study of the mayflies of Idaho.

Holotype ♂ imago. Mexico; Arriaga, Chiapas Prov.; 22.VIII.65; P. J. Spangler, collector. In collection of University of Utah. Paratypes. 2 ♂ imagos, same data as holotype (UU)

D. jenseni is readily separable from all other species of this genus, with the exception of a single male subimago from Peru, by reason of the purplish red triangular markings on some of the terga. These markings, together with the rather large orange turbinate eyes, the well-marked tracheae of the pleural fold, the dark *posterior* margins of terga 1-6 and the rather pale thorax distinguish *D. jenseni* from all other species.

Imagos designated by letter only

As previously indicated, the following two groups of imagos, both from Mexico, are here described but not named, designated merely as sp. A and sp. B. Reasons for this have already been stated.

Dactylobaetis sp. A. Fig. 5, 53, 66, 74.

♂♂: Body 4.5-5.5 mm; fore wing 4.5 mm. ♀♀: Body 4.5-5.5 mm; fore wing 5.0-5.5 mm. Turbinate eyes of ♂ yellowish, small to moderate in size, on stalks of medium height; hemispheroidal, divergent dorsally. Head and thorax pale reddish brown. Scape and pedicel of anten-

nae pale reddish brown, slightly darker apically, filaments pale. Lateral areas of pronotum shaded with darker brown; dark line above leg base. Mesonotal scutellum pale, margined by darker areas; narrow brownish border anteriorly before wing bases; metanotum not darker in color than mesonotum. Narrow brownish lines on pleura above leg bases; sternum yellowish. Femora pale yellowish, tibiae and tarsi yellowish white; no dark markings; claws faintly brown-tinged. Longitudinal veins along costal margin pale yellowish, all others hyaline. Five-7 slanting stigmatic cross veins in fore wing, occasionally 1 such vein may be forked. Hind wing as in fig. 53. Abdomen yellowish white, semihyaline, no difference in color between dorsum and venter; joinings of terga may be rather opaque but not darkened; tracheae of pleural fold not darkened. Caudal filaments pale yellowish white, not darker at joinings. Genitalia as in fig. 5, 66, 74. ♀ paler than ♂. Head and thorax yellowish with very faint reddish tinge. Legs and wings as in ♂. Abdomen appears pale reddish brown when ova are present, otherwise yellowish. Caudal filaments as in ♂. Species represented by 10 ♂ imagos, 13 ♀ imagos and 2 ♂ subimagos. Mexico: Tamaulipas Province, Rio Guayalejo; 22. XII. 39; L. Berner, collector (JRT).

Adults of *Dactylobaetis* sp. A differ thus from *D. warreni*: turbinate eyes rather smaller, more widely divergent dorsally, on stalks of medium height; metanotum not darker in color than mesonotum; tracheae of pleural fold not darkened. The lack of tergal markings separates *Dactylobaetis* sp. A from all other species of the genus having semi-hyaline mid-abdominal segments. It is possible that sp. A may prove to be the adult stage of *D. mexicanus*, which is known from nymphs only.

***Dactylobaetis* sp. B.** Fig. 49, 70.

♂: Body 5.5 mm; fore wing 6.0-6.5 mm. ♀: body 6.5 mm; fore wing 7.5 mm. Turbinate eyes of ♂ large, orange, hemispheroidal, almost contiguous dorsally (fig. 70). Head and thorax largely reddish brown. Scape of antennae pale reddish brown, darker at apex; pedicel yellowish; filaments missing. Lateral and posterior margins of pronotum narrowly dark brown. Mid-line of mesonotal shield narrowly dark, as are also inner and outer parapsidal furrows, paler area laterad of inner furrow; scutellum yellowish. Metanotum and metasternum brighter red-brown than mesothorax; narrow mid-line, tip of scutellum and posterior margin of metanotum darker brown. Pleura pale reddish brown, darker markings above leg bases; prosternum yellowish brown; mesosternum reddish brown, darker at anterior margin. Legs yellowish, claws faintly brown-tinged. Longitudinal veins in fore wing, especially along costal margin, very pale yellowish. Three-5 complete slanting stigmatic cross veins in fore wing plus 1-3 incomplete ones. Hind wing as in fig. 49. Abdomen yellowish brown dorsally, slightly paler ventrally; segments 1-6 semi-opaque, 7-10 opaque, anterior margins narrowly dark brown; terga 7, 8 and 10 somewhat darker than others, 9 pale in mid-area. Pleural fold faintly margined with brown on ventral side; tracheae not darkened; 1 or 2 stigmatic dots in most segments. Caudal filaments missing. Head of ♀ flesh-colored; thorax rather pale yellowish brown; femora pale yellow, tibiae and tarsi whitish, tips of claws pale orange. In 1♀, 7 incomplete stigmatic cross veins; in another, 4-5 are complete, 1-2 incomplete. Abdomen yellowish; as in ♂ but only terga are dark-margined. Tracheae of pleural fold very faintly black-outlined, as are a few lateral branches. Ova impart a pinkish cast to abdomen. Two ♂ and 3 ♀ imagos, 2 subimago ♂; Metlac, Mexico; 25. XII. 40; H. H. Hobbs, collector (JRT).

Dactylobaetis sp. B is distinguishable from *D. zenobia*, the only other species of this genus having semi-opaque abdominal segments: abdominal terga less opaque and yellowish instead of dark olive brown; absence of darkened tracheal trunk; larger turbinate eyes more closely approximated dorsally. From *D. warreni* and *D. cepheus*, in both of which the metanotum is also brighter reddish brown than the mesothorax, *Dactylobaetis* sp. B is sepa-

rable by reason of the semi-opacity of the abdominal segments, lack of darkened tracheal trunk and longer fore wing.

Dactylobaetis mexicanus Traver and Edmunds, new species Fig. 2, 10, 24.

This species is known from nymphs only.

Diagnosis. Claws with 5-6 denticles (fig. 2, 10). Labrum of Group I B (1); no intermediary, 2 laterals. Mandibular incisors of Grade I; on left mandible, middle, denticle very minute; thumb blunt, wide at base. Maxillary body subequal; palpi of Type I. Dilation on inner margin of 2nd segment of labial palpus rounded; 6-7 spines on dorsal surface of paraglossae. Gills seldom show any darkening of the tracheae. Body pale reddish brown.

Body of nymph 4.0-5.5 mm. Head of ♂ yellowish, developing turbinate eyes reddish brown; no dark spot between ocelli. Pronotum yellow, lateral areas mottled with brown, a dark spot on each side of pale mid-line near anterior margin. Mesonotum pale reddish brown; darker mid-stripe contains a very narrow pale mid-line; on each side of mid-stripe a pale line, followed by a wider brownish band with irregular margins, laterad of this a paler area; a small dark spot may be present just above base of wing bud. Metanotum dark reddish brown, mid-line narrowly pale. Sternum pale yellowish. Legs yellowish; no dark mark on femora except shading at femoro-tibial articulation; tarsi and claws brown-shaded. Eight-14 tarsal spines, most numerous on leg 1; 4-5 spines at tip of tibia. Abdominal terga 4-6 as in fig. 24. Anterior margin of tergum 1 brown, remainder pale; tergum 2 narrowly black at mid-anterior margin; brown oblique submedian dashes may be connected apically; an oblique streak from black anterior margin almost to posterolateral corner on each side; tergum 8 largely pale. Posterior margins of all terga very narrowly darkened, most evident on 5-7 and 9-10. Posterior margins of sterna very narrowly darkened; apical sterna somewhat darker than those preceding. Caudal filaments yellow, faintly smoky apically; terminal filament almost as long as cerci. Female nymphs essentially as in ♂♂, but abdomen less well marked on most specimens. Head wholly yellowish. Two dark spots on metanotum, 1 each side of mid-line, in some specimens. Terga 8-10 and apical 1/2 of 7 often mostly pale.

Holotype ♂ nymph, mature. Rio Guayalejo, Tamaulipas Prov., Mexico; 22. XII. 39; L. Berner, coll. In personal collection of J. R. Traver. Paratypes. 7 mature ♂ and 8 mature ♀ nymphs, same data as above. A few immatures in same vial are not included as paratypes. 6 ♂♂ and 7 ♀♀ all nearly mature, same data as for holotype (JRT, LB). For the above locations, we quote from Dr Berner's field notes: "Near village of Magiscatzin where river crosses Tampico road. Broad (200-300 feet), deep. Slowly flowing in deeper areas. Flowing through clay hills; bottom composed of sticky gray clay. Young burrowers here; also some submerged vegetation at banks from which Baetinae taken... Mayflies are the most predominant form in the river, with the caddis-flies running a close second". From Rio Frio, Tamaulipas Prov., Mexico, 24. XII. 39; L. Berner, coll. (JRT); 2 mature and 1 immature ♂ nymphs, 2 immature ♀ nymphs. At same location but taken on 20. XII. 39 another mature ♂ nymph. Of the December 20 collection site, Dr Berner notes: "Slowly flowing river.... deep.... Vegetation anchored near shore and moss on surface of rocks was abode of mayflies-not common here"... For the Dec. 24 area he writes: "Very swiftly flowing; white caps formed. Fauna much like that of Guayalejo which is only a short distance away and into which the Rio Frio flows. *Baetis*... taken from floating roots in slower water." From 16 km (10 mi.) N of Monterey, Mexico; 25. XII. 47; S. Mulaik, collector (JRT), another mature ♂ nymph.

Several other specimens taken by L. Berner and other collectors, although not included among the types, seem quite probably to belong in this species. These are from the following localities; Río Ramos, Nuevo Leon Prov., Mexico, 20. XII. 39; Santiago, N. L. Prov., same date; Río Potosi, N. L. Prov., same date, L. Berner, collector (JRT) Metlac, Veracruz Prov., Mexico, a single mature ♂ nymph, 26. XII. 40, H. H. Hobbs, collector (JRT); Río Santa Lucia, N. L. Prov., Linares, Mexico, 28. XII. 47, S. Mulaik, collector (JRT).

Nymphs of *Dactylobaetis mexicanus* differ thus from those of *D. warreni*: 5-6 denticles only on each claw; smaller specimens, somewhat paler in color, dorsal markings on thorax and abdomen less well defined. The imagos listed as *Dactylobaetis* sp. A, taken from the same locality and on the same date as the types of *D. mexicanus*, probably represent the adult stages of these nymphs.

Dactylobaetis musseri Traver and Edmunds, new species Fig. 6, 14, 26, 34, 43, 81.

This species is represented by nymphs only. The species is named in honor of G. G. Musser who collected many specimens in Mexico, Guatemala and Costa Rica.

Diagnosis. Claws with 30-35 denticles (fig. 14, 26). Labrum of Group, I B (2); intermediary and 5-6 lateral spines (fig. 34). Mandibular incisors of Grade II or Grade III; short and flattened to slightly pyramidal on left mandible, pyramidal on right; thumb unusually long and slender. Molar surface of left mandible tends to be more or less parallel to apical margin (fig. 43). Maxillary body subequal; palpi of Type II. Dilatation at inner apical margin of labial palpus truncate (fig. 81); 3-4 spines on dorsal surface of paraglossae. Gills pale, tracheae only faintly darkened. Body reddish brown dorsally, dark reddish brown tergal markings.

Body of nymph: 5.75-6.0 mm in ♂♂; 7.0-8.0 mm in ♀♀. Frons of head yellow at extreme mid-anterior margin; broad orange-brown transverse band passing through and around bases of ocelli. Vertex of head dusky reddish brown, mid-line pale; turbinate eyes of ♂ nymph orange brown. Pronotum yellowish on paler specimens, yellowish to reddish brown on others; all margins and submedian lines each side of mid-line darker; lateral margins mottled. Mesonotum reddish brown, very dark in fully mature nymphs; mid-line and inner parapsidal furrows pale, anterior margin dark brown, yellowish mottling anterolaterally. Metanotum reddish brown, midline narrowly pale, dark submedian spots on or near anterior margin. Legs yellowish. Brown transverse bands on femora of ♂♂, faintly indicated on ♀♀; femoro-tibial articulation brown-shaded; tibiae narrowly blackish at apex; tips of tarsi and claws orange-brown. Two spines only at tip of tibia; 5-6 tarsal spines. Abdominal terga reddish brown; both anterior and posterior margins narrowly dark brown; tergal markings dark reddish brown (fig. 6). Terga 3, 6 and 7 darker than others; in ♂♂ tergum 8 and often the anterior portion of tergum 9 pale. Abdominal sterna yellowish, apical margins faintly brown-shaded; narrowly brownish on anterior margins; a brown line each side parallel to pleural fold, darker spot at apical end of this line on sterna 6 and 7. Gills pale; tracheae faintly or not at all darkened. Caudal filaments yellowish to very pale yellowish brown; not darkened at tips, no dusky transverse band at mid-length.

Holotype ♂ nymph. Mexico, Veracruz Prov., Tenndido River, 3 km N of El Fortin; 1. VII. 55; R. B. Selander, coll. In collection of University of Utah. Paratypes: 5 ♂ and 19 ♀ nymphs, same data as holotype (UU); 7 ♂♂ and 1 ♀ nymph, Solola Pena Fachel, Guatemala, 31. VIII. 62; G. G. Musser, coll. (UU); 1 ♀ nymph, Mexico, Veracruz Prov., Metlac, 26. XII. 40. H. H. Hobbs, coll. (JRT).

Nymphs of *Dactylobaetis musseri* resemble those of *D. penai* from Argentina in certain morphological features, but differ in these respects. Intermediary spine present on

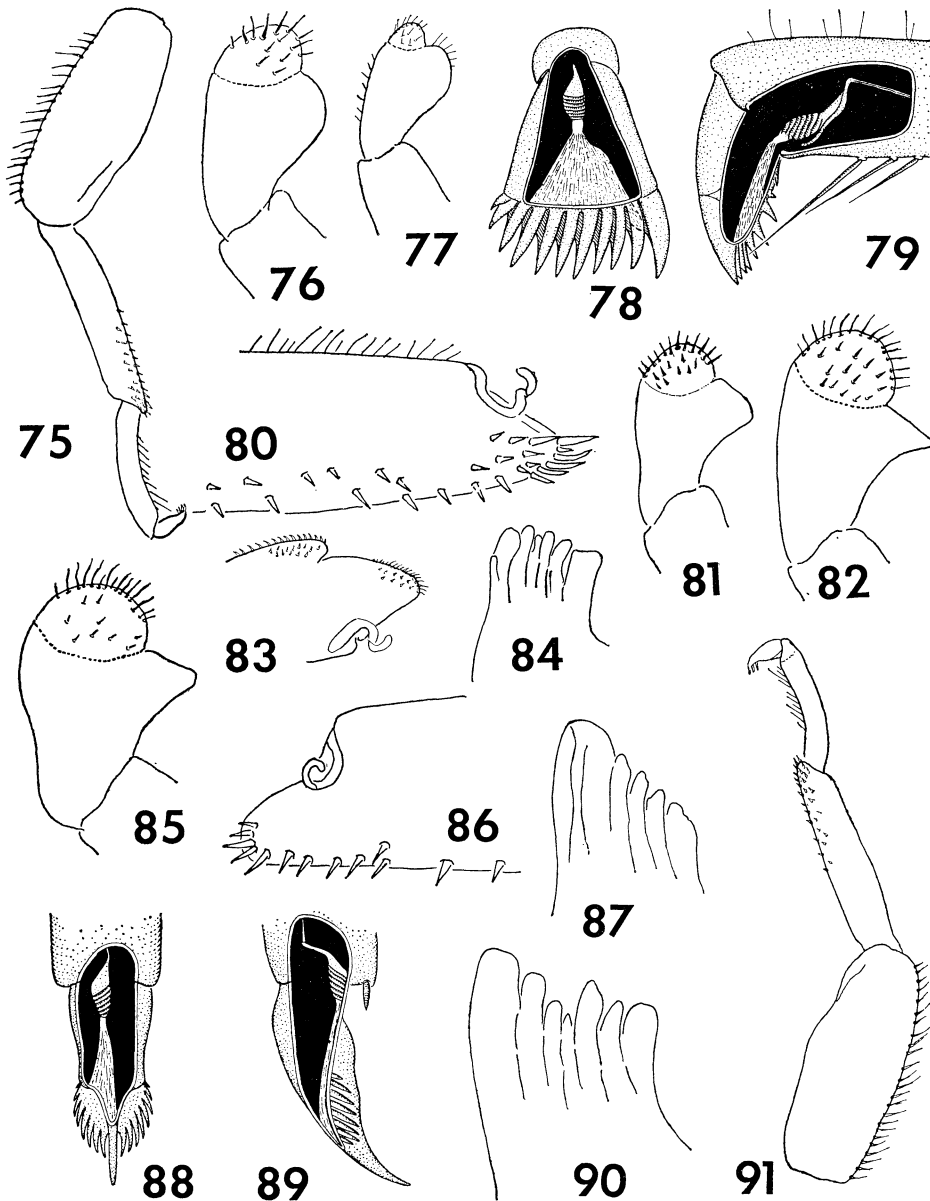


Fig. 75-91. *Dactylobaetis*, *Camelobaetidius* and baetid of unknown genus from Peru; nymphal structures. All are *Dactylobaetis* unless indicated. 75, *D. phaedrus*: leg I. 76, *D. warreni*: labial palpus, distal portion. 77, *Camelobaetidius mantis*: labial palpus, distal portion. 78-80, *D. phaedrus*: inner structure of claw, showing denticles, deltoid tendon-like region, unguitractor plate fastened by tendon-like extension to levator muscles; dorsal view. 79, inner structure of claw showing same features listed in Fig. 78; lateral view. 80, tip of tibia I. 81, *D. musseri*: labial palpus.

labrum, 5-6 instead of 3 laterals; thumb on left mandible more slender; dilation at inner apical margin of 2nd segment of labial palpus truncate rather than sharp-pointed; tracheae in gills only faintly darkened. Body reddish brown dorsally rather than grayish olive brown; caudal filaments not darkened at tips, no dusky midway transverse band present.

It is quite possible that the imagos here described as *Dactylobaetis* sp. B, taken at Metlac, Mexico on approximately the same date as 1 ♀ paratype of *D. musseri*, represent the adult stage of nymphs of this species.

Allies of D. musseri. Nymphs from 2 localities in Costa Rica are closely allied to *D. musseri*. One series is from San Jose, San Jose Prov., C.R., 1160 m; 9. VIII. 62; G. G. Musser, coll. (UU). 4 ♂ nymphs in this collection measure 5.0-5.5 mm; 8 ♀♀, 4.75-5.0 mm. Claws with 30-35 denticles; labrum of Group I B (1); 4 lateral spines, no intermediary; mandibular incisors of Grade II; maxillary body subequal, palpi of Type II; dilation of 2nd segment of labial palpus truncate. On only 2 specimens is there even a faint indication of the brown triangle between ocelli. Head reddish brown with pale mid-line. Dark bands on femora; 3-4 spines at tip of tibia; 6-8 tarsal spines. Terga rather similar to those of *D. musseri*; 1 and 8 pale in ♂, likewise parts of 2, sometimes also of 7; sterna somewhat better marked than in *D. musseri*. Caudal filaments darkened at tips. The 2nd series is from Heredia, Rio Sarapiquí, Puerto Viejo, C.R.; 90 m (300 ft); 10. VII. 62; G. G. Musser, coll. (UU). 5 ♂♂, 4.5-5.0 mm in length; 7 ♀♀ 5.0-5.5 mm. Claws with 30-35 denticles; labrum of Group I B (1); no intermediary, 3-4 laterals; mandibular incisors of Grade I; maxillary body short to subequal, palpi of type II; dilation of 2nd segment of labial palpus truncate. Dark band across femora; 2-3 spines at tip of tibia III; 4-7 tarsal spines. Tergum 8 and parts of 1 and 2 pale, in ♂♂, Sterna as in San Jose specimens. Caudal filaments in mature specimens wholly brownish except for a pale band preceding tip. These 2 series from Costa Rica may represent species distinct from *D. musseri* and perhaps from one another.

Two series of nymphs from Honduras are tentatively listed as allies of *D. musseri*. Series 1 is composed of 27 nymphs, 5.5-6.5 mm in length; claws with 35-40 denticles; labrum of Group I B (2) as in *D. musseri*; mandibular incisors of Grade II; maxillary body subequal, palpi of Type II; dilation of 2nd segment of labial palpus more pointed than truncate in many, but distinctly truncate in others; 3-4 paraglossal spines. Some have a dark brown spot between ocelli as in *D. musseri*. Femora dark at femoro-tibial articulation; longitudinal streak present but faint; claws and apex of tarsi very dark brown. Dorsum of thorax rather dark brown, markings quite distinct. Four-7 tarsal spines; 2-3 spines at tip of tibia. Abdominal terga yellowish brown with darker brown markings. Well marked ♂♂ have terga 3, 6, 7, 9 and 10 dark, 8 pale; ♀♀, terga 3, 6 and basal 1/2 of 7 dark, 8-10 pale. Gills quite large, main tracheae and branches darkened. Caudal filaments pale.

Series II consists of 21 nymphs; body ca. 4 mm in length; claws with 30-35 denticles. Lab-

tion. 82, *D. anubis*: labial palpus, distal portion. 83, *Camelobaetidius mantis*: tip of tibia I. 84, *D. serapis*: denticles of left mandible, showing outer denticle at left in "set back" position. 85, *Dactylobaetis* sp. from Rio Chillón, Peru: labial palpus, distal portion. 86, *D. warreni*: tip of tibia I. 87, *Dactylobaetis* sp. from San Jose, Costa Rica: denticles of left mandible, showing beginning of fusion in early Grade II of compaction. 88 & 89, Baetid nymph of unknown genus from Peru: inner structure of claw, showing denticles in an arc on either side of centrally located tip of claw; deltoid tendon inserted into central apex along denticles of 1 side of claw only; dorsal view. 89, inner structure of claw showing same features listed in Fig. 88; lateral view. 90, *D. warreni*: denticles of left mandible, representing Grade I of compaction. 91, *D. phaedrus*: leg III.

rum of Group I B (1) or I B (2); usually no intermediary, 3-4 lateral spines; mandibular incisors of Grade I in a few, of Grade II or III in others; in the latter case, incisors may be truncate. Maxillary body subequal, palpi of type II; dilation on 2nd segment of labial palpus rather pointed in some, definitely truncate in others; 2-4 paraglossal spines. Several morphological features in each of the 2 series resemble the same features in *D. musseri*. These groups may represent 2 as yet undescribed species.

A single ♀ nymph from Honduras very possibly belongs here. Body 5 mm; claws with 20 denticles; labrum of Group I B (1); intermediary and 5 lateral spines; maxillary body and palpi as in series II above; 3-4 paraglossal spines, dilation of 2nd segment of labial palpus rather truncate. Body pale yellowish brown dorsally, almost no dark markings on thorax or abdomen. Three-4 tarsal spines; 2-3 spines at tip of tibia. Main tracheal trunk in gills darkened near base, no laterals visible. It may represent still a 3rd undescribed species.

The above specimens were taken by J.S. Packer in 1964. Many are from localities listed for nymphs included under the discussion of *D. zenobia*. Localities not previously listed are: Dept. Choluteca, 30 km (16 mi.) E of Jicaro-Galan on Pan-American Highway, small stream; Dept. Cortez, Chamelecon, Rio Chamelecon; and Dept. Olancho, 10 km (6 mi.) E of Juticalpa on Highway #3, Rio Telica (UU).

Dactylobaetis anubis Traver and Edmunds, new species Fig. 35, 82.

This species is represented by nymphs only.

Diagnosis. Claws with 20-27 denticles, more numerous in ♀♀ than in ♂♂. Labrum of Group I B (1); no intermediary, 2-3 lateral spines. Mandibular incisors of Grade I, region elevated but not really pyramidal; maxillary body subequal, palpi of Type II, basal segment wide, appears twisted (fig. 35); dilation on 2nd segment of labial palpus quite sharply pointed (fig. 82); 4-6 paraglossal spines. Thoracic gill at base of leg I well developed. Margins of abdominal gills narrowly black, chitinized; tracheal trunk and branches darkened. Body rather dark reddish brown.

Body of ♂ nymph: 6.5-7.0 mm; of ♀, 6.5-10.0 mm in length. Front of head and line around eyes in ♂ yellow; developing turbinate eyes dark red-brown. Thorax dorsally dark red-brown. Mottled areas on pronotum on each side of central area in middle and on posterior margins. Mesonotum darker than pronotum; mid-line very narrowly pale; pale line each side of central dark stripe, mottled laterally. Metanotum very dark red-brown; blackish spots each side of mid-line at anterior margin. Thoracic gill at base of leg I well developed. Pleura yellowish brown, darker around leg bases. Thoracic sternum yellowish; on dark specimens, sclerites narrowly outlined in brown. Legs reddish brown; femora blackish brown on posterior margins and at femoro-tibial articulation; pale spot near base, also a longitudinal stripe; femora thus appear to have a wide brown partial transverse band. Tibiae dark brown at each end; tarsi and claws dark brown; 2-3 spines at tip of tibia; 6-8 tarsal spines. Dorsum of abdomen reddish brown with olive brown tinge. Pattern of dark markings essentially as in *D. warreni*. Both anterior and posterior margins of terga darker; submedian oblique dashes from anterior margin end in a dark dot; oblique black lines laterad from anterior margin; yellow spot near antero-lateral corner, outlined in brown and enclosing a dark spot, this spot elongated on tergum 8. On tergum 9, submedian dashes reduced in size; on 10, replaced by dark spot each side of mid-line anteriorly and parallel streaks in posterior portions; on both 9 and 10, mid-lines narrowly paler. Pleural fold pale. Abdominal sterna yellowish; anterior margins dark, likewise faint submedian dashes from anterior margins, spot near posterolateral corners and longitudinal streaks laterally on middle and apical sterna. Caudal filaments dark brown, faintly paler at tips, in fully mature ♂♂; in immature ♂♂ and in ♀♀, paler brown basally and at tips. Female nymphs

as in ♂♂, except as noted; narrow pale mid-line on vertex and occiput, dark stripe with irregular margins each side of this, brown shading laterad; mesonotum paler brown, more extensive pale areas; thoracic sternum usually unmarked.

Holotype ♂ nymph. Guapuava, Rio Campo-Novo, Parana, Brazil: 25°16' S, 51°29' W; III. 63; F. Plaumann, coll. In collection of University of Utah. Paratypes: 6 ♂ and 5 ♀ nymphs, same data as holotype; 2 ♂ and 7 ♀ nymphs, Campos Novas, Rio Arroio, Taborao, Brazil, V.62, F. Plaumann, coll. (UU); 1 ♀, Seara, Brazil, 18. IV. 62, 1 ♀, Rio Jacutinga, Brazil, IV. 62, 10 ♂♂ and 23 ♀♀, Serra do Puruna, Brazil, Rio Tibagi, V.64, all by F. Plaumann (UU).

Other Brazilian specimens not included among the types are from: Guapuava, Rio des Mortes, Parana, III. 63; Ariranha River, Nova Teutonia, II.62; Cruzeiro Brook, XII.62; Santa Clara Brook, XII.62; Lages, Indios River, XII. 62; Serra do Mar, Brook and Rio Bonito, V. 64. Eighteen ♂ and 28 ♀ nymphs are in these collections; F. Plaumann, coll. (UU).

Nymphs of *Dactylobaetis anubis* are readily distinguishable from those of all other known species approaching them in size by reason of the thoracic gill near the base of leg I. The 2 other named species in which such a gill occurs, *D. phaedrus* and *D. serapis*, are relatively small in size, and have distinctive tergal patterns quite different from *D. anubis*. Female nymphs of *D. anubis* are unusually large, and all nymphs have very dark bodies. In numbers of denticles per claw, *D. anubis* approaches *D. penai*, but the latter lacks the thoracic gill and differs in details of mouthparts.

Dactylobaetis phaedrus Traver and Edmunds, new species Fig. 29, 36, 42, 54, 58,
65, 75, 78-80, 91.

This species is represented by nymphs only.

Diagnosis. Claws with 7-11 denticles (fig. 78, 79). Distinctive features: labrum of Group I A (1) or I A (2) (fig. 36); 6-7 lateral spines; mandibular incisors of Grade I or II (fig. 29), pyramidal in shape; long maxillary body and palpi of Type I (fig. 58); unusually long labial palpus and ligular area (fig. 42). Distal segment of labial palpus very small, seems partially surrounded by the greatly expanded and rounded dilation of the apical portion of the 2nd segment (fig. 54); 3-4 paraglossal spines. Thoracic gill at base of leg I unusually long, appears 3-segmented, extends backward as far as leg III. Abdominal gills large, apex blunt, few or no tracheal branches on some specimens; in others, gills narrower and with abundant darkened tracheal branches. Body rather dark reddish brown, with distinctive tergal pattern (fig. 65).

Body of nymph 4.5-5.0 mm in length. Head pale anterior to middle ocellus and between bases of antennae; dark brown lunate area above and laterad of antennal base. Scape of antenna pale, banded with brown; pedicel wholly dark brown. Mid-line of vertex pale, dark brown stripes each side. Irregular dark brown longitudinal streak laterally on pronotum; blackish shading near middle of anterior margin. Mesonotum almost wholly reddish brown; anterior margin very narrowly black; customary markings seem lacking. Metanotum dark brown, blackish posteriorly. On pleura, no dark markings other than above leg bases. Indistinct brown spots near bases of legs II and III, on thoracic sternum. Legs pale reddish brown; femora dark-margined, no definite longitudinal darker streak; tibiae dark on posterior margin. Legs I and III shown in fig. 75, 91. Eight-13 tarsal spines, most numerous on leg I. Numerous spines at tip of tibia (fig. 80). Abdomen rather dark reddish brown; anterior margins narrowly black in mid-area; markings do not conform to usual pattern. Blackish markings near posterior margins of terga 2-6, most prominent on 6, appear there as large black circular areas occupying most of posterior

half of tergum and enclosing pale areas; these markings, in detail, shown in fig. 65. Terga 7-9 with black longitudinal streak each side of mid-line, those on 7 with lateral anterior extension; tergum 9 mostly pale. Anterior margins of abdominal sterna narrowly blackish. Darkened outlines of main tracheae show through faintly, from these transverse branches extend on to middle and apical sterna; small dark spot within outline of main tracheae, on each sternum. Mid-line of venter narrowly pale, so that lateral areas appear darkened, giving appearance of lateral dusky quadrate marks. Caudal filaments pale reddish brown.

Holotype ♀ nymph. Ariranha River, Brazil, 27° 11' S, 52°23' W; II.62; F. Plaumann, coll. In collection of University of Utah. Paratypes: 1 ♂ and 4 ♀♀ nymphs, same locality as holotype, XII.61 and II.62, F. Plaumann, collector (UU); 38 nymphs, Rio Grande do Sul Province, Brazil, 30°43'S, 53°30' W, XI.64, F. Plaumann, collector (UU); 1 nymph, Rio Grande do Sul, Arroio Irapua, Brazil, 30°19' S, 53°13' W, XI.64, F. Plaumann, coll. (UU).

The unique features which distinguish this unusual species have been stated under *Diagnosis*.

Ally of D. phaedrus (Fig. 30). We place here a single ♀ nymph from Brazil, allied to *D. phaedrus* by the structural features of the mouthparts but differing in color of abdominal terga and in the number of denticles of claws. Body 4.5 mm; claw with ca. 40 denticles. Head reddish brown, antennae paler red-brown. All mouthparts as in *D. phaedrus*; labrum as in fig. 30. Thoracic notum dark reddish brown. Pronotum darker on lateral margins and on each side of mid-line at anterior margin. Mesonotum faintly darker at mid-line; 2 or 3 small black dots in area anterior to wing root. Metanotum still darker. Legs light reddish brown; 9-10 tarsal spines. Seven or more spines in a cluster at apex of tibia. Pleura pale yellowish between dark brown crescents surrounding leg bases. Sternum yellowish. Thoracic gill near base of leg I not quite as long as in *D. phaedrus*. Abdominal terga blackish brown, paler intersegmentally. Lateral margins widely, and anterior margins narrowly pale yellowish. Just back of pale anterior margin a blackish transverse line; posterior margins very narrowly darkened. No evidence of the usual tergal markings. Tergum 10 slightly paler than others; darker mid-triangle based on anterior margin. Faint submedian dark spots on 9. Abdominal sterna yellow; mid-line paler; small brownish patch on each side of adjacent pleural fold, on basal and apical sterna. Main tracheal trunk shows through faintly as a dark gray line; from this into each sternum a lateral branch, itself branched, extends transversely. Only a few gills remain; these are small, only a faint trace of the main trachea shows near base on a few of them. Caudal filaments missing. Specimen from Lago Santa Clara, Santa Clara, Brazil; XII.59; F. Plaumann, coll. (UU).

Dactylobaetis serapis Traver and Edmunds, new species Fig. 61, 84.

This species is represented by nymphs only.

Diagnosis. Claws with 30-40 denticles. Labrum of Group I B (1); no intermediary, 2 lateral spines. Mandibular incisors of Grade I (fig. 84). Body of maxilla subequal; palpi of Type II. Dilation at inner apical margin of 2nd segment of labial palpus distinctly pointed; 3 paraglossal spines. Thoracic gill near base of leg I rather short. Abdominal gills moderate in size; main trachea and a few lateral branches usually darkened. Body yellowish to pale reddish brown with yellow tinge; tergal pattern as in fig. 61.

Body of nymph 4.5-5.0 mm. Front of head pale, brown shading between eyes and ocelli; brown streak laterad of ocelli above antennae. Pronotum mottled yellow and brown; in some specimens, a tiny reddish spot each side of mid-line at anterior margin. Mesonotum yellowish olive brown, somewhat grayed; dark brown stripe each side of narrow pale mid-line, other mark-

ings diffuse, indistinct in some specimens; in others, a dark brown spot at base of wing pad, anterior to this 1 large and 1 smaller dark spot, or 3 small reddish spots. Metanotum reddish brown, mid-line narrowly pale; large triangular reddish or brownish spots each side of mid-line based on posterior margin; dark spot laterally near anterior margin, on 1♂. In another ♂, metanotum yellowish, posterior margin black, pale mid-line outlined in brown. Pleura pale yellowish brown. Sternum yellowish; narrow dark markings near bases of legs. Femora mainly yellowish; femoro-tibial articulation and posterior margins reddish brown; near center a brown area which may be longitudinal or partially transverse; narrow black longitudinal line near center. Tibiae brownish except for pale margins; tips narrowly dark; 2 or 3 spines at tip of tibia. Tarsi and claws brown-shaded, with or without yellowish tinge; 4-7 tarsal spines. Abdominal terga 3 and 6 dark, 8-10 pale yellowish. In well-marked ♂♂, the dark reddish-brown pattern appears as in fig. 61. Oblique lateral stripes from anterior margin toward posterolateral angle are prominently blackish where parallel to pleural fold. On each side of mid-line just laterad of end of submedian dashes a reddish-brown triangle based on posterior margin. Most distinctive feature is the dark spot on mid-line of terga 3 (or 4) and 6, near posterior margin, between oblique dashes, surrounded by paler background; this spot may be dark brown or reddish to purplish black. Rather wide brown band on anterior margins of terga 7 and 9; on these and on 8, 1 or sometimes 2 small brown or reddish brown dots near end of submedian dashes. Caudal filaments broken, except stubs near base; these yellow, with indication of a dark band a little distance from base.

Females similar to ♂♂ with these differences. Entire body more yellowish, including legs, which do not show distinct dark marks on femora except for discontinuous black dashes longitudinally in basal half. Markings of abdominal terga not as dark but similar in pattern; dark triangles each side of mid-line more reddish and with extensions anteriorly on tergum 2 and laterad on terga 3-7; dark mid-dorsal spots on 3 and 6 also reddish brown, as in some ♂♂. Many ♀♀ not included as types are much less well marked than the paratypes.

Holotype ♂ nymph, mature. Ariranha River, Nova Teutonia, Brazil, 27°11' S, 52°23' W; II.62; F. Plaumann, coll. In entomological collection of University of Utah. Paratypes: 3 ♂ and 1 ♀ nymphs, same data as holotype. 1 ♂ nymph, Ariranha River, Brazil, XII.61; 2 ♂ nymphs, Seara, Brazil, 18.IV.62; 1 ♀ nymph, Ariranha River, Brazil, XI.61 (UU). All specimens collected by F. Plaumann.

Other nymphs not included among the types are also from Ariranha River, Brazil, II.62; 20 nymphs, both sexes represented. F. Plaumann, coll. (UU).

Dactylobaetis serapis differs from both *D. anubis* and *D. phaedrus* by reason of the pattern of the abdominal terga; smaller than *D. anubis*; details of mouthparts unlike those of *D. phaedrus*. These 3 species are the only named members of this genus having a thoracic gill near the base of leg I; this gill less well developed in *D. serapis* than in the other 2.

***Dactylobaetis cayumba* Traver and Edmunds, new species**

This species is represented by nymphs only.

Diagnosis. Claws with 15-17 denticles. Labrum of Group I B (1); 2 lateral spines present. In-cisor region of mandibles of Grade I, in ♀ nymphs rather truncate on apical margin; thumb moderately long. Body of maxilla subequal; palpi of Type II. Dilation of 2nd segment of labial palpus pseudo-pointed; only 2 paraglossal spines. Gills may show main trachea faintly darkened, lateral margins narrowly dark toward base. Body pale olive brown; reddish markings on meso- and metanota in 2 ♂♂.

Body of nymph 3.5 mm in length. Front of head yellow; brown triangle each side of middle ocellus, another between lateral ocellus and eye. Turbinate eyes of ♂ reddish brown. Thorax pale olive brown with yellowish markings. Large pale spot extending almost the length of the pronotum laterally, ca. halfway between mid-line and lateral margin; margins narrowly dark; on each side of mid-line at anterior margin a dark mark; small pale spot in same position on posterior margin. Mesonotum narrowly pale on mid-line, faintly darkened on each side; in 1 ♂, reddish lines parallel this center strip. Tip of scutellum pale, preceded by small olive patch; anterior to this patch a yellow area forms an arch, lateral streaks extending forward from it along wing bases. Anterior to wing bases a large yellow spot. Metanotum dark brown in mid-area; on holotype and 1 paratype ♂, a red line on posterior margin. Pleura pale; crescentic arches only faintly darkened. Sternum pale, no dark marks evident. Legs pale yellowish. Incomplete dark band across femora, femoro-tibial articulation dark; apex of tibiae blackish, claws pale orange. Two or 3 spines at tip of tibia; 3-6 tarsal spines, most numerous on leg I. Abdomen pale olive brown dorsally, yellow ventrally. Anterior margins of terga very narrowly black in mid-area; basal and middle terga darker also on posterior margins. Tergum 1 largely whitish; a dark dot each side of mid-line at anterior margin, in place of usual submedian oblique dashes; on following terga, these dashes present but faint, also the lateral arched line on each side. Pale median triangle on terga 4 and 5; terga 8 and base of 10 as pale as tergum 1. On holotype and 1 ♂ paratype, reddish line on posterior margins of 2-7, also 9-10; tergum 3 may be red-shaded. On 3-7 a pale spot surrounded by darker area on each side of mid-line near anterior margin; similar pale spots laterally near the posterior margins. Anterior margins of sterna narrowly dark. Caudal filaments pale yellowish white; a slightly darker transverse band precedes the tip. Terga of ♀♀ more yellowish than in ♂♂, markings less well defined, fainter; femoral bands very faint.

Holotype ♂ nymph, mature. Province Huallaga, Peru, 21 km from Tingo Maria: 25. IX. 63; M. Pandura, coll. In collection of University of Utah. Paratype: 3 ♂ and 2 ♀ nymphs, same data as holotype. 2 ♀ nymphs, Province San Martin, Rio Tulumayo, Peru, 20 km E of Tingo Maria; 23. VI. 63; W. L. Peters, coll. (UU).

Nymphs of *Dactylobaetis cayumba* are smaller than those of any other species we have seen. Tergal markings should also serve to distinguish it.

Ally of D. cayumba. ♂ subimago. Body 6 mm; fore wing crumpled, ca. 4 mm. Turbinate eyes pale orange, rather small, not contiguous dorsally. Pronotum pale reddish brown, slightly darker laterally and on each side of mid-line. Mesonotum darker reddish brown; lateral margins of scutellum very dark; metanotum reddish brown, lateral margins and basal 1/2 of mid-line dark brown. Three or 4 dark transverse lines across thoracic sternum. Legs whitish, unmarked. Abdomen pale reddish brown. Posterior margins of terga narrowly reddish, most evident on 1-6 but faintly indicated also on 7; on 1 and 2, interrupted by a pale mid-line; on 3 and 6, prolonged forward into a triangle along mid-dorsal line to ca. 1/2 length of segment; widened slightly on each side of mid-line on terga 2, 4 and 5. Tracheae along pleural fold faintly indicated; sterna unmarked. Caudal filaments missing. Huanuco Province, Rio Huallaga, Tingo Maria, Peru; 2/5. VIII. 63; W. L. Peters, coll. (UU).

Other nymphs from Peru Fig. 39, 85.

In none of the specimens from Peru which we have examined, including the species described above, did a ventral thoracic gill occur near the base of leg I. A marked similarity in details of the mouthparts is evident in the majority of these specimens, and may be briefly summarized as follows. Labrum of Group I B (1) (Fig. 39); number of lateral spines varies from 2-5. Incisor region of mandibles of Grade I, with the exception of 2 collections made by Mr Peters

from Huanuco Prov., Rio Huallaga; in these, compaction is in the earliest phase of Stage II. In all, thumb on left mandible is moderately stout and long; maxillary body subequal; palpi of Type II. Labial palpi unusually stout, especially the basal segments; dilation of inner margin of 2nd segment never as sharp-pointed as in the Brazilian forms, nor as evenly rounded as in several of the specimens from North America, but rather intermediate between these types, which we designate as "pseudo-pointed" (see fig. 85). Any variations from the above will be mentioned in discussions of the several groups involved. Four groups of these nymphs are briefly discussed, as Groups A, B, C and D respectively.

Group A. This we subdivide into A_1 and A_2 . Body yellowish olive brown.

A_1 . 10 nymphs in this group. Claws with 24-35 denticles. Body 5.0-6.0 mm. In both sexes body pale yellowish to olive brown. Markings of thoracic dorsum rather diffuse, not clearly defined, but often with extensive pale areas, much as in *D. cayumba*, but lack the red markings. Femoral bands present but indistinct. Posterior margins of terga very dark, especially the apicals. In ♂♂, brown band near anterior margins of terga 3, 6 and 7; pale spot between submedian dashes on 4 and 5; 3 and 6 dark, anterior half of 1, and 7, even darker; 8 pale. Anterior margins of sterna and lateral lines darkened. Here belong the nymphs exhibiting Grade II of incisor area of mandibles, along with several others that are in Grade I. Nymphs in this group are from the following localities: Huanuco Province, Rio Huallaga, Tingo Maria, 10/12. VII. 63; 26. VII. 63; 29/31. VII. 63 and 14/16. VII. 63; W. L. Peters, coll. (UU). Loreto Province, Rio Aguaytia; 15. VII. 63; same coll. (UU).

A_2 . All in this group are ♀♀; 6 specimens. Claws with 18-23 denticles. Body 5.5-6.5 mm. Paler than ♀♀ in Group A_1 ; same markings as above, but less well defined. These specimens may represent a different species than the above. Collected from these localities: San Martin Province, Rio Pendescia, Tulumayo Valley, 24 km E of Tingo Maria; 14/18. VI. 63; W. L. Peters, coll. (UU). Huanuco Province, Rio Huallaga; 26. V. 58; J. Illies, coll. (UU). Same locality; 17/19. VIII. 63; W. L. Peters (UU). Loreto Province, Rio Yurac, 1 km S of Aguaytia; 16. VII. 63; W. L. Peters, coll. (UU).

Group B. ♂♂ dark reddish brown, ♀♀ paler. 7 nymphs in this group. Claws with 26-35 denticles. Body 4.5-5.5 mm. Males dark reddish brown; 1 ♂ from Rio Chillon much darker than others, and abdominal sterna brown except for pale mid-area. Pale mid-line of mesonotum, in ♂♂, bounded by dark streak in anterior half, this in turn bounded by a pale streak; posteriorly, a pale mid-area. Metanotum dark brown. Femora blackish on both margins and at apex; prominent dark femoral band; tibiae pale in middle, base and apex brown; tarsi smoky brown, pale at base. Posterior margins of terga in both sexes black, especially pronounced on apical terga. Terga 2 and 8 with prominent pale mid-dorsal spot; smaller pale spots on 4, 5 and 7; 3, 6 and 9 darker brown than others. At ends of oblique submedian dashes a small dark spot. Sterna yellowish; anterior margins narrowly dark; lateral dark line near pleural fold on middle and apical terga. Gills rather small; margins may be slightly sclerotized and darkened, convex margin particularly; tracheae barely visible. Caudal filaments pale at base, tips dusky. In ♀♀, mesonotum much as in *D. cayumba*; metanotum not much darker. Terga less conspicuously marked than in ♂; anterior half of tergum 1 dark brown; rather indistinct pale middorsal spots on 4, 5, 7 and 8. These nymphs are from Huanuco Province, Rio Bella at junction of Rio Monzon, Monzon Valley; 25. VII. 63; W. L. Peters, coll. (UU). Others collected by J. Illies, are from Rio Chillon, 3. V. 58, (Illies collection).

Group C. 3 nymphs in this group. These may be allied to *D. cayumba*, but are somewhat larger specimens, and have more extensive reddish thoracic and abdominal markings than in that species. Claws with 26-35 denticles. Size 4.5-5.5 mm. Body of ♂ reddish brown. Head pale; brown spot between ocelli; turbinate eyes orange. Reddish tinge on pronotum. Mesonotum has extensive pale areas as in *D. cayumba*; mid-line narrowly pale, brown line borders this; parallel

to brown line on each side, a red line. Small reddish spot near anterior margin, halfway to lateral margin. Reddish line forward from near scutellum along wing bases. Posterior margin of metanotum red. Legs yellowish white. Dark band on femora, femoro-tibial articulation dark. Tibiae narrowly dark at each end; on tibia I only, faint brownish longitudinal streak; claws brown-tinged. Abdominal terga 1-7 with red posterior margins; on 3 and 6, red extends forward on each side of mid-line. Reddish oblique streak laterally on terga 2, 5 and 6. Abdominal sterna yellowish white; anterior margins of middle sterna narrowly dark; faint dark line parallels pleural fold; dark spot at posterolateral angle on 5-7. Caudal filaments pale yellowish white. Tracheae and branches in pleural fold distinctly darkened. Body of ♀ nymph pale yellowish. Differs from male as noted: head whitish, unmarked; pronotum grayish white, short red lines each side of mid-line near anterior margin; short red line laterally near margin. Mesonotum with 3 or 4 red dots just anterior to wing bases, 1 red dot at anterior end of red line along wing bases. Red line along posterior margins of all terga; as a dash each side, on terga 1 and 2; as wide border on 3 and 6; narrower on 4, 5 and apical terga; interrupted at mid-line on tergum 4; on 3 and 6, this red posterior margin extends forward near the pleural fold, forming there a red spot; similar spot on 5; on tergum 6, posterior margin extends forward at mid-line. These nymphs taken at Rio Previsto, Loreto Province, 32 km W of Aguaytia; 16. VII. 65; W. L. Peters, collector (UU). Rio Huallaga, Huanuco Province, Tingo Maria; 8. VIII. 63; M. Pandura, coll. (UU).

Group D. 14 nymphs in this group; large, yellowish, prominently marked with dark reddish-brown on thorax and abdomen. Claws with ca. 30 denticles. Body 7.5-8.0 mm. Reddish brown spot on head between ocelli; anterior margin of pronotum widely dark, mid-line pale; mesonotum brown on anterior margin; mid-line pale; reddish brown submedian and 2 oblique lateral streaks each side; on metanotum, blackish brown median triangle based on anterior margin, mid-line narrowly pale. Legs with femoro-tibial articulations, tarsi and claws quite dark brown except bases of tarsi. Pleura mostly pale; sterna pale, unmarked. All abdominal terga dark brown on posterior margins; brown band across anterior 1/2 of tergum 1; terga 2 and 8 largely pale in ♂ nymphs; tergum 2 may have submedian dashes, or these may be replaced by a dot each side of mid-line; oblique lateral streaks, submedian dashes and mid-dorsal area of anterior margins dark brown, particularly on terga 3 and 6; on 9 and 10, submedian streaks only, parallel to mid-line. Sterna yellow, unmarked; caudal filaments yellow, not darkened at joinings. These nymphs were taken in Peru, no additional data (collection from E. J. Fittkau); (UU).

Nymph from Uruguay Fig. 3, 21, 22, 28.

A single nymph from Uruguay was collected by Dr C. S. Carbonell of the Dept. of Entomology at the University of the Republic of Uruguay at Montevideo. This specimen may well be allied to some of the Brazilian specimens previously described. It is of importance as representing the southeasternmost locality of the genus *Dactylobaetis* of which we have any record. Claws with 18 denticles (fig. 3, 21, 22). Labrum of Group I B (1); intermediary, 2 lateral spines present. Mandibular incisors of Grade I; thumb rather stout. Maxillary body subequal; palpi of Type II. Dilation of 2nd segment of labial palpus sharp-pointed; 3-4 paraglossal spines. Thoracic gill present. Body 5 mm in length. Body yellowish brown. Pronotum pale at midline, dark along lateral margins; meso- and metanota lack dark markings; a few dark lines on pleura above leg bases; sternum unmarked. Legs darkened at femoro-tibial articulations, tips of claws. Posterior margins of terga and posterolateral corners darkened; tibiae and dark spot in anterolateral corner. Abdominal terga 4-6 as in fig. 28. Pale mid-dorsal streak between dark submedian dashes. Gills pale, tracheae only faintly darkened. Caudal filaments yellowish. Sterna darkened on posterior margins. This nymph, as in the nymphs from South-eastern Brazil which we have studied, has well-developed thoracic gills near bases of the fore

legs. Taken in Maldonado Province, Uruguay, IX. 52; C. S. Carbonell, coll. (JRT).

Described species of Baetis vs. Dactylobaetis

Do any of the species of *Baetis* described from the western hemisphere seem to belong in the new genus *Dactylobaetis*? For those known only in the adult stage, both the male genitalia and the form of the hind wing must show conformity with similar structures in *Dactylobaetis*, to be possible representatives of this new genus; nymphs must of course be "comb-claws." In the Nearctic region, *Dactylobaetis* nymphs are known only from the western United States; it seems necessary therefore to consider only the 4 species of *Baetis* known from that area and from western Canada having 2 veins only in the hind wing. Of these, the nymphs of *B. bicaudatus* Dodds and *B. spinosus* McDunnough are known and they are clearly not *Dactylobaetis*. *B. insignificans* McD. and *B. akataleptos* McD., both known as adults only, do not conform to the characters of the genus *Dactylobaetis*. The only Neotropical species of *Baetis* for which the nymphal stage has been described is *B. garcianus* Traver from Puerto Rico; the nymph shows that it is not *Dactylobaetis*. Nine other Neotropical species of *Baetis* are known which have but 2 veins in the hind wing. No figures for genitalia or hind wing have been given for *B. nocturnus* Navas from Argentina. Of the other 8 species, only *B. dryops* Needham & Murphy from Peru, and *B. alcyoneus* Traver from Venezuela have hind wings that conform with those of *Dactylobaetis*. Male genitalia of *B. dryops* do not conform too well but this species cannot be ruled out as a possible representative of *Dactylobaetis* until more is known of it. Unfortunately the male genitalia of the only known specimen of *B. alcyoneus* is imperfect; the parts that remain suggest that this species may indeed, when better known, prove to be a *Dactylobaetis*.

Genus *Camelobaetidius* Demoulin

Camelobaetidius Demoulin, 1967, Bull. Inst. R. Sci. Nat. Belg. 42 (37): 9.

This genus was established by Demoulin for 6 nymphs of one species from Surinam. Because only 1 species was known to him, the only certain character of generic value was the unique form of the claws. Demoulin does not cite references to baetid nymphs with such claws by Day (1955), Edmunds & Musser (1960), Illies (1964), and Roback (1966), but does give reference to Traver (1944). Figures are given by Illies and Roback. Our species *mantis* is clearly congeneric with *C. leentvaari*, the type species of *Camelobaetidius*. We had originally included *mantis* as an unusual species of *Dactylobaetis* and it is possible that *Dactylobaetis* will eventually fall as a synonym of *Camelobaetidius*. But for the present there are compelling reasons for recognizing 2 genera. The genus *Camelobaetidius* as represented by *C. leentvaari* and *C. mantis* differs from *Dactylobaetis* in several nymphal characters and possibly in adult characters.

In nymphs of *Camelobaetidius* the terminal filament is about 1/2 as long as the *tenth tergum*, while in *Dactylobaetis* the terminal filament is at least 3/4 as long as the *cerci*. The basal 1/3 of the *cerci* and the terminal filament are without setae in *Camelobaetidius*, but the inner margins of the *cerci* and both sides of the terminal filament have a row of setae in *Dactylobaetis*. The apex of tibia I has a spinous pad and femur I an opposing

rounded basal tubercle in *Camelobaetidius*. No such structures are found on the forelegs of *Dactylobaetis*. The nymphs of *Camelobaetidius mantis* have a notch and excavation on the anterior apical margin of the tibia of each leg although it is clearly evident in the hind legs only of *C. leentvaari*; such notches and excavations do not occur in *Dactylobaetis*. The paraglossae are relatively broader in *Camelobaetidius* than in *Dactylobaetis*.

The adults of *Camelobaetidius* are unknown but Demoulin has determined from the wing pads that the marginal intercalaries of the fore wings are single and that the hind wings have a short third vein near the hind margin. *Dactylobaetis* adults have the marginal intercalaries in pairs and the hind wing has two veins only. This should allow a ready distinction of the adults, but the reported wing venational characters of *Camelobaetidius* must be regarded with extreme caution. A study by one of us (GFE) has created some doubt about the value of determining the wing veins of adult Baetidae by studying the nymphal wing pads. While studying a peculiar Central American group of nymphs to determine if they were Baetidae or members of the *Metamonius* complex of the closely related Siphonurinae, the venation of the wing pads of a nymph was studied. The fore wing showed the detached forks of MA and MP typical of Baetidae, but the hind wing pads showed numerous developing veins and cross veins as in the Siphonuridae. To clarify the details of the venation, several more wing pads were studied. It was discovered that as the nymphs matured, the number of veins and cross veins diminished until the nearly mature nymphs showed only 2 longitudinal veins and no cross veins. It therefore is possible that the 3rd vein of the *Camelobaetidius* will not appear in the adults. The marginal intercalaries of *Dactylobaetis cepheus*-ally was found by Edmunds to appear single in the wing pads although the adult has paired intercalaries. The marginal intercalaries of *Camelobaetidius* adults may also be paired.

We believe that there are no adult characters by which to confidently identify the adults of *Camelobaetidius*, and especially to distinguish them from *Dactylobaetis*. The mouthparts show *Camelobaetidius* to be obviously closely related to *Dactylobaetis*. In fact, in every character in the nymph it is obvious that *Camelobaetidius* is an apomorphic sister group of *Dactylobaetis*.

The species of *Camelobaetidius* are keyed with the nymphs of *Dactylobaetis*.

***Camelobaetidius leentvaari* Demoulin**

Camelobaetidius leentvaari Demoulin, 1967, Bull. Inst. R. Sci. Nat. Belg. **42** (37) : 9.

This species is known from nymphs only.

Diagnosis. Distinctive features: protuberance at base of femur I broadly rounded; spinous apex of tibia I not clearly bilobed. Claws apparently with only 9-10 denticles. Labrum of group I A (2); 7-8 lateral spines. Mandibular incisors of grade I, thumb blunt; maxillary body subequal, palpi of type II; dilation on 2nd segment of labial palpus rounded, distal segment short. Gills rather large, rounded at apex; without darkened trachea. Body brown, without maculations.

Type locality. "Fleuve Surinam, à Djoemoe, rapide Tapawatra."

Camelobaetidius mantis Traver and Edmunds, new species Fig. 33, 37, 38, 48,
50, 77, 83.

This species is represented by a single nymph only.

Diagnosis. Distinctive features: terminal filament shorter than 10th segment; protuberance near base of femur I, indentation near apical margin of tibia I. Claws with ca. 25 denticles. Labrum of Group IA (1); 6-7 lateral spines. Mandibular incisors of Grade I, thumb blunt; maxillary body subequal, palpi of Type II (fig. 37); dilation on second segment of labial palpus rounded, distal segment very short, 2-3 paraglossal spines (fig. 33, 77). Gills rather large, rounded at apex; main tracheal trunk and a few lateral branches darkened. Body pale yellowish.

Body of nymph (immature) 3 mm in length. Head and thorax yellowish; metanotum pale brown in mid-area. Legs yellowish; pale brown median transverse bands on femora, least evident on leg I; femoro-tibial articulation, extreme tips of tibiae and claws orange-tinged. Prominent protuberance near base of femur I on anterior margin (fig. 48); an indentation or 'pocket' on same margin near apex of tibia I, its margin set with fine backwardly-directed spines (fig. 83). Very slight indentations in the same areas present on tibiae II and III (fig. 50). *No thoracic gill* at base of leg I. Eight-10 spines at tip of tibia III; 7-9 tarsal spines arranged in 2 clusters. Abdominal terga 3-4 and 6-7 shaded transversely with pale brown. Terminal filament barely 1/2 the length of segment 10, consisting of ca. 5 segments only (fig. 38). Cerci lack hairs on inner margins in basal 1/3 of their length; beyond this a fringe of hairs, not closely set, extends almost to the tips, the tips hairless.

Holotype. Immature nymph. Brazil, Amazonas State, Rio Amazonas near junction with Rio Negro, SE of Manaus; 16. III. 61; E. J. Fittkau, coll. In collection of University of Utah.

Camelobaetidius mantis differs from *C. leentyaari* Demoulin in the following features. The apex of the protuberance on the anterior margin near the base of femur I is more acute in *C. mantis*. Claws with ca. 25 denticles in *C. mantis*; apparently ca. 9 in *C. leentyaari* ("nombreuses" according to Demoulin). Central trachea and a few lateral branches pigmented in *C. mantis* but unpigmented in *C. leentyaari*. Demoulin (*op. cit.*, p. 10, fig. 5i) shows what appears to be a spatulate tubercle with apical setae near the apex of the fore tibia; no such structure can be seen in *C. mantis*.

Baetidae, genus unknown

We have examined a single nymph in poor condition from Peru (no other data) in which the claws are spatulate but clearly not of the type found in *Dactylobaetis* and *Camelobaetidius*. The claws have denticles on each side of the apex (fig. 88, 89) rather than on one side only as in *Dactylobaetis* and *Camelobaetidius*. It must be assumed that this spatulate claw has originated independently of the spatulate claws of *Dactylobaetis* and *Camelobaetidius*. The claw structure indicates that the origin was from a baetid with a double row of denticles as in *Callibaetis*. It is impossible to determine the affinities of this genus and no further description is presented. In the complex taxonomic situation in the Baetidae it would seem unwise to name this genus without knowing anything about the adults.

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REFERENCES CITED

- Berner, L.** 1950. The mayflies of Florida. *Univ. Florida Studies, Biol. Sci. Ser.* **4** (4): XII + 267 p., 88 fig., 24 pl., 19 maps.
- Burks, B. D.** 1953. The mayflies, or Ephemeroptera, of Illinois. *Bull. Ill. Nat. Hist. Surv.* **26** (Art. 1): 1-216, 395 fig.
- Day, W. C.** 1955. New genera of mayflies from California (Ephemeroptera). *Pan-Pacif. Ent.* **31**: 121-37, 27 fig.
- Demoulin, G.** 1956. Exploration hydrobiologique du Lac Tanganyika (1946-47). *Inst. R. Sci. Nat. Belg.* **32** (7): 1-24, 9 fig., 1 table
1965. LXXXVIII-Ephemeroptera. Mission zoologique de l'I. R. S. A. C. en Afrique orientale. *Ann. Mus. Roy. Afr. Centr., Serie in-8^o-Sci. Zool.* **138**: 91-114.
1967. Contribution a l'etude des Ephemeropteres du Surinam. *Inst. Roy. Sci. Nat. Belg.* **42** (37): 1-22, 12 fig.
- Eaton, A. E.** 1883-1888. A revisional monograph of recent Ephemeridae or mayflies. *Trans. Linn. Soc. Lond., Sec. Ser. Zool.* **3**: 1-352, 65 pl.
- Edmunds, G. F., Jr. & G. G. Musser** 1960. The mayfly fauna of Green River in the Flaming Gorge Reservoir Basin, Wyoming and Utah. *Univ. Utah Anthropol. Pap.*, **48**: Upper Colorado Ser. **3**: 112-23.
- Eshen-Petersen, T.** 1912. New and little-known species of Ephemerida from Argentine (Neuropt.). *Deut. Ent. Zs.* **1912**: 333-42, 13 fig.
- Grandi, M.** 1949. Contributi allo studio degli "Efemeroidei" Italiani, XIII. *Bol. Istituto Entomol., Univ. Bologna XVII*, **1948**: 287-300, 11 fig.
1960. Contributi allo studio degli Efemeroidei Italiani, XXXIII. *Bol. Istituto Entomol., Univ. Bologna XXIV*, **1960**: 67-120, 26 fig.
- Harker, J. E.** 1954. The Ephemeroptera of Eastern Australia. *Trans. R. Ent. Soc. Lond.* **105**: 241-68, 90 fig.
- Ide, F. P.** 1935. Postembryonal development of Ephemeroptera (Mayflies). External characters only. *Canad. J. Res.* **12**: 433-78.
1937. Descriptions of Eastern North American species of Baetinae mayflies with particular reference to the nymphal stages. *Canad. Ent.* **69**: 219-31, 235-43, 5 pl.
- Illies, J.** 1964. The invertebrate fauna of the Huallaga, a Peruvian tributary of the Amazon river, from the sources down to Tingo Maria. *Verh. Internat. Verein. Limnol.* **15**: 1077-83, 4 fig.
- Kapur, A. P. & M. B. Kripalani.** 1963. The mayflies (Ephemeroptera) from the North-Western Himalaya. *Rec. Indian Mus.* **59** (1 and 2): 183-221, 16 fig., 1 pl.
- Kimmins, D. E.** 1938. A new Moroccan Ephemeropteron. *Ann. Mag. Nat. Hist. Ser. 11*, **1**: 302-5, 1 pl.
1955. Ephemeroptera from Nyasaland, with descriptions of three new species and some interesting nymphal forms. *Ann. Mag. Nat. Hist. ser 12*, **8**: 859-80, 13 fig.
- Macan, T. T.** 1961. A key to the nymphs of the British species of Ephemeroptera. *Fresh-water Biol. Assoc., Sci. Publ.* **20**: 1-63, 37 fig.

- Needham, J. G. & H. E. Murphy** 1924. Neotropical mayflies. *Bull. Lloyd Lib.*, 24, Ent. Ser **4**: 1-79, 185 fig.
- Roback, S. S.** 1966. Catherwood Foundation Peruvian-Amazon Expedition, VI-Ephemeroptera nymphs. *Monogr. Acad. Nat. Sci. Phila.* **14**: 129-99, 22 pl.
- Traver, J. R.** 1944. Notes on Brazilian mayflies. *Bol. Mus. Nacional Zool.* **22**: 1-52, 8 fig.
- Ulmer, G.** 1940. Eintagsfliegen (Ephemeropteren) von den Sunda-Inseln. Zweiter Teil: Beschreibung von Nymphen. *Arch. Hydrobiol., Suppl.* **16**: 581-698, 292 fig.