

Notes on Neotropical Mayflies. Part III. Family Ephemeridae

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(With 39 figures)

The present paper deals only with those adult mayflies from Mexico, Central and South America which fall into the family Ephemeridae, according to the classification used in the Biology of Mayflies.¹ As in Parts I and II of this series, the material on which the paper is based is to be found in the Cornell University Entomological Collection and in the personal collection of the writer. Statements in Part I as regards method of treatment of genitalia previous to the preparation of sketches of those structures, the use of camera lucida for all drawings unless specified to the contrary, and the use of type material in the case of the Needham and Murphy species², hold good for this paper also. Such new figures of genitalia of the Needham and Murphy species as seemed desirable, are presented, along with additional data and new distribution records for some of these species. A few typographical errors noted in checking the type material against the descriptions given in Neotropical Mayflies² are indicated.

Subfamily Ephemerinae.

This subfamily is represented in the Neotropical fauna by a single genus.

Genus *Hexagenia* Walsh

Five species of this genus have been described from Mexico, Central and South America. It is probable that *callineura* Banks, *benedicta* Navas, and *dominans* Navas, are synonyms of *albivitta* Walker. Spieth³ proposes the subgeneric name *Pseudeatonia* for Eaton's Mexican species, *H. mexicana*.

Hexagenia albivitta Walker

Both male and female specimens of this species were taken by the Cornell University Entomological Expedition, at Kartabo, Bartica District, British Guiana, on the following dates in 1924: April 2 and 19; May 25 and 26; June 9; and July 9.

Subfamily Campsurinae

The four genera of this subfamily fall into two groups: (1) pronotum very short and ring-like, not broader posteriorly than in front; fore leg of male almost as long as or longer than

body; forceps stout. To this group belong *Asthenopus* Eaton and *Asthenopodes* Ulmer. (2) Pronotum about as wide as long, much broader posteriorly than in front; fore leg of male about half as long as body; forceps long and slender. To this group belong *Campsurus* Eaton and *Tortopus* Needham and Murphy.

Genus *Campsurus* Eaton

Forty-one Neotropical species of this peculiar and interesting genus have been described to date. As Spieth⁴ has indicated, many of these are imperfectly known, due in part to incomplete descriptions and inadequate figures, and in part to the general similarity in appearance of all individuals in this group.

As to certain of the older species of *Campsurus*, the three species *holmbergi* Weyenberg, *nappii* Weyenb. and *wappaei* Weyenb. are, as Ulmer⁵ indicates, very uncertain. Lestage⁶ notes that Hagen had identified three females and one male of *wappaei*, stating that the genitalia were of the *latipennis* type. Hagen considered *holmbergi* to be probably the female of *wappaei*. Since these three species cannot be located now from the descriptions given of them, it is suggested that they be retained as names only. Probably *albicans* Perch. should be placed in this category also. Of the ten species described by Navas, both figures and descriptions are woefully inadequate in most instances, and determination must rest almost wholly on the type material, which is not readily available. Thus, Navas' species *pfeifferi* might, from the published figure of the genitalia, be allied to the *decoloratus* group, or to *dorsalis* Burmeister. *C. longicauda* Nav. appears allied to *albifilum* Wlk., and *meyeri* to *segnis* Ndhm. and Murphy, although for *meyeri* Navas indicates an affinity with *notatus* Ndhm. and Murphy,—an affinity not readily discernible from the genitalic figure. *C. juradinus* Nav. seems closely allied to if not identical with *cuspidatus* Etn. *C. dallasi* Nav. bears little if any resemblance to *segnis* as regards genitalia, yet Navas indicates its similarity to that species. Published figures of the genitalia of *zottai* and *zikani* Nav. do not seem to show any kinship to any other species of the genus. Lestage thinks that the anal area of the fore wing of *paraguarius* Nav., as figured, is abnormal for a *Campsurus*; this, with the transverse pronotum indicated by Navas, reminds Lestage of *Asthenopus* rather than of *Campsurus*. Until better figures and descriptions of the types of Navas' species can be made available, it would seem advisable

to retain these species as names only, without attempt to reduce them to synonymy with previously described species, or to assign any other specimens to these species. The identity of the type species of the genus, *latipennis* Wlk., is difficult to determine with certainty. Eaton's figures of the genitalia were made from dried specimens. Four of the twelve species described by Needham and Murphy, — *claudus*, *corumbanus*, *mutilus* and *striatus*, — are from female specimens only, and cannot therefore be correlated with any other species of the genus until or if the corresponding males can be determined. On the basis of the rather inadequate figure of the genitalia, *parishi* Bks. seems to belong to the genus *Tortopus* rather than to *Campsurus*. Burmeister's species *dorsalis* is quite unlike all other known species of *Campsurus*, and it is probable that it, too, should be transferred to *Tortopus*, under which genus both *parishi* and *dorsalis* are here considered.

Needham and Murphy² found that certain venational characters were "unexpectedly trustworthy": (1) "the general abundance or scarcity of cross veins", and the distribution of these veins in different areas of the wing; and (2) the relations of the longitudinal veins to one another, particularly the relation of the proximal end of M_2 of the fore wing (in their paper termed Cu_2) to Cu_1 , or to the bisector of the median fork. They found "two fairly well-marked sections in the genus": (1) M_2 of fore wing intermediate between Cu_1 and the bisector of the median fork, often joined to this bisector; the anterior median border of the prothorax elevated to form a triangular hump which "fits against the rear of the head"; and (2) M_2 of fore wing "more closely approximated to" Cu_1 , often seeming to arise from it; no such elevated hump present, the anterior margin of the prothorax "smoothly truncate". They present a key to eighteen species of the genus, based largely on venational characters. None of Nava's species are included in this key; also missing are *parishi* Bks., *decoloratus* Hag., *quadridentatus* Etn., *albicans* Perch., *truncatus* Ulm., *dorsalis* Burm., *wappaei* Weyenb., and *nappii* Weyenb. They do not make use of the parallelism stated to exist between the position of M_2 at its base, and the presence or absence of an elevated anterior margin of the prothorax.

In actual practice, this key is neither as simple as it seems, nor as easy to use. Several questions arise in connection with it. (1) Is there a constant parallelism between the presence of a prominent prothoracic hump and the intermediate position of M_2 ,

and its absence of such a hump always correlated with an M_2 closely associated with Cu_1 ? (2) Is it always possible to determine unhesitatingly the group to which a given specimen should be assigned, on the basis of this venational character? Is there as great a constancy in the location of M_2 proximally, in most species, as the authors of the key indicate to be the case in *corumbanus*? Is the location of M_2 proximally always the same in the two wings of a single specimen? (3) Is it always possible to say with certainty that a specimen does or does not have a prominent prothoracic hump? (4) Are species with genitalia of similar type thrown into the same or different groups, using a key based on the relative position of M_2 ? After an examination of all the type material of the Needham and Murphy species, and of many other specimens of *Campsurus* from other sources, and many attempts to work out a correlation such as is suggested by Needham and Murphy, the writer answers these queries as follows. (1) There is no such constant correlation between prothoracic hump and position of M_2 at its proximal end, as Needham and Murphy state. It does occur in many, but by no means in all cases. Thus, in *decoloratus* Hag., a definite prothoracic hump is present, but M_2 is more closely associated with Cu_1 than with the bisector, and in some of the wings examined appears to arise from it. In *Campsurus* sp. B, of this paper, nothing worth calling a hump is present, but M_2 is definitely in the intermediate position. (2) It is often very difficult to say whether or not M_2 should be considered intermediate or when it is more closely associated with Cu_1 . Even on the two wings of the same specimen, it is often possible to consider one wing as of group 1, the other wing of group 2. Thus, Figs. 1 and 1b of Neotropical Mayflies indicate that in the species *evanidus*, on the basis of the proximal position of M_2 , some specimens would fall in one and some in the other of the two sections indicated by Needham and Murphy. They assign their species *violaceus* to group 1, but an examination of the type material shows M_2 closely approaching Cu_1 (in some cases, seeming definitely to arise from it), although connected to the bisector by a cross vein. Indeed their own figure shows this close approximation of M_2 to Cu_1 . Of the wings of four specimens of *decoloratus* examined by the writer, those of one specimen only were alike on both sides. (See note under *decoloratus*). This character, — the position of M_2 proximally, — is so difficult of interpretation that there are many specimens which could as

well be assigned to one group as to the other. (3) In many instances, a definite and prominent prothoracic hump is present. But there are others, particularly dried specimens, in which it is very difficult to decide whether or not there is an actual hump. Again, a difficult character, likely to be interpreted differently by different workers. (4) On the basis of interpretation of venation, Needham and Murphy placed in different groups the two species *violaceus* and *notatus*, which have extremely similar genitalia. Likewise *pallidus* and *major* are placed by them in different groups, although the genitalia have much in common. Spieth¹ states that on the basis of venation, his species *pedicellarius* "belongs to the same section of the genus as do *segnis* and *pallidus*". Yet the genitalia are so similar to *lucidus* as to indicate a very close relationship between the two species, if indeed *pedicellarius* is distinct from *lucidus*, — and *lucidus* is placed in group 1 by Needham and Murphy, who described it. Considering the difficulties of interpretation involved, it would seem that neither venational characters nor the correlation of these with the prothoracic hump, will solve the problem of the relationships of the different species of *Campsurus*. Genitalic structures seems the only trustworthy character, — and we are far indeed from an answer to the problem, if this be so.

The structure of the genitalia in this genus is quite complicated, and its several parts are not easily correlated with those of other genera. Eaton⁷ considered that the unsegmented forceps arise "each from a separate basis above and distinct from the posterior ventral margin of the 9th segment, and not upon a deflexible lobe prolonged from the margin". Needham and Murphy interpret this basal piece as the basal joint of the forceps. We follow this latter interpretation. This basal forceps joint may be more or less conical or cylindrical, the terminal joint arising from a slight excavation on its outer margin (as in *albifilum*, *pallidus* and *major*); it may be an elongated modification of the above, but possessing now a definite rounded projection on its inner margin (as in *decoloratus*, *violaceus* and *notatus*); or it may be cleft almost to its proximal margin (from which cleft the terminal joint of the forceps arises) with a long outer and a short inner projection continuing beyond the insertion of the terminal joint (as in *latipennis*, *jörgenseni*, *scutellaris* and *segnis*). The terminal joint of the forceps consists of a long slender process, usually more or less spatulate near the tip, and covered with short hairs in that area. In the third group indicated

above, the relative length and thickness of the outer and inner projections of the basal joint may be of specific value. The penes in turn are borne on basal pieces each of which is more or less arched. The part to which the penes are attached is usually triangular, the two triangles united in whole or part at their middle line. From these triangular pieces the remainder of the basal piece arches forward and downward and is attached at the base of the forceps on each side. The entire penis base is therefore horseshoe-shaped. The penes appear to be much more soft and flexible than their bases. Often two or more parts are recognizable in each penis division (as in *scutellaris*), when each may end in a finger-like projection. Again each division may consist of a single incurved crescentic piece, the tips of which frequently overlap (as in *notatus*). Many other variations occur. In all, however, there seems to be a tendency under certain circumstances for the penes to fold forward on their bases, overlapping the 9th segment, leaving the triangular penes bases as the most distal and most prominent part of the genitalia. This would seem to be the explanation of the unusual figure presented by Needham and Murphy for the genitalia of *major*. As noted under the discussion of that species, the penes were wholly lacking from the type specimen. Another interesting structure, perhaps relating to the genitalia, occurs in at least one species, — *duplicatus* Sph., — paired forceps-like processes on segment 10. Spieth⁴ suggests that these are used in copulation. When in due time accurate figures of the genitalia of all described species of this genus have been made available, certain of the above-mentioned characters should prove useful as the basis for a new key to the species, or as useful supplements to the venational and prothoracic characters noted above.

Two main difficulties are encountered in studying the genitalia of *Campsurus*. First, as in mayflies in general, is the discrepancy in appearance between dried specimens and those from which the genitalia have been removed and treated with potash. Many of the published figures were probably drawn from dried specimens, in which a considerable distortion of the parts often occurs. Secondly, there is considerable variation in the genitalia of the same species, both in dried specimens and in those treated with potash. As indicated in the preceding paragraph, the penes tend to fold forward over the 9th segment; sometimes, too, they fold around or over one another. Again, one or both divisions of the penes may be twisted laterally. Thus it is impossible to

show in a single sketch all aspects which the genitalia of one species may assume. Several figures are presented which illustrate these points. It begins to be apparent, too, that allied but different species may possess very similar genitalia. Note the likeness between: (1) *notatus* and *violaceus*; (2) *segnis*, and Dr. Ulmer's unnamed species from Brazil; (3) *jörgenseni* and *scutellaris*. See also the several species with genitalia of the *latipennis* type which are described in this paper.

Many species of *Campsurus* are strikingly similar in color. The majority have pale yellowish or whitish abdomens, with or without dark markings, although in a few species almost the entire body is brownish. Coloration of the following parts of the body is of use in identification: (1) base of antenna; (2) anterior and posterior margins of head, and area between the eyes; (3) dark shading or definite streaks and markings on abdomen; (4) fore legs of male; (5) in some species, venation of wings, or tinted wing membranes. Color characters in general are probably of much less value in this genus than in many others, however. Almost nothing is known of the length of the emergence period of any one single species, and of the possible seasonal variations both in size and coloration for a given species. Hence even the lengths of wing and body of the type specimens may not delimit a species with accuracy.

Notes on the Needham and Murphy Species

Campsurus lucidus (p. 16, Neotropical Mayflies)

A new figure of the genitalia of this species is presented, from type material *not* treated with potash (Fig. 1). Note the small rounded "electric light bulb" structure just below the apex of each penis lobe. In the holotype (Fig. 1) these structures are asymmetrical, the lobe on the right side of the drawing being distorted in drying. Note also the very long slender outer projections of the basal joint of the forceps. Fig. 2 shows the normal appearance of the genitalia after treatment with potash; this specimen, taken by J. C. Bradley at Rio Putumayo, Peru, Aug. 14, 1920 (same data as holotype) was not designated as a paratype, nor mentioned in Neotropical Mayflies, but is labeled in Dr. Murphy's handwriting, "*C. lucidus*". I propose to designate this as a paratype. Two tooth-like projections occur near the apex of each penis lobe, in this specimen; likewise the 9th sternite seems to show the median notch mentioned (but not well seen in the holotype) in the description of the species. It

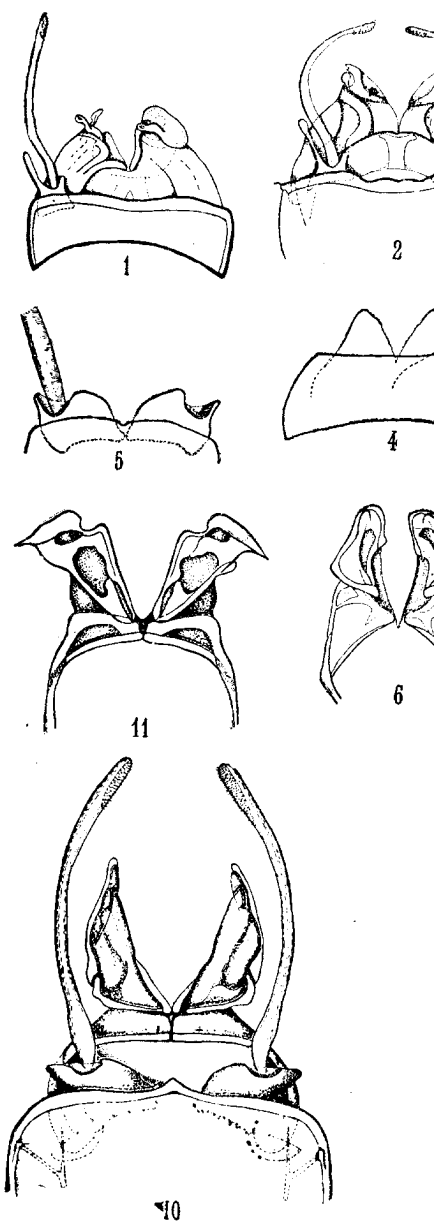


Fig. 1. *Campsurus lucidus*. Male genitalia of untreated with potash. — Fig. 2. Same. Male as paratype. — Fig. 3. Same. Male genitalia. — Fig. 4. *Campsurus major*. Portion of male mount, not treated with potash. Note absence base and portions of forceps of specimen here. Same. Penes and penis base; male genitalia as paratype. — Fig. 7. Same specimen as shown also basal joint of forceps on one side. — Fig. 6. Lateral portions of forceps base omitted of third specimen here designated as paratype only. — Fig. 10. *Campsurus evanidus*. Male mount. Not treated with potash. — Fig. 11 here designated as paratype. Penes and portions of penes, as compared

which the genitalia of one are presented which illustrate too, that allied but different genitalia. Note the likeness us; (2) *segnis*, and Dr. Brazil; (3) *jörgenseni* and species with genitalia of the in this paper.

strikingly similar in color. whitish abdomens, with or a few species almost the of the following parts of (1) base of antenna; (2) head, and area between the streaks and markings on in some species, venation Color characters in general this genus than in many known of the length of the species, and of the possible variation for a given species. body of the type specimens racy.

Murphy Species

(Neotropical Mayflies)
this species is presented, potash (Fig. 1). Note the structure just below the apex (Fig. 1) these structures are side of the drawing being very long slender outer forceps. Fig. 2 shows the after treatment with potash; y at Rio Putumayo, Peru, e) was not designated as al Mayflies, but is labeled "*lucidus*". I propose to both-like projections occur this specimen; likewise the notch mentioned (but not description of the species. It

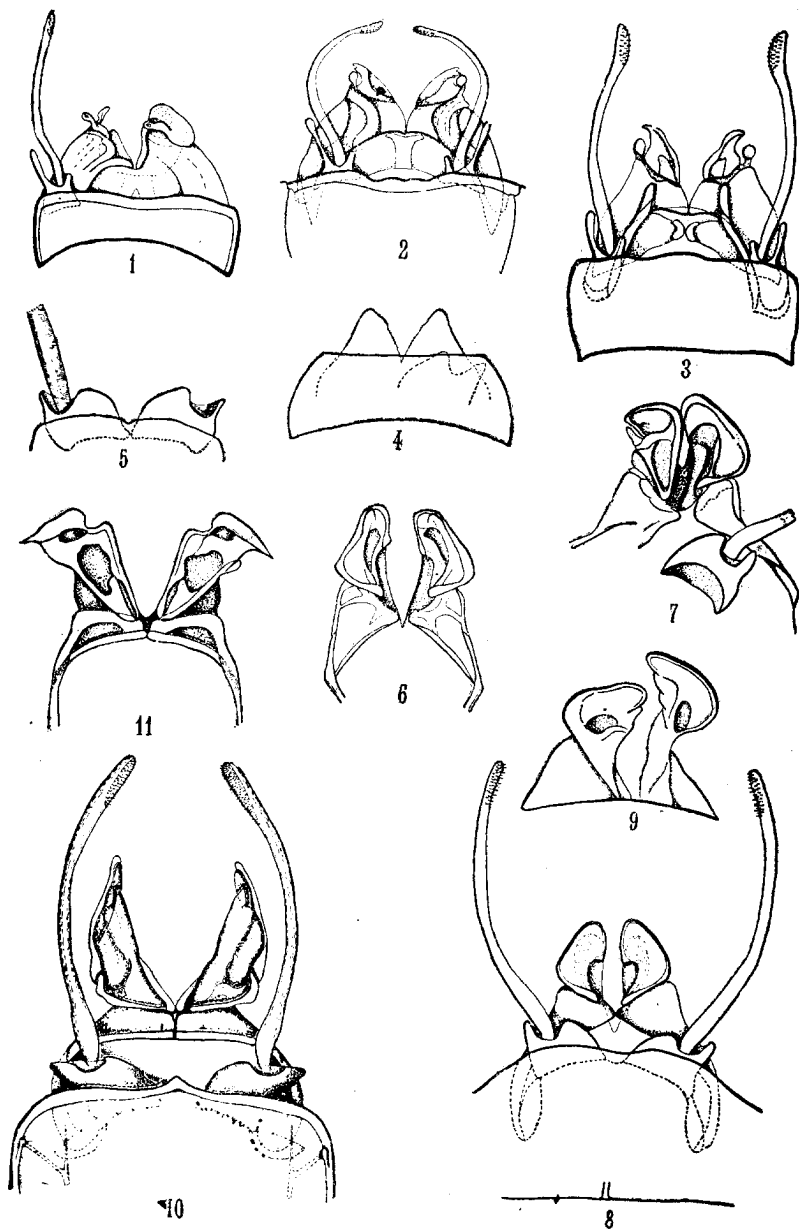


Fig. 1. *Campsurus lucidus*. Male genitalia of holotype, from original mount, not treated with potash. — Fig. 2. Same. Male genitalia of specimen here designated as paratype. — Fig. 3. Same. Male genitalia. Specimen from British Guiana. — Fig. 4. *Campsurus major*. Portion of male genitalia of holotype, from original mount, not treated with potash. Note absence of penes. — Fig. 5. Same. Forceps base and portions of forceps of specimen here designated as paratype. — Fig. 6. Same. Penes and penis base; male genitalia of second specimen here designated as paratype. — Fig. 7. Same specimen as shown in Fig. 5. Penes and penis base. — Fig. 8. Same specimen as shown in Fig. 5. Lateral portions of forceps base omitted. — Fig. 9. Same. Male genitalia of third specimen here designated as paratype. — Fig. 10. *Campsurus evanidus*. Male genitalia of holotype, from original mount. Not treated with potash. — Fig. 11. Same. Male genitalia of specimen here designated as paratype. Penes and portion of penis base only. Note rotation of penes, as compared with Fig. 10.

may be that Fig. 30 in Neotropical Mayflies was prepared from this specimen, as it bears very little resemblance to the genitalia of the holotype as the latter appear now.

Specimens which vary slightly from the above, but possess the lateral round "bulb", and long slender outer projections of the basal forceps joint, are present in the Cornell Collection from Rockstone, British Guiana (June 25-30, 1927; P. P. Babiy, Coll.). The genitalia of one of these specimens, treated with potash, is shown in Fig. 3. Only one toothlike projection occurs here, near apex of each penis lobe. Another specimen, from Bartica District, British Guiana (H. S. Parish, Coll.) seems also to be of this species; in this specimen, the penes are folded down over their bases, even more than in the case of the holotype. In the British Guiana specimens, the penes are strongly reminiscent of those structures as shown in Spieth's figure of his species *pedicellarius*, but in none of them is the 9th sternite split as indicated for the latter species. I consider these specimens from British Guiana to be of the species *lucidus*, in spite of the minor differences noted. It is likewise a question whether *pedicellarius* is in reality a valid species, distinct from *lucidus*.

Campsurus major (p. 17)

The wings of the holotype are broken at the tips, hence only an estimate can be made of their length, but 20 mm., as recorded in the original description, is certainly too long. Other specimens in the Cornell Collection, not mentioned in Neotropical Mayflies, but taken at the same time and place as the holotype of *major*, seem to be of this species. Wings and genitalia of three male specimens are mounted on slides, remaining parts unfortunately cannot now be located. The slides bear, in Prof. Needham's handwriting, the notation: "Baer — Male *Campsurus* — Buenos Aires — Dec. 16, 1898". I consider these specimens to be *C. major*, and designate them as paratypes. The wings of these males measure 16 mm. each; hence the aforementioned 20 mm. would seem to be a typographical error. As regards the figure of the genitalia presented with the original description, it is so unlike all other known species of this genus, except those in which the penes are missing or folded forward, as to suggest immediately that the specimen was abnormal or defective. A portion of the genitalia of the holotype, as drawn from the type slide (not treated with potash) is shown in Fig. 4. The specimen was evidently imperfect at the time the slide

was made. Genitalia of one of the three males I consider paratypes, when treated with potash, shows the following structures (Figs. 6 and 8); a second one, similarly treated, is shown in Figs. 5 and 7; while the third is indicated in Fig. 9. In each of these specimens, it will be noted that the basic portion of the penes resembles the most distal portion of the figure given for the holotype (Fig. 28, Neotropical Mayflies). For this reason I consider that drawing to be of an imperfect specimen, whilst Figs. 5 to 9 of this paper are considered normal and accurate representations. A resemblance in type may be noted, between these new figures of the genitalia of *major*, and the published figure of the genitalia of *argentinus* Esb. Petersen⁸, particularly in the structure of the forceps base. This type of basal joint of the forceps occurs also in *albifilum* Wlk., *truncatus* Ulm.; *pallidus* Ndhm. and Murphy, and *brasiliensis* Traver.⁹

Campsurus evanidus (p. 18)

The wing of the holotype specimen measures 10 mm., that of the allotype 12 mm. (measurements in Neotropical Mayflies include several specimens of each sex). Genitalia of the holotype, not treated with potash, are shown in Fig. 10. At least one of the other males among the type material has very similar genitalia, but in one of these specimens (all of which I propose to designate as paratypes) the penis division on each side has been rotated so that its parts are the reverse of those shown in Fig. 10. This specimen is indicated in Fig. 11. This is an excellent example of the difference in appearance of the genitalia of a single species, due to changes in position of these parts.

Campsurus violaceus (p. 18)

The wing of the holotype measures 11 mm., that of the allotype 13 mm. (not 10 and 14 respectively, as in the original description). As noted previously, this species seems to the writer to fall into the second division of the Needham and Murphy key rather than into the first part, where it was placed by them. As might be expected from the great similarity in appearance of genitalia of this species and *notatus*, this change would place the two species quite close together. The genitalia of the holotype, not treated with potash, are shown in Figs. 12 and 13. I designate as paratypes the other specimens mentioned by Needham and Murphy.

Campsurus scutellaris (p. 19)

The new figures of the genitalia of the holotype herewith presented (Figs. 14 and 15; genitalia not treated with potash) show a striking similarity to the same structures in *jörgenseni* Esb. Pet.⁸ These figures are made from the original slide.

Campsurus segnis (p. 19)

Wing of the holotype, 8 mm.; those of the other two male specimens in the type material, from British Guiana, are each 7 mm. in length, as given in the original description. Fig. 16 shows details of the genitalia of a specimen of this species from Rockstone, Essequibo River, British Guiana, taken June 26, 1927 (P. P. Babi, Coll.). Several other specimens of this species were taken by the Cornell University Entomological Expedition to British Guiana in 1924, at Kartabo, Bartica District, in May and June. While the species seems at first glance to be unique in its type of genitalia, care must be exercised not to place here all specimens with apparently similar genitalia, unless the insects under consideration are similar in appearance to *segnis*. Thus, a number of specimens from Brazil, sent by Dr. Georg Ulmer of Hamburg, Germany, to Prof. Needham for comparison with type material of *segnis*, might be considered that species, on the basis of a not-too-critical examination of the genitalia. But the insects themselves are fairly large and yellowish, not at all like the small dark-colored *segnis*. The genitalia of Dr. Ulmer's specimens are figured in Figs. 17 and 18. These specimens probably represent a new species, which it is left to Dr. Ulmer to describe, at such time as the specimens can be returned to him. Note that in their key, Needham and Murphy refer to *segnis* as a pale species, yet their description calls for one almost uniformly brown. I designate as paratypes the other specimens mentioned by Needham and Murphy.

Campsurus pallidus (p. 20)

The writer interprets the position of M_2 in the fore wing of the holotype as intermediate, and joined by cross veins both to the bisector and to Cu_1 . This would place the species near *major*, to which it is seemingly allied by type of genitalia. From the slide of the genitalia of the holotype, the following figure

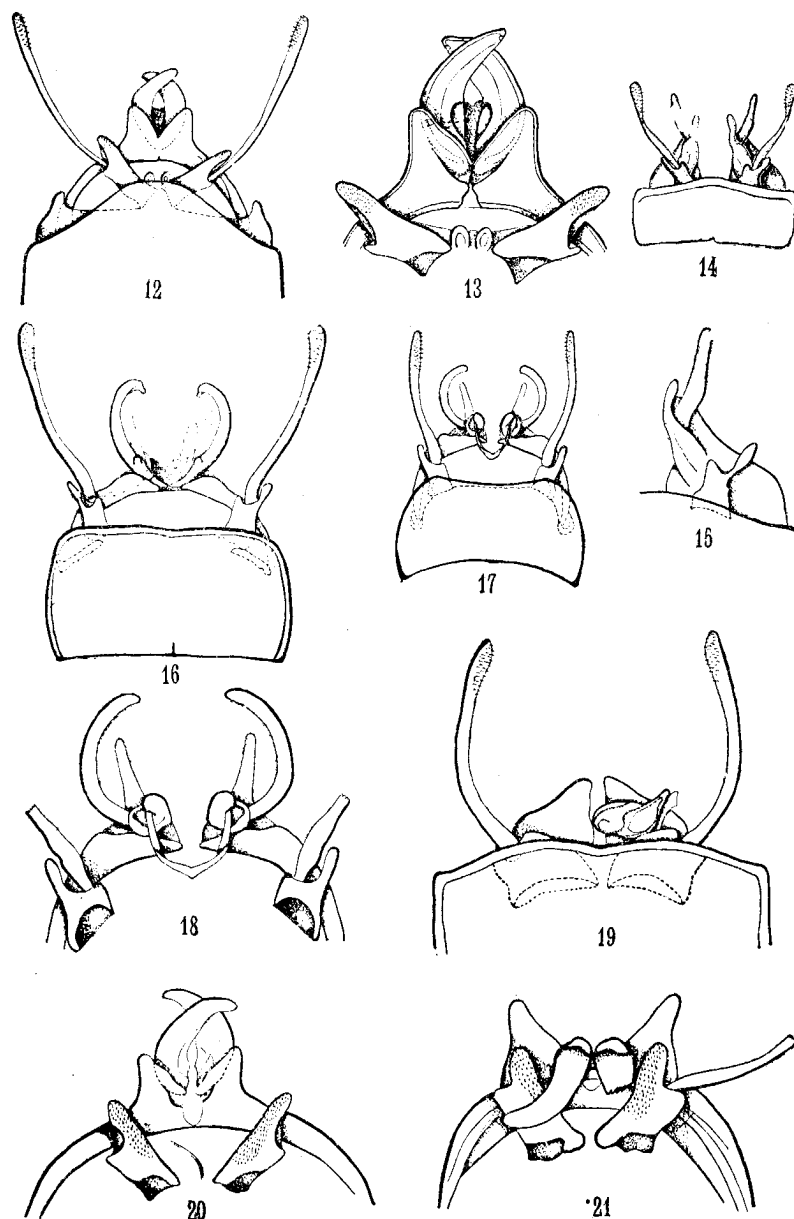


Fig. 12. *Campsurus violaceus*. Male genitalia of holotype, from original mount, not treated with potash. — Fig. 13. Same. Penes and penis base; enlarged. — Fig. 14. *Campsurus scutellaris*. Male genitalia of holotype, from original mount, not treated with potash. — Fig. 15. Same. Penes and base of one side, enlarged. — Fig. 16. *Campsurus segnis*. Male genitalia of specimen from British Guiana. — Fig. 17. *Campsurus* sp. Male genitalia of Dr. Ulmer's undescribed species. Compare with Fig. 16. — Fig. 18. Same, showing penes and penis base enlarged. — Fig. 19. *Campsurus pallidus*. Male genitalia of holotype, from original mount, not treated with potash. Note absence of one penis lobe, and remaining one folded forward on its base. — Fig. 20. *Campsurus notatus*. Male genitalia of holotype, from original mount, not treated with potash. — Fig. 21. Same. Male genitalia of large specimen here designated as paratype.

is presented (Fig. 19). It is apparent that the penes have been folded forward upon their bases, so that their normal appearance cannot be determined unless the genitalia should be removed from the slide and treated with potash, then remounted. This has not been done, lest injury result to the one and only type specimen. Evidently the genitalia shifted position in the mounting medium after the original figure was made (compare Fig. 19 with Fig. 26 of Neotropical Mayflies). Note that the basal forceps joint and the bases of the penes are quite similar in type to corresponding parts of *major*, although the penes seem to differ in the two species.

Campsurus notatus (p. 20)

Type specimens of this species are of two sizes: two are large, two smaller. Body of holotype measures 12 mm., wing 10 mm.; for the other large specimen, 13 and 11 respectively. The two smaller specimens measure but 9 mm. for body and 8 mm. for wing, however. Two new figures of the genitalia are presented. Fig. 20 is from the holotype, not treated with potash. Fig. 21 represents the genitalia of the other large type specimen, after treatment with potash. Note the typical appearance of genitalia when the penes are folded forward on their bases, as seen in Fig. 21. The smaller specimens are somewhat darker than the large ones, but have the same types of markings and similar genitalia. Note the similarity between the genitalia of this species and those of *violaceus*. This species, although close to *violaceus*, seems to be distinct from it. I designate as paratypes the other three specimens mentioned by Needham and Murphy.

Campsurus corumbanus (p. 21)

As noted in the original description, there is a great variation in wing lengths (14 to 19 mm.) in the many specimens which are assumed to belong to this species. The variation proves to be even greater than noted in Neotropical Mayflies, since the wing of holotype is but 10 mm. in length. It does not seem probable that such a wide range in size (based on wings, not bodies) would be likely to occur among specimens of the same species taken at approximately the same season of the year. It is more probable that two species are here represented. Yet again, we have no knowledge of the range of variability to be expected among specimens of any single species of this genus. The species was described from females only.

Campsurus mutilus (p. 22)

The length of wing of the holotype is 15 mm. Females specimens only.

Campsurus striatus (p. 22)

Measurements as indicated in the original description. The species was described from a single female specimen.

Campsurus claudus (p. 23)

Measurements as indicated in the original description, which was based on two female specimens.

Notes on Species by Other Authorities

Campsurus decoloratus Hagen

New drawings (figs. 22 and 23) of the genitalia of this species are presented, as the figure given in Biology of Mayflies is very sketchy and does not show clearly the relationships of the different parts. Figs. 24 and 25 show variations in the position of M_2 in the fore wings of two specimens of this species.

Campsurus duplicatus Spieth

Two male imagos of this species are present in the Cornell Collection, presumably from British Guiana, but no data can be found associated with them.

Campsurus albifilum Walker

The genitalic figure given by Banks¹⁰ for the Brazilian specimen he identified as *C. dorsalis* seems to be that of *albifilum*. Certainly it is in no way related to the true *dorsalis*, as Ulmer¹¹ has shown the genitalia of that species to be.

Campsurus latipennis Walker

Eaton⁷ figures the genitalia of this, the type species of the genus, evidently from dried specimens. Banks¹⁰ figures these appendages (also apparently from a dried specimen) from material he examined that was taken in Brazil, and which agreed well with Eaton's description as to size and markings.

In the material collected by the Cornell University Entomological Expedition to British Guiana, there are a number of specimens of *Campsurus* which are allied to *latipennis* in type of

genitalia. One group of these specimens is being held tentatively under the name *latipennis*; two other groups are described as new species. Two others may represent new species, but for the present are designated merely as species A and species B. Most of the above specimens seem to have been dried before immersion in alcohol, resulting in much less fading and in less change of color than usually occurs in specimens preserved in alcohol immediately. This relative lack of fading has been verified by comparison with pinned specimens taken at the same time and place by the same collecting party.

? *Campsurus latipennis* Walker? In this group are three male imagos which have been immersed in alcohol for a long time, and evidently not dried before such immersion. A fourth specimen is pinned. Genitalia of the alcoholic specimens and the pinned one are very similar, but as there are some differences in color the two are treated separately.

Male imago. Pinned specimen. Body 7 mm.; wing 7 mm. British Guiana, Apl. 5, 1913. A rather stout specimen, as compared with the slender species called *C. essequibo*. Head purplish brown; antennal filaments pale. Thorax light reddish brown; pronotum and mesonotum darker than pleura; sternum yellowish. Margins of pronotum and V-shaped area at base of fore wing very narrowly blackish or very deep red-brown. Fore legs very dark reddish brown shaded with deep smoky; claws slightly paler, but definitely brownish rather than whitish. Costal margin of fore wing tinged very faintly with pale purplish gray in basal half. *C*, *Sc* and *R* purplish brown; other longitudinal veins very pale amber; cross veins fine, white. M_2 may probably be said to occupy intermediate position, although slightly nearer Cu_1 than bisector of median fork; basal end does not turn down toward Cu_1 . Abdominal tergites grayish. Mid-dorsal line and posterior margins shaded rather heavily with smoky gray-brown; narrow band of same shading along anterior margin. On each side, above pleura and between the darker bands, is a yellowish area. Pleural areas yellow shaded with blackish. Sternites paler than tergites; yellowish, with faint grayish lateral shading and rather indefinite grayish posterior margins. Tails missing. Genitalia as in Fig. 26.

Three male imagos immersed in alcohol. Body 8 mm.; wing 7 mm. Rather stout specimens, as compared with *C. cuyuniensis*, *essequibo* and species A. Head almost wholly dark red-brown, nearly black; posterior margin less heavily pigmented.

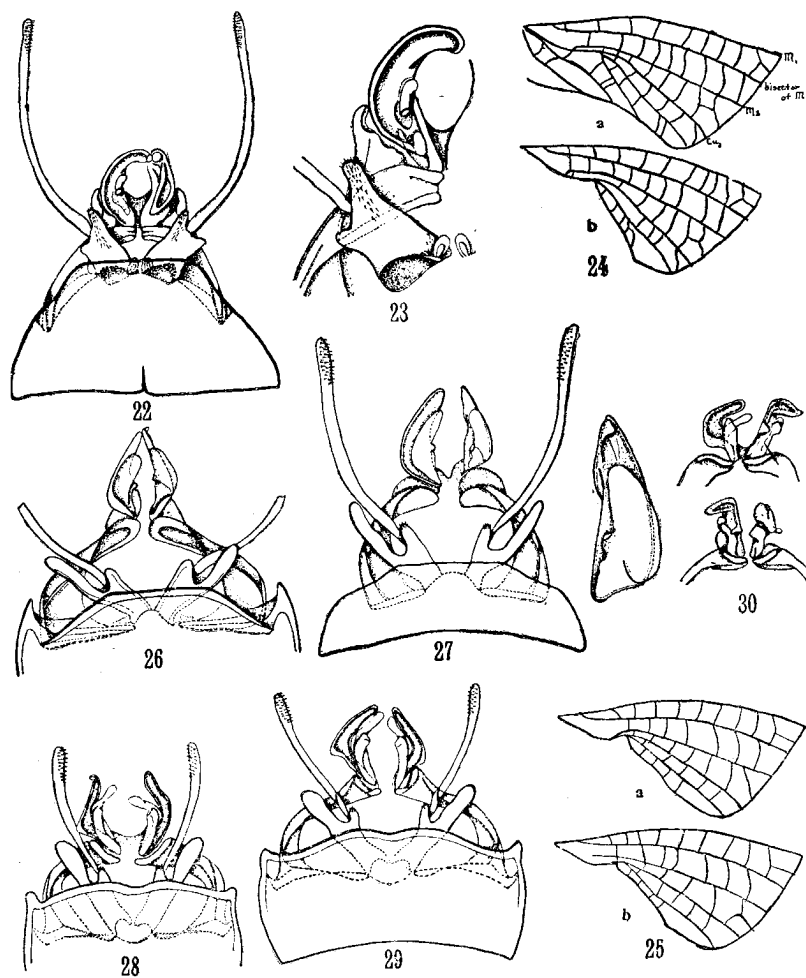


Fig. 22. *Campsurus decoloratus*. Male genitalia. — Fig. 23. Same. Details of one lobe of penis, penis base and basal joint of forceps. — Fig. 24. Same. Cubito-anal angles of (a) right and (b) left fore wings of specimen A. — Fig. 25. Same. Similar angles of (a) right and (b) left fore wings of specimen B. — Fig. 26. ?*Campsurus latipennis*. Male genitalia, from pinned specimen, after potash treatment. — Fig. 27. Same. Specimen in alcohol. — Fig. 28. *Campsurus cuyuniensis*. Male genitalia of holotype before treatment with potash. — Fig. 29. Same. Male genitalia of holotype after treatment with potash. Fig. 30. Same. Details of penes of two of the paratypes.

Thorax rather dark red-brown; sternum and pleura (in part) more yellowish. Fore legs brownish throughout length; femur and tibia red-brown, tarsal joints deep smoky, narrowly paler at joinings; claws grayish white. Veins *Sc* and *R* of fore wing brownish in basal half; all longitudinal veins yellowish. M_2 occupies intermediate position. Abdomen paler than thorax, yellowish brown with faint tinge of red, dorsally, each tergite

largely shaded with smoky. Tergites 2-7 with a C-shaped mark (or irregular triangle, its longest side on median line). Where C-mark is evident, head of C is near anterior margin; downward stroke along mid-dorsal line; tail extends across posterior margin until it turns dorsad to pleural margin, leaving paler triangle postero-laterally. Tergites 8 to 10 almost wholly brownish, except for yellowish antero-lateral angles. Narrow pale mid-dorsal line, bounded on each side by a dark streak (in dried specimen, such a streak might not be visible). Sternites paler than tergites, yellowish; in some lights, paler areas over ganglionic regions. Pleural patches red-brown, outer margin blackish. Tails white. Genitalia of one of these specimens shown in Fig. 27. Above specimens taken at Kartabo, British Guiana, May 1 and 21, 1924.

Eaton's description of *latipennis* calls for: "thorax fusco-luteous", "abdomen above very light umber-grey, more distinctly so in segments 4-10 than in others, with the joinings of the segments and the line of the dorsal vessel darker; venter testaceous; setae pellucid white. Fore legs sepia-brown, with white unguis". Body 7, wing 8. As neither the alcoholic nor the pinned specimens just described fulfil all the above requirements, it is quite possible that they do not represent the true *latipennis*.

It seems evident that genitalia of species of the *latipennis* group are quite similar one to another. Drawings from dried specimens would not bring out any small specific differences. Thus it is that genitalia of the four specimens just described, of *C. essequibo*, of *C. cuyuniensis*, of species A, and of species B, all bear much resemblance to the figures of *latipennis* as given by Eaton and by Banks. Yet specimens of each species mentioned differ quite markedly from one another, in size and coloration of body and in small details of genitalic structure. Therefore it is deemed best to hold these as separate species, until such time as more can be known about *latipennis*.

Campsurus pedicellarius Spieth

Evidently very closely allied to *lucidus*, if indeed it is distinct from that species. Genitalia differ from those of *lucidus* mainly in the deeply-cleft forceps base (which might be due to an artifact). As noted above, the species *lucidus* is represented in the Cornell Collection by several specimens from British Guiana. On the basis of venation, Spieth places his species in the

same section of the genus as "*segnis* and *pallidus*". See above for a discussion of this point. Wing same length as that of *lucidus*; body given as 8 mm. (*lucidus*, 6 mm.).

Notes on Undescribed Species of *Campsurus*.

1. *Allies of latipennis*.

Campsurus cuyuniensis, sp. nov.

A small yellowish species, allied to *latipennis*, but of smaller size. Distinguished from the specimens tentatively called *latipennis* by details of the genitalia, as well as by the color and size. Tips of penes blunt and finger-like; basal joint of forceps wider both in basal and apical portions, the outer apical portion relatively shorter and thicker.

Male imago (holotype). Alcoholic specimen. Body 5 mm.; wing 5½ mm. Head deep red-brown on posterior margin, V-shaped area on vertex, and on under surface. Black line between eyes. Bases of antennae and frontal margin of head dark red-brown. Thorax red-brown with yellowish tinge; prothorax paler than remainder, more yellowish. Short triangular extension of anterior margin of prothorax covering only a small portion of posterior margin of head. Posterior margin of prothorax flaring, somewhat elevated above mesothorax. Narrow black markings on pleura, sternum, and carina of mesoscutellum. Median ventral line of thorax heavily shaded with blackish. Fore femur and tibia smoky brown; tarsus paler, yellowish; claws grayish white. *Sc* and *R* of fore wing purplish brown in basal half; other veins pale. *M*₂ of fore wing intermediate in position. A very faint tinge of yellowish on wing membrane. Abdomen paler than thorax, yellowish; tergites and sternites very similar, yellowish with faint smoky tinge. Intersegmental areas paler. Posterior margins of segments only slightly darker than preceding portions. Segments 9 and 10 darker, brownish black. Pleural patches distinct; outer margins of these outlined in blackish brown. Dorsad of each patch, a double row of blackish brown dashes, the row adjacent to the patch more conspicuous. Very pale mid-dorsal and mid-ventral lines, faintly margined on each side by dusky lines. Tails yellow. Genitalia shown in Figs. 28, 29 and 30. Note that 28 represents the genitalia of the holotype before treatment with potash, while 29 shows the same structures after treatment with potash. Evidently the genitalia of specimens

of the *latipennis* group are quite similar, in the dried and the treated condition.

Paratype males. In some of these, the head is largely shaded with blackish. Almost all of them have a more distinct yellowish tinge to the wing membrane than is the case in the holotype. In several of these males, the dark smoky tinge of the abdominal tergites is deepened into definite dark bands across the segments, usually one band near each margin; pale mid-dorsal line with its outlining black lines much more distinct also. Abdomen thus appears quite definitely banded, in the better-marked specimens.

Females. Twelve females, taken at the same time and place as the holotype and four of the paratypes, are presumably of this specie, although not associated with the males. Head and thorax paler than in the males; frons of head and bases of antennae yellow. Margins of sclerites outlining median areas of pro- and mesonota blackish. Sternites paler yellow than tergites, the latter heavily shaded with gray except for paler margins, mid-dorsal line, and transverse pale line in outer half of each lateral gray patch, near middle of segments. Body 6-7 mm.; wing 6-7 mm.

Holotype: Male imago, in alcohol. British Guiana, between Camaria and Matope on the Cuyuni River; July 23, 1924. Swarming, 4-5 p. m. W. A. Myers, collector. In Cornell University Collection.

Paratypes: Four male imagos, same data as holotype; size: body 5-5½ mm.; wing 5-5¼ mm. Five male imagos, labeled British Guiana, no other data; body 5½-6 mm.; wing 5½-6 mm. Four of these paratypes in Cornell University Collection, remainder in private collection of J. R. Traver.

Campsurus essequibo, sp. nov.

A slender dark red-brown species. Allied to *latipennis* in genitalic type, but smaller than that species, and seeming to differ in certain details of genitalic structure.

Male imago (holotype). Alcoholic specimen. Body 6 mm.; wing 6 mm. Head, thorax and abdomen dark red-brown; pronotum yellowish brown; lateral and sternal borders of prothorax, and narrow markings at wing roots, blackish. Midsternal line of thorax black. Anterior margin of mesonotum, and metanotal scutellum, yellowish. Fore leg blackish brown; tarsus somewhat paler than femur and tibia; claws yellowish white. C, Sc and R

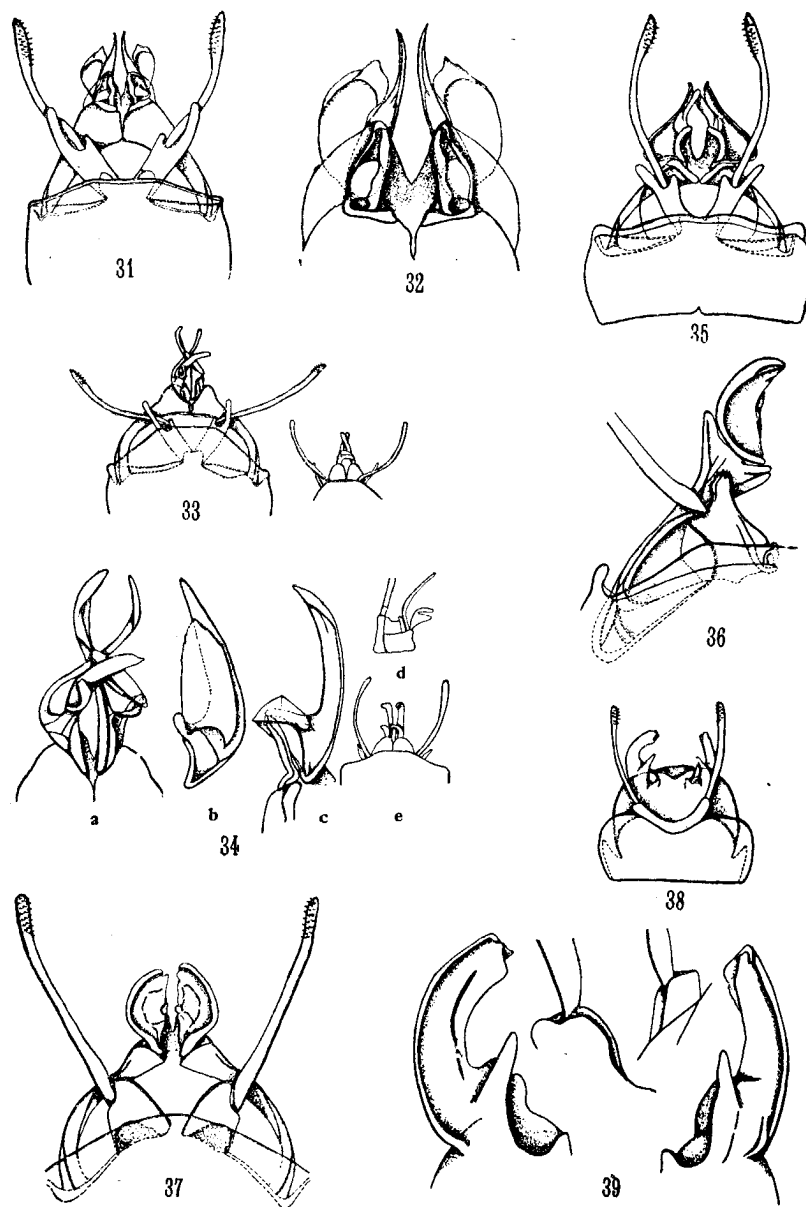


Fig. 31. *Campsurus essequibo*. Male genitalia of holotype. — Fig. 32. Same. Details of penes, holotype. — Fig. 33. Same. Male genitalia of one of the paratypes. At right, sketch of genitalia (under binocular) before removal from body (dried specimen). At left, same genitalia after treatment with potash. — Fig. 34. Same. (a) Details of genitalia of specimen shown in Fig. 33; (b) and (c), details of penes of paratype from Mackenzie, June 23, 1927; (d) and (e), lateral and ventral aspects of genitalia of same specimen, (under binocular) before removal from body (dried specimen). — Fig. 35. *Campsurus species B*. Male genitalia. — Fig. 36. *Campsurus emersoni*. Male genitalia of holotype. — Fig. 37. *Campsurus species C*. Male genitalia. — Fig. 38. *Campsurus species D*. Male genitalia. — Fig. 39. Same. Details of genitalia: penes at right and left; basal portions of forceps, in center.

of fore wing purplish brown except in apical third; cross veins in costal space faintly yellowish, this space with very faint yellowish tinge. Other longitudinal veins of fore wing, and those in apical half of hind wing, yellowish in basal half or third; Sc and humeral cross vein of hind wing purplish brown at base; all other veins colorless. M_2 of fore wing occupies intermediate position. Abdominal tergites with quite wide black posterior margins and black midline. Outer margins of pleural patches narrowly black. Sternites shaded with blackish brown. Tails yellowish.

Male imago (pinned). One of the paratypes, taken Apl. 13, 1913. Head purplish black. Antennal filament pale reddish brown. Pronotum reddish brown, rather heavily shaded with blackish in lateral angles; margins and mid-dorsal line narrowly blackish. Mesonotum yellowish brown, scutellum red-brown. Metanotum likewise yellowish. Pleura red-brown; sternum slightly paler, mid-line blackish. Fore legs deep red-brown, shaded with deep smoky; tarsus somewhat paler than femur and tibia; claws pale yellowish white. Costal margin of fore wing tinged faintly with pale red-brown, most distinct in basal half of area; main longitudinal veins in this area red-brown in basal two-thirds, pale distally. Other veins pale. Abdomen darker than thorax; very little if any difference in color between tergites and sternites; red-brown, shaded quite evenly with deep smoky. Mid-dorsal line blackish; posterior margins of tergites slightly darkened. Pleural areas more reddish, but with heavy and extensive black shading. Tails missing. Genitalia shown in Figs. 33 and 34.

In two other pinned specimens studied, the meso- and metanota appeared reddish rather than yellow; pleural areas of abdomen almost wholly black. Tails (present on one of these) distinctly *yellowish*.

Holotype: Male imago (alcoholic). Rockstone, British Guiana, Essequibo River, June 25, 1927. C. U. Ent. Expedition. In Cornell University Collection.

Paratypes: Four male imagos, pinned: Apl. 12 and 13, 1927, British Guiana, and June 23, 1927, Demerara, Mackenzie River, British Guiana, taken by C. U. Ent. Expedition; Mch. 18, 1913, Bartica, British Guiana, taken by H. S. Parish. Two of these in Cornell Collection; two in private collection of J. R. Traver.

Campsurus species A.

Body 6 mm.; wing 6 mm. Alcoholic specimen. Much more slender than the forms held here as *latipennis*. Differs in coloration from specimen described as ? *latipennis*, as follows: Thorax pale reddish to yellowish brown, pro- and mesonota somewhat deeper in color. Femur and tibia of fore leg purplish brown; tarsus pale grayish yellow. M_2 of fore wing somewhat closer to Cu_1 than to median intercalary. Tails missing. Genitalia so similar to those figured as ? *latipennis* that no sketch of these structures is presented. Rockstone, Essequibo River, British Guiana, June 25, 1927 (same time and place as *C. essequibo*). Five other specimens taken in British Guiana (no date) by the C. U. Ent. Expedition, appear to belong here. The similarity of genitalic structure to that of the specimens held as ? *latipennis* may indicate that species A is merely a later-season form of the so-called *latipennis*.

Campsurus species B.

A slender brownish species, in which the abdomen appears to be definitely banded. Allied to *latipennis* and the three species just preceding. Body $5\frac{1}{2}$ mm.; wing $5\frac{1}{4}$ mm.

Male imago (alcoholic). Frontal margin of head pale; bases of antennae dusky; remainder of head deep brown. Thorax red-brown, paler than head but darker than abdomen (except apical segments). Prothorax not produced anteriorly into a hump. Anterior and lateral margins of pronotum, also anterior half of mid-dorsal area, heavily shaded with black. Sclerites anterior to wing roots dark-margined; one prominent black transverse bar here; other margins red-brown. Mesonotal scutellum very narrowly outlined in black. Narrow transverse black line across central area of metanotum. Prosternum shaded with black; prominent black line alongside bases of fore legs. V-shaped margining at anterior border of mesosternum black. Fore femur and tibia dark red-brown with blackish shading; tarsus paler, smoky brown, distal joint palest. Sc and R of fore wing red-brown in basal half; a few of the larger longitudinal veins yellowish near base; all other veins pale, except humeral vein and basal portion of Sc in hind wing. M_2 of fore wing intermediate in position, but joined to Cu_1 by a cross vein. Abdomen pale red-brown; tergites and pleural patches much shaded with smoky; tergites 8-10

almost wholly smoky red-brown. Shading on basal and middle tergites in form of diffuse band covering all of each segment except anterior and posterior margins and a narrow transverse strip on each side of each smoky patch, about center of segment. Narrow pale mid-dorsal line. Outer margins of all pleural patches, as well as most of central areas of those on 5 and 6, heavily shaded with smoky. Longitudinal black streak along inner margin of each. Sternites likewise shaded with smoky, but paler than tergites. Mid-ventral line of apical sternites faintly dark-penciled; lateral blackish streaks and prominent black pleural streak on these sternites. Tails yellowish with very faint reddish tinge; some of the more basal joinings indistinctly darker. Genitalia as shown in Fig. 35. Note that the basal joints of forceps are somewhat as in *segnis* and *scutellaris*. Lateral margins of penes more flaring than in allied species. In general, much more slender than the specimens held as ? *latipennis*; much darker than *cuyuniensis*, to which species it is most closely allied in genitalic structure; differs in details of genitalic structure from *essequibo*, which it most closely resembles in coloration.

Rockstone, Essequibo River, British Guiana, June 30, 1927, taken by C. U. Ent. Expedition.

Comments on the latipennis complex. — It is obvious that venational characters of *latipennis* Wlk., as shown in Eaton's Monography, Pl. 5, Fig. 8c, are very similar to those of the species described here as ? *latipennis*, *cuyuniensis*, *essequibo*, species A and species B. According to genitalic structure, *cuyuniensis* and species B form one group, *essequibo* a second group, and ? *latipennis* and species A a third group, of this complex. Whether or not any of these groups represents the true *latipennis*, cannot at this time be determined. Nor is it possible, with our very limited knowledge of the habits, life cycles, and lengths of emergence periods of members of the genus *Campsurus*, to determine how much variation in size and coloration may be evidenced by individuals of any one species. Enough details of genitalic structure are presented here, however, to indicate that more than one species is involved in this complex.

II. Allies of *notatus* and *decoloratus*.

Campsurus emersoni, sp. nov.

A very pale species, with yellowish thorax, creamy white unmarked abdomen, and pale fore legs.

Male imago (holotype). Alcoholic specimen. Body 11 mm.; wing 11 mm. Antennae yellowish white, the second joint very faintly tinged with smoky. Head yellow; ocelli black-ringed

at base; vertex and most of posterior area washed lightly with purplish brown. Anterior margin of prothorax slightly inflated, covering a portion of posterior margin of head. Prothorax bright yellow; faint brownish shading at base of fore leg; no other dark markings. Meso- and metathorax yellowish to flesh-colored; groove at anterior margin of mesopleura reddish brown; mesonotum very narrowly outlined in brown; median line of mesoscutellum brownish; narrow brown line above leg bases. Fore leg yellow; tarsus somewhat paler than tibia, which is paler than femur; very faint smoky tinge on base of femur, and all of tibia and tarsus; claws white. Wings white, hyaline; C, Sc and R of fore wing lavender as far as or slightly beyond bulla; all other veins colorless. Proximal end of M_2 nearer to Cu_1 than to median intercalary, appearing to arise from Cu_1 ; not connected at end by cross vein to intercalary. Abdomen very pale yellowish white; basal and middle segments translucent; apical segments more opaque, yellowish. Pleural patches yellowish. Pale mid-dorsal and mid-ventral lines. No dark markings. Genitalia of the *notatus* type, as shown in Fig. 36.

Female imago (allotype). Alcoholic specimen. Body 12 mm.; wing $12\frac{1}{2}$ mm. Grayish shading on head confined to a band between the lateral ocelli, from extensions that run forward to median ocellus. Otherwise similar to male except for faint grayish shading on each side of a wide pale mid-dorsal stripe on middle and apical abdominal tergites, and narrow grayish posterior margins on same tergites, next to these dark stripes, but not extending to pleural region; these margins darker on last three tergites. Tails missing.

Paratypes: Six other female imagos, also in alcohol. Body 12-15 mm.; wing 12-13 mm. Very similar to allotype; some slightly paler, one with a trifle more gray shading on tergites.

Holotype: Male imago (alcoholic). Barro Colorado Island, Canal Zone, July 7, 1935. Taken at light, 7.45 p. m. A. E. Emerson, Collector. In Cornell University Collection.

Allotype: Female imago. Same data. In Cornell Collection.

Paratypes: Six female imagos, same data. Three of these in Cornell Collection; three in private collection of J. R. Traver.

III. *Allies of major*.*Campsurus* species C.

A yellowish-red species. Body of male imago, 6 mm.; wings missing. Anterior margin of pronotum appears to form hump over posterior margin of head. Head blackish; bases of antennae yellowish white. Pronotum yellowish, with reddish brown shading laterally; meso- and metanota light reddish brown. Fore femur and tibia smoky; tarsus whitish, the two proximal joinings blackish; claws yellowish. Abdomen yellow; apical tergites considerably shaded with reddish brown. Pleural patches paler red-brown, with narrow black pencilings on dorsal margin. No evidence of paler mid-dorsal line. Tails yellowish white. Genitalia as shown in Fig. 37. A single male imago from Bartica, British Guiana; no date. Taken by C. U. Ent. Expedition.

In terms of genitalia, this specimen is allied to *pallidus* and *major*, also to *brasiliensis*.

IV. *Allies of quadridentatus*.*Campsurus* species D.

A red-brown species. Body of male imago 6½ mm.; wing 7½ mm. Head and bases of antennae suffused with black. Thorax and abdomen reddish brown. Narrow black pencilings at leg bases, on margin of fold extending to mesoscutellum, and on meso- and metascutella. Median area of thorax paler than surrounding areas. Pronotum much shaded with smoky; posterior margin blackish. Legs pale smoky; tarsal joinings and tip of tarsus whitish. Vein M_2 of fore wing runs backward directly into Cu_1 . Large veins of costal margins of both wings yellowish; all other veins silvery white. Abdominal tergites red-brown with dark shading; posterior margins of basal and middle tergites blackish. Paler mid-dorsal streak. Pleural patches outlined narrowly in black, most prominent along dorsal margin. Sternites yellowish, paler than tergites. Tails yellowish white. Genitalia quite distinctive, as shown in Figs. 38 and 39. In type of genitalia, this species is probably allied to *quadridentatus* Etn., but differs from that species in many details of genitalic structure as well as in its smaller size. It bears some slight resemblance to *segnis* also, but differs from it in important details of genitalic structure. One male imago, Kartabo, British Guiana, Apl. 17, 1924. Taken by C. U. Ent. Expedition. In Cornell University Collection.

This specimen most certainly represents a new species, but is not named at this time, due to the scanty and wholly inadequate material available.

Corrigenda.

In Part II of this series (Rev. de Ent. August 1947), Figs. 3 and 4 as given on page 151, are not correctly listed below the plate, but are really of *Thraulius primanus*, as stated in the text.

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More Flies of the Genus *Baccha* (Dipt. Syrphidae).

By F. M. Hull, University of Mississippi

Recent collections of flies submitted to the author contain a number of neotropical species of *Baccha* which are undescribed. This paper gives the descriptions of these flies. Types, except as otherwise mentioned, in the collection of the author.

Baccha titan, n. sp.

A large petiolate and vittate species with yellowish brown wings. Separated from *arx* Fluke by the much longer pile along the base of the abdomen and the absence of a medial yellow stripe. Length 17 mm.

Male. — *Head*: vertex opaque black, slightly yellowish pollinose upon a round small spot at the upper eye corners; the vertical pile is thick and black and placed in several rows. All of the occipital pile is yellow, except four or five black hairs some-