A REVIEW OF THE MAYFLY FAMILY METRETOPODIDAE[1]

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Some years ago, I collected nymphs of a species of *Siphloplecton* from the Withlacoochee River near Valdosta, Georgia, from which I was able to rear adults. As I worked with them, it appeared that they were *Siphloplecton basale* (Walker), but further study convinced me that they represented a new species. Dr. W. L. Peters, collecting in northwestern Florida, also reared adults, which at first inspection seemed to be *S. basale*, but he, too, concluded that his specimens represented a new species and he asked that I add his collections to mine. As I attempted to understand the relationships of these two new forms to species earlier described, I realized that it would be well to review the entire genus. Among the specimens loaned to me for study by Dr. G. F. Edmunds, Jr., I found a collection of nymphs from Alaska which had been identified as *Siphloplecton*. It soon became apparent to me that they had been misidentified, but the similarities of the nymphs to those of *Siphloplecton* were so great that the misidentification was no surprise. The nymphs were those of *Metretopus* (probably *borealis* [Eaton]). I concluded that such close similarities required that I include a study of *Metretopus* along with my review of *Siphloplecton*. My examination of the immatures of the two genera has revealed morphological characteristics that now permit ready separation. These differences are detailed below and are included in the key.

The genus *Siphloplecton* was erected by W. A. Clemens (1915) after he decided that his species, *Siphlonurus flexus* (1913), was

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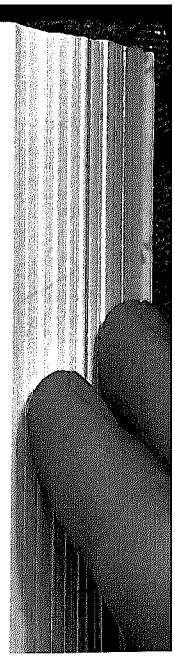
sufficiently distinct from other species of that genus to justify such action. *S. flexus* was the only species he recognized as belonging to the new genus.

McDunnough (1923, p. 47) stated that " . . . *Siphloplecton* Clem. (1915, Can. Ent. XLVII, p. 258) obviously falls into the Heptageninae, as it shows the two pairs of intercalaries between the first and second anal veins; in fact the type species, *flexus* Clem., is a synonym of *basalis* Wlk. treated by Eaton under *Heptagenia* (Mon. Eph. p. 298)." In 1924, he again discussed *Siphloplecton*, reiterating his conclusion as to the synonymy of *flexus* with *basalis*. He further pointed out differences between *S. basalis* and *S. interlineatum* (Walsh).

The classic work, *The Biology of Mayflies*, by Needham, Traver, and Hsu (1935), placed *Siphloplecton* in the Baetidae, subfamily Metretopinae, allying the three genera, *Metretopus, Siphloplecton,* and *Pseudiron*. Their belief was that the subfamily might well be included in the Heptageniidae if venation and genitalial structures were the only considerations. They concluded, however, that near fusion of the basal tarsal segment with the tibia (except in the fore leg of the male), as in the Siphlonurinae and the close similarity of nymphs to the Siphlonurinae both provided evidence of the correctness of including the Metretopinae in the Baetidae.

Demoulin (1951) reviewed the familial problems, explaining that in 1920 Ulmer established the family Ametropodidae to include *Ametropus* and *Metretopus*. Later, Needham, Traver, and Hsu (1935) separated *Ametropus* from *Metretopus*, placing them in related subfamilies in the Baetidae but including *Pseudiron* with the Metretopinae. Lestage (1938) also reviewed the family placement of the concerned genera and proposed the establishment of three families to resolve the difficulties: Ametropodidae to include *Ametretopus*; Metretopodidae with *Metretopus*; and Siphloplectonidae for *Siphloplecton* and *Pseudiron*.

Edmunds, Allen, and Peters (1963) gave their view of ephemeropteran families and subfamilies and placed *Metretopus* and *Siphloplecton* in the subfamily Metretopodinae, family Ametropodidae. The genus *Pseudiron* was recognized as being an heptageniid and placed in a separate subfamily, Pseudironinae. Grandi (1960), Tshernova (1964), and Landa (1969) included the



two genera *Metretopus* and *Ametropus* in the Ametropodidae.

Burks (1953) inclusion of *Pseudiron, Ametretopus, Metreturus,* and *Siphloplecton* in the Ametretopodidae, in light of our present knowledge, provides a structure that is no longer tenable. The genus *Metreturus* is now recognized as being synonymous with *Acanthametropus*, a genus in the family Siphlonuridae (Edmunds et al., 1976), while, as I have pointed out above, *Pseudiron* is an heptageniid.

Edmunds' (1972) study of the higher categories of Ephemeroptera has led him to conclude that two genera, *Metretopus* and *Siphloplecton*, should be considered as the only members of the family Metretopodidae. The morphological similarities of adults and nymphs of the two genera clearly lead to this conclusion, one with which I fully concur. The present concept of the family Metretopodidae includes two extant genera, *Metretopus* and *Siphloplecton*; only *Ametropus* is recognized as belonging to the family Ametropodidae. Koss and Edmunds (1974), reporting on their study of ephemeropteran eggs as related to the phylogeny of the order, concluded that the egg structure of *Metretopus* and *Siphloplecton* supports the concept of a monophyletic origin in the Metretopodidae distinct from that of *Ametropus* (Ametropodidae).

Information concerning the ecology, life history, and mating habits of *Siphloplecton* and *Metretopus* is limited. However, an excellent study of *Siphloplecton basale* has recently been published by Dr. Hugh Clifford (1976) in which he reviewed the life history, feeding habits, emergence, and swarming behavior of adults as the species develops through its yearly cycle in the Bigoray River, Alberta. Edmunds et al. (1976) also briefly summarized what is known of these aspects of the biology of both *Siphloplecton* and *Metretopus*.

In 1940, Dr. H. T. Spieth described the nuptial flight of *S. basale,* while Lyman (1956) discussed the environmental factors influencing the distribution of the immatures in Douglas Lake, Michigan, and in another paper (1955) their seasonal distribution and life cycles. Leonard and Leonard (1962) described the method they employed in capturing nymphs and briefly treated the swarming behavior of adults. The ecology and seasonal distribution of *S.*

speciosum was reviewed for the Florida species by me (Berner, 1950).

Little has been written about *Metretopus*, although Tiensuu (1939) cites the remarks of Aro (1910) regarding the nymphal habitat. Tiensuu (1935) also reported collecting adults after sunset.

Metretopus was described by Eaton (1901) from specimens taken at Aal, Norway. Subsequently Bengtsson (1909) described, but did not figure, the nymph. Ulmer (1919) described *M. balcanicus* from the Balkans on the basis of a single male collected in 1864; Demoulin (1951) concluded that the species should be assigned to his new genus *Metreletus*. Other species described as *Metretopus* but subsequently transferred by Demoulin to *Metreletus* were *M. hessei* (Fizaine) and M. goetghebueri (Lestage). The type species of *Metretopus, M. norvegicus* Eaton, was synonymized with *borealis* (Eaton) by Brekke (1938). The first reported occurrence of *Metretopus* in North America was that of McDunnough (1925). Subsequently there have been infrequent references to finds of *M. borealis* in the northern part of the continent (Edmunds, 1957, Leonard and Leonard, 1962, Hilsenhoff, 1975, Wiens et al., 1975, Edmunds et al., 1976).

Demoulin reviewed the characteristics used to separate the genera of Metretopodidae in which he included only the genera *Metretopus* and *Metreletus*. *Siphloplecton* was left in Lestage's family, Siphloplectonidae. In his 1958 paper, Demoulin correctly assigned *Metreletus* to the Siphlonuridae and placed *Metretopus* and *Siphloplecton* in the subfamily Metretopodinae.

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Metretopus. Dr. William Hilsenhoff, University of Wisconsin, kindly made available his collection of *Siphloplecton* nymphs, and Dr. Dennis Lehmkuhl, University of Saskatchewan, lent me his specimens as well. Dr. Hugh Clifford and Mr. Hans Boerger, of the University of Alberta, have provided valuable specimens for my use. Dr. J. E. H. Martin lent a male specimen of *Metretopus borealis* and others of *Siphloplecton* from the Canadian National Collection. The valuable series of nymphs and adults collected by Mr. T. Mingo in Maine were provided by Dr. Peters. Dr. John J. Flannagan, Freshwater Institute of Winnipeg, lent me reared specimens of *S. basale* for study. Dr. Selwyn S. Roback, Academy of Natural Sciences of Philadelphia, also lent me his institution's specimens.

A fine series of *Metretopus* nymphs and adults was provided through the kind cooperation of Dr. John E. Brittain, Zoological Museum, University of Oslo, Norway. He also forwarded specimens for study from Dr. Jan. I. Koksvik, University of Trondheim, Norway. Dr. Steffan Ulfstrand and Dr. Bjorn Svensson, University of Lund, Sweden, provided both adults and nymphs of *Metretopus*. Mrs. Esta Belcher, Staff Artist, Department of Zoology at the University of Florida, made the wing drawings and prepared the plates.

To all the persons mentioned above, I want to express my deep appreciation for their assistance and interest in this project.

In listing sources of specimens, I have used the following abbreviations:

AMNH, American Museum of Natural History.
ANSP, Academy of Natural Sciences of Philadelphia.
CNC, Canadian National Collection.
CU, Cornell University.
FAMU, Florida A. & M. University.
FSCA, Florida State Collection of Arthropods.
GFE, Dr. George F. Edmunds, Jr.
MT, Museet Trondheim.
WH, Dr. William Hilsenhoff.
ZMO, Zoological Museum, Oslo.

The Adults of Siphloplecton Clemens and Metretopus Eaton

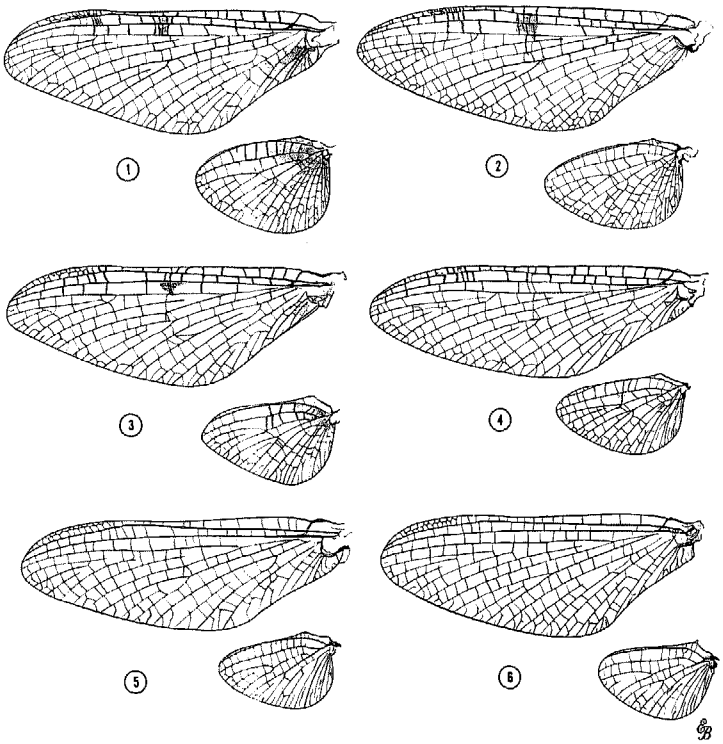
The adults of *Siphlopecton* are characterized by having two pairs of cubital intercalary veins in the fore wings and by having MP_2 strongly divergent from MP_1 at the base. The crossveins of the stigmatic area are anastomosed and form two rows of cells. The wings of the males of most species are marked with brown at the base and the bulla; many of the costal and discal crossveins are infuscated. Compound eyes of the male are large and contiguous dorsally; the first tarsal segment of both the middle and hind legs of the male and of all the legs of the female is fused to the tibia. Two caudal filaments are present.

Adult *Siphloplecton* are readily separated into two groups, one including the species *interlineatum, costalense,* and *fuscum*; the other composed of *basale, simile, brunneum,* and *speciosum*. The males of the *interlineatum* group are characterized by limited pigmentation in the wings, the shape of the male genitalia, and the presence of broad spines bordered with a brush of hairs located on the outer margin of the fore tibia (figs. 3, 15, and 42). The males of the *basale* complex have strongly pigmented areas in the wing membrane (except *S. speciosum*), the genitalia are differently shaped from those of the *interlineatum* group, and the fore tibia is bordered with sharp spines lacking the associated brush (figs. 1, 8, and 41). Females are not as easily characterized as males, but generally they can be separated into the two complexes based on the wing patterns; those of the basale complex (except *S. speciosum*) are more heavily pigmented than the *interlineatum* complex.

Metretopus adults have large, nearly contiguous compound eyes. The wings are hyaline, there is one pair of cubital intercalaries, vein MP_2 of the fore wing is only slightly divergent from MP_1 at the base, and there is some anastomosis of the stigmatic crossveins (fig. 6). The first tarsal segment of all legs is fused to the tibia, except that of the male fore leg. There are two caudal filaments.

The Nymphs of Siphloplecton and Metretopus

The nymphs of *Siphloplecton* and *Metretopus* are very similar and can easily be differentiated from those of all other mayfly genera with which they might be confused by the presence of bifid



FIGURES 1-6. — Fore and hind wings. 1. *S. basale* male; 2. *S. basale* female; 3. *S. interlineatum* male; 4. *S. interlineatum* female; 5. *S. speciosum* male; 6. *M. borealis* male.

claws on the fore legs (figs. 43-46). Both have streamlined bodies, tarsi that are longer than their respective tibiae, platelike gills, and relatively stout, caudal filaments, which have long hairs mesally on the cerci and laterally on both sides of the terminal filament.

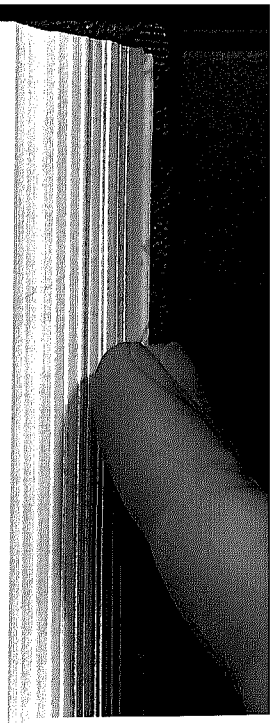
Siphloplecton: The nymphs of *Siphloplecton* were described rather adequately by Traver (Needham, Traver, and Hsu, 1935), Daggy (1945), Burks (1953), and Edmunds et al. (1976). A full page drawing of *S. basale* was included in Leonard and Leonard (1962, p. 98) but their description is very sketchy; another such drawing is presented on page 150 of the book by Edmunds et al. (1976). I have made a most careful study of morphological features of all nymphs available to me. This study included a

detailed examination of exuviae of reared specimens, which enabled me to assign specific identifications to the adults and to confirm the identity of the exuviae. I was unable to find any traits that make it possible to place a species name on an unassociated immature. The nymphs, however, can be divided into two major groups, but this division is based on only a single characteristic, the presence or absence of ventral flaps on the first three gills. With younger specimens even this trait may be somewhat unreliable as the flaps are small and sometimes difficult to see. There is no problem in locating the flaps in mature or nearly mature nymphs as they are generally large. The flaps are developed at the base of each of the first three gills at the outer edge and folded inward beneath the gill plate (figs. 22, 23).

I have examined mouthparts of many *Siphloplecton* nymphs and could find no specific differences in any of them. Additionally, I have measured leg segments with similar results and in all cases found the tarsal claws to be from two-thirds to three-fourths the length of the respective tarsus. The tarsus is always subequal to or longer than the tibia of the same leg and the femur is the longest leg segment. The femur is about three-fourths the length of the combined tibia and tarsus of the fore leg; 90 percent of the length of the tibia and tarsus of the middle leg; and 97 percent of the same segments in the hind leg.

The integument of the nymphal abdomen is clothed with a covering of rather broad setae and the posterior edge of each tergite is bordered with conspicuous spines (figs. 29-32). There are no specific differences in either the setae or spines among the nymphs. I have studied these structures in nymphs at various stages of development as well as in exuviae without detecting visible differences.

In her key to the nymphs of *Siphloplecton* (*in* Needham, Traver, and Hsu, 1935), Traver employed two characteristics, neither of which is reliable. One of these, the differences in length of the tarsal claw of the middle and hind legs as related to the length of the tarsal segment, cannot be used to separate the species. The second trait, the presence of a mid-ventral, abdominal, brown line and the presence or absence of a pair of lateral lines, is too variable to be meaningful. Traver separated *S. basale* from *S. signatum* (here



synonymized with *basale*) and *S. speciosum* using these ventral lines as one of the differentiating characteristics. Generally, the key characteristic holds in separating *S. basale* from *speciosum* but because of the high degree of variability among the other species, some resembling *speciosum*, identification cannot be made with any degree of confidence. The key characteristic as given by Traver (l.c., p. 440), "Venter of abdomen marked with a very dark brown median line, and on each side near the pleural fold a row of black dots, two on each side of each sternite," usually is apparent on *S. speciosum* nymphs. My study of *S. speciosum* nymphs showed that most do have such a pattern but in some cases, perhaps as frequently as 20% of the time, the lateral spots are absent. A similar pattern of mid-line and lateral spots may be found in nymphs of *S. interlineatum* and *S. simile*. Possibly the same may be true of nymphs of other species but available, correctly associated specimens are insufficient in number to draw any conclusions. The lack of lateral markings as noted for *speciosum* may be true of *interlineatum, basale,* and *simile* as well. Obviously accurate identification cannot be made on the basis of ventral abdominal color pattern. To summarize, the unreliability of this characteristic to differentiate species is demonstrated in Table 1.

I have found caudal filaments to be of no value in separating species, nor does size serve in this regard as there is too much overlap among the species. Mature nymphs have a body length ranging from a low of less than 10 mm. in *S. speciosum* to as much as 19.5 mm. in *S. basale*. *S. interlineatum* nymphs overlap both

TABLE 1. — Pattern of lines and spots on abdominal sternites of *Siphloplecton* nymphs

	Median line + lateral lines	Median line + lateral spots	Median line only	Partial median line	No median line
basale	X		X		X
brunneum	X	?	?	?	?
costalense	Nymph unknown				
fuscum	X	?	?	?	?
interlineatum	X	X	X	X	X
simile	X	X	X	X	?
speciosum		X	X		

species in size and *fuscum* is intermediate as is *simile*. Caudal filaments measure from a low of 3.3 mm. in *speciosum* to a high of 7.6 mm. in *basale*.

One pattern that seems to have emerged from the measurements of the nymphs of southern versus northern species is that the nymphs of the northern species are consistently larger than those of the south. The southern nymphs which have been associated, by rearing, with adults, such as *speciosum*, range from 9 mm. (male) to 16 mm. (female). By supposition, based on adult size as identifiable nymphal specimens are not available for measuring, the nymphs of *S. brunneum, simile,* and *fuscum* must also be much smaller than the related northern species.

The nymphs of *Siphloplecton* can be separated only into two groups and this separation is based solely on the structure of gills 1-3. The *interlineatum* group includes *S. interlineatum, S. costalense* (nymph unknown), and *S. fuscum*; the species of the *basale* group are *S. basale, S. simile, S. brunneum,* and *S. speciosum*.

Metretopus: The nymph of *Metretopus* was first described by Bengtsson (1909) and his description, presented without illustrating morphological details, was repeated in French by Lestage (1917). In a later paper, Bengtsson (1913) described the egg of *Metretopus*. Esben-Petersen (1916) also described the *Metretopus* nymph but he provided drawings of mouthparts, gills, and the hind leg. Traver (*in* Needham, Traver, and Hsu, 1935) repeated the salient features of Bengtsson's description but she, too, failed to include drawings of anatomical features. Later, Demoulin (1951) presented a key to the nymphs of the two species of the genus in which he gave characteristics differentiating between *M. borealis* and the presumed nymph of *M. alter*, again not illustrated. Edmunds (1957) discussed the problem of separating the nymphs of *Metretopus* and *Siphloplecton* and attempted to resolve it by using the shape of the labial palpi as a differentiating trait but in so doing, he inadvertently reversed the generic names. The nymph of *Metretopus* was described again by me (Berner, 1959) and I repeated Traver's notations and Edmunds' erroneous assignment of the shape of labial palpi.

The most recent treatment of *Metretopus* nymphs is given in Edmunds et al. (1976) but both the description of nymphal characteristics and the key are too limited to be useful in distinguishing the immatures from those of the closely related *Siphloplecton*.

Siphloplecton and *Metretopus distinguishing characteristics*: After carefully studying the nymphs of *Metretopus* and *Siphloplecton*, I have found five useful characteristics, which when taken together reliably separate the two genera. These include two of the mouthparts, claws, gills, and integument.

Edmunds (1957, p. 161) stated "The most reliable difference in the nymphs of the two genera is found in the shape of the terminal segment of the labial palpi. This segment is rounded in *Siphloplecton* (as seen in *S. basale* Walker) while it is expanded and truncate apically in *Metretopus* (as seen in *Metretopus borealis* from Finland)." If the names of the genera are reversed, this is a reliable trait. To see the shape of the segment, it is necessary to remove the labium, detach the apical segment of the palpus, and manipulate it so that it can be seen in lateral view. Figures 35 and 36 show the segment as it occurs in the two genera.

A second mouthpart character, but one not as distinctive as the preceding, is found in the shape of the free margin of the labrum. In *Metretopus* the edge is usually deeply emarginate; in *Siphloplecton* it is much less so and there is a median lobe at the margin (figs. 37-40).

The bifid fore claws of the nymphs of *Metretopus* and *Siphloplecton* are also rather different. That of *Siphloplecton* terminates in two long, sharp spines and additionally the claw is bordered with a few long, thin spines. *Metretopus* claws terminate in much shorter spines and the lateral edges of the claws are much more spinose than those of *Siphloplecton* (figs. 43-46). Tiensu (1939, p. 107) quoting Aro (1910), stated about *Metretopus* ". . . The claw of the fore leg of the nymph is scooplike and comb-edged, and with it the nymph hauls mud and sand from the bottom in front of its mouth, where the labial palpi choose the suitable stuffs to be carried between the mandibles and maxillae, while the sand grains etc. are shoved aside."

The fourth, and most easily seen, differentiating characteristic is found on gills 3-7 but is best seen on gill 4. At the outer edge of these gills, *Siphloplecton* nymphs have small, distinct setae. *Metretopus* nymphs have, in addition to the setae, 2-7 stout spines, with the greatest number found on gill 4 and the fewest on gill 7. Figures 26 and 27 show the setal nature of the *Siphloplecton* gill processes and figures 24 and 25 the spines found in *Metretopus*.

The fifth distinguishing trait I have discovered is not easily seen without the use of a compound microscope. The integument of the abdominal tergites of *Siphloplecton* is clothed with conspicuous, broad setae that can easily be distinguished at a magnification of about 200 X (figs. 29-32). These setae also are found on the legs and the basal and second segments of the maxillary palpi. *Metretopus* nymphs have no such broad spinose covering of the abdominal tergites, although there are knoblike structures present (most easily seen with an interference contrast microscope) (figs. 33, 34). These may represent the sockets of setae, nearly all of which have been shed from the specimens available to me. I have been able to find only an occasional long, thin seta on the tergites of some specimens but their fragility may be the cause of their breakage at the setal socket. The legs of *Metretopus*, however, do have broad spines, but they are sparser than in *Siphloplecton*. *Metretopus* nymphs have setae on the maxillary palpi, but the setae are much longer and narrower than the short, broad ones of *Siphloplecton*. Both genera have small, closeset spines that are seen most easily near the lateral margin of the abdominal tergites (fig. 33). The spines are most apparent on nymphal exuviae or on specimens that have had their internal organs and muscles removed and been treated with potassium hydroxide.

It has been reported repeatedly that the segmentation of the maxillary palpi of the two genera is different. Bengtsson's (1909) description stated that *Metretopus* has two-segmented palpi. Esben-Petersen's (1916) drawing shows only two segments; Demoulin (1951) claims the palpi are two-segmented and Edmunds (1957), too, reported that the palpi are two-segmented. In his description of *Siphloplecton*, Clemens (1915) illustrated the three-segmented condition in the nymphal maxillary palpus. Traver (*in*

Needham, Traver, and Hsu, 1935) also described the maxillary palpi of *Siphloplecton* as being three-segmented, with the second joint (segment) being very short. Actually, I have found that the nymphs of both genera have three-segmented maxillary palpi with the middle segment and the terminal one so closely joined that no movement between them is possible. The joint is seen easily in both stained and unstained preparations and, in addition, is marked by a change in the character of the setae on the terminal segment from the type found on the two basal segments (fig. 28). Those of the terminal segment are much finer and longer than those of segments 1 and 2. Clearly, the nymphs cannot be separated by differences in segmentation of the maxillary palpi.

In the most recent key to the genera of mayfly nymphs (Edmunds et al., 1976), the two genera were separated on the basis of gills 1-3 being single (*Metretopus*) or with recurved flaps (*Siphloplecton*). As the nymphs of *S. interlineatum*, and probably those of *S. fuscum* and *S. costalense* as well, have single gills on segments 1-3, this characteristic is not satisfactory for use in differentiating the immatures. Nor is a second character used in this key of value, for it concern the length to width of the ninth tergite; differences here do not appear to have any significance.

Traver (*in* Needham, Traver, and Hsu, 1935) used a supposed difference in the ratio of tibia to tarsal length in her key to separate the nymphs of the two genera. I have been unable to verify that such a difference exists. She claimed that in *Metretopus* the tarsi are longer than the tibiae while in *Siphloplecton* the two are subequal. I have found consistently that the tibia is shorter than the tarsus in both genera.

One of the more recent misstatements about *Metretopus* nymphs was made by Leonard and Leonard (1962, p. 95) when they said, " . . . the nymphs, which we have not seen, differ from those of *Siphloplecton* in having the eyes directed forward rather than laterally; in having the gills single on all segments; and in having a large appendage at the base of each fore leg." Only the gill characteristic applies to *Metretopus*, the two others are found in nymphs of the genus *Ametropus*.

FAMILY METRETOPODIDAE

Key to Adults

1. Two pairs of cubital intercalaries in fore wing; vein MP_2 strongly divergent from MP_1 at base (fig. 1) ..... *Siphloplecton*
   One pair of cubital intercalaries in fore wing; vein MP_2 only slightly divergent from MP_1 at base (fig. 6) ..... *Metretopus*

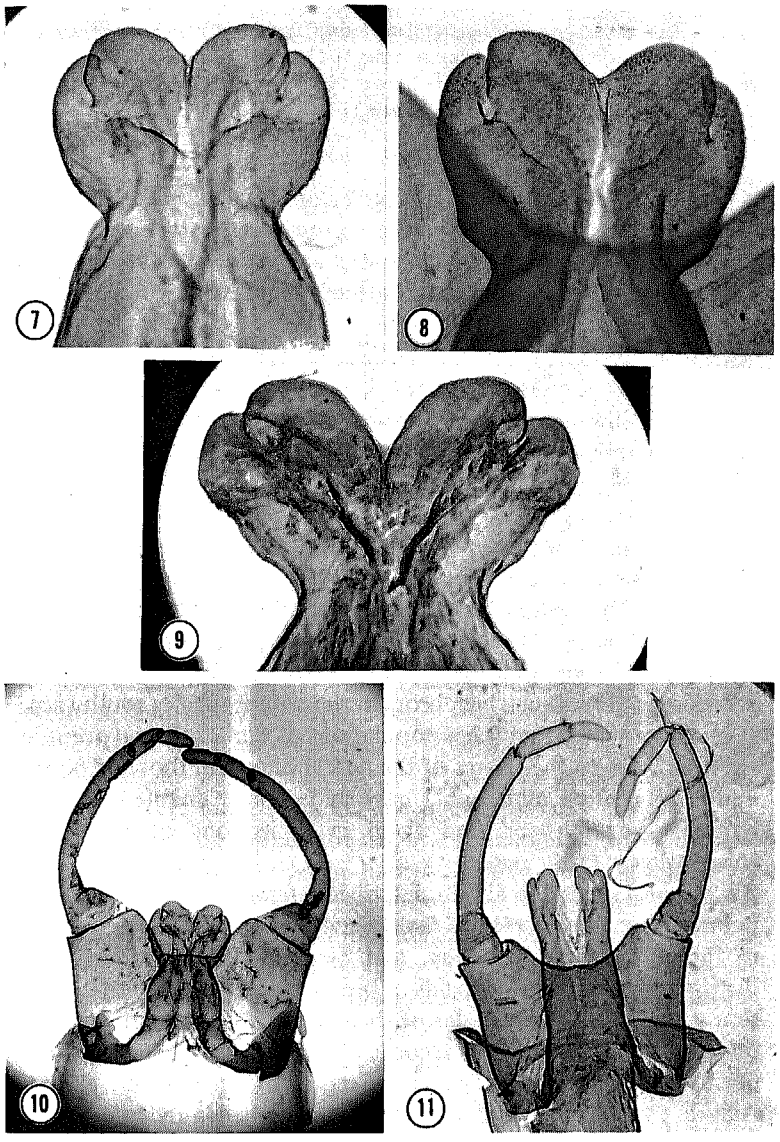
Key to Nymphs

1. Terminal segment of labial palpus expanded and truncate; distal margin of labrum slightly emarginate; gills 3-7 with small setae along outer margin (fig. 26, 27, 36, 37, 38) ..... *Siphloplecton*
   Terminal segment of labial palpus rounded at its free end; distal margin of labrum moderately to deeply emarginate; gills 3-7 with stout spines on outer edge in addition to small setae (figs. 24, 25, 35, 39, 40) ..... *Metretopus*

SIPHLOPLECTON

Key to Adults

1. Crossveins of costal, subcostal, and radial spaces of fore wing strongly brown margined and membrane in region of bullae with brown stain (fig. 1) 2
1′. Crossveins not margined with brown and membrane without brown stain (fig. 5) ..... *speciosum*
2(1). Venation of fore wing dark, crossveins of disc of wing heavily infuscated; brown stain at base of wing extends to CuA in male; female wing without basal stain. Hind wing with stain covering basal fourth in male; stain absent in female (figs. 1 and 2). Penes of *basale* type (figs. 7-10) .5
2′. Venation of fore wing much lighter, crossveins of wing disc not heavily infuscated; in male brown stain at wing base extends only to CuP or absent; absent in female. Hind wing with brown stain mostly limited to subcostal space in male; stain absent in female (figs. 3 and 4). Penes of *interlineatum* type (figs. 15-17) 3
3(2′). Male with brown stain at base of fore wing in cubito-anal area 4
3′. Male without brown stain in cubito-anal area of fore wing ..... *fuscum*
4(3). Posterior sternites (7-9) fuscous; eastern species ..... *costalense*
4′. Posterior sternites (7-9) with variable coloration; 7 may be unmarked, 8 and 9 with only limited brown markings; midwestern species ..... *interlineatum*
5(2). Caudal filaments uniformly brown; penes of type shown in fig. 9 ..... *brunneum*
5′. Caudal filaments light brown or pale with strong brown annulations; penes as shown in figs. 7 and 8 6



FIGURES 7-11. — Male genitalia. 7. *S. simile*; 8. *S. basale*; 9. *S. brunneum*; 10. *S. basale*; 11. *M. borealis*.

6(5). Thorax and posterior tergites deep brown; femora of middle and hind legs brown basally; fore wing of males 11-13.5 mm ..... *simile*

6'. Thorax and posterior tergites brown; femora of middle and hind legs light brown basally; fore wing of male 13-14.5 mm ..... *basale*

DISTRIBUTION

Siphloplecton: The genus *Siphloplecton* is widely distributed in North America occurring from the northwestern part of the Yukon Territory (Wiens et al., 1975) southward into Alberta, eastward across Canada, and southward through the eastern United States into northern Florida. No species has been recorded west of the Rocky Mountains, nor is any known, except from rather isolated collections, in the central United States.

The affinities of *Siphloplecton* with *Metretopus* point clearly to a recent separation of the two genera, both of which are upper boreal in origin. *Siphloplecton* has a nearctic distribution while that of *Metretopus* is holarctic. Although *Siphloplecton* has speciated to a limited extent, *Metretopus* appears to have split much less. The three new species described in this paper are widely separated geographically from rather uniform northern populations. Likely this speciation resulted after residual populations of *basale* and *interlineatum* were isolated in the extreme southeast by the Pleistocene glaciation which brought the parent species southward. It is very probable that other populations of *Siphloplecton* occur in the area between the ranges of the new species and those of *basale* and *interlineatum*, although I have as yet been unable to collect nymphs or adults or find them in collections of other entomologists.

Metretopus: Lestage (1938) described *Metretopus* as being truly holarctic because it is found from Slave Lake, Alberta, in Canada to the Arctic Urals, Norway, and Sweden. He considered the distribution to represent islands of preservation as a relict of glaciation. Our present knowledge of the distribution adds little to that of Lestage. There are now records of *Metretopus* occurring in the northwestern part of the Yukon Territory (Wiens et al., 1975), Alaska, eastwards to Michigan and Maine in the United States, and New Brunswick in Canada.

Demoulin (1951) also pointed out that the genus *Metretopus*, with an holarctic distribution, does not occur below the 55th

parallel north. Generally this conclusion is correct, but there are exceptions in North America where specimens have been collected in Maine as far south as the 45th parallel north.

Siphloplecton basale (Walker)

References: Berner, 1950, p. 106, figs.; 1959, p. 51; 1977, p. 15. Boerger and Clifford, 1975, p. 3022-3028. Burks, 1953, p. 150, figs. Carlson, 1971, p. 82-83. Clemens, 1913, p. 338-340, figs. (as *Siphlurus flexus*); 1915, p. 258, figs. (as *Siphloplecton flexus*). Clifford, 1972, p. 976; 1976, 265-271. Clifford and Boerger, 1974, p. 1113, 1115, 1118. Daggy, 1941, p. 188-190, figs.; 1945, p. 386. Eaton, 1871, p. 139, figs. (as *Heptagenia basalis*); 1885, p. 298 (as *Heptagenia basalis*). Edmunds, 1957, p. 161; 1962, p. 11. Edmunds and Allen, 1957, p. 320. Edmunds, Jensen, and Berner, 1976, p. 149, figs. Hagen, 1861, p. 50 (as *Baetis basalis*). Hilsenhoff, 1975, p. 9. Ide, 1930, p. 227-228. Koss, 1968, p. 708. Krueger, 1969, p. 92. Leonard and Leonard, 1962, p. 96-97, figs. Lyman, 1955, p. 386; 1956, p. 572, 574. McDunnough, 1923, p. 47; 1924, p. 129. Neave, 1934, 159, 166. Needham, Traver, and Hsu, 1935, p. 440-441, figs.; p. 442-443 (as *Siphloplecton signatum*). Spieth, 1938, p. 3-4; 1938, p. 215; 1940, p. 332; 1940, p. 382. Traver, 1932, p. 185-186; 1932, p. 186-190, figs. (as *Siphloplecton signatum*). Walker, 1853, p. 565 (as *Baetis basalis*).

Siphloplecton basale, the first species described in the genus, is still the best known. Although it is not a common mayfly, it has been collected over a vast range extending from Alberta in the west to Massachusetts in the east; southwards, specimens have been collected in Indiana and Wisconsin. Traver (1932) reported the species from the Piedmont region of North Carolina, but she was dubious about her identification. I have had an opportunity to study her slides made from her specimens and have found that the male genitalia fit within the range of variability of *S. basale*. Carlson (1971) stated that he had nymphs of a new species from South Carolina, basing his conclusion that they were new on the lack of ventral abdominal markings. I have examined these nymphs and, although I cannot provide a specific name for them, they obviously belong to the *basale* complex. Very likely they do not represent a new species but confirmation must await the rearing of adult males. Clearly then, this wide ranging species is distributed over a large part of North America, excluding the south-central and western part of the United States.

The male adults may be differentiated from other species of the genus by their large size, intensity and distribution of pigmentation

in the wings, and the shape of the male genitalia as described in the key. The coloration of the female resembles that of the male, except for minor differences in the wings.

Male imago (in alcohol): Body 14.9-15.6 mm.; wings — 12.9-14.4 mm.; caudal filaments 25-26 mm.

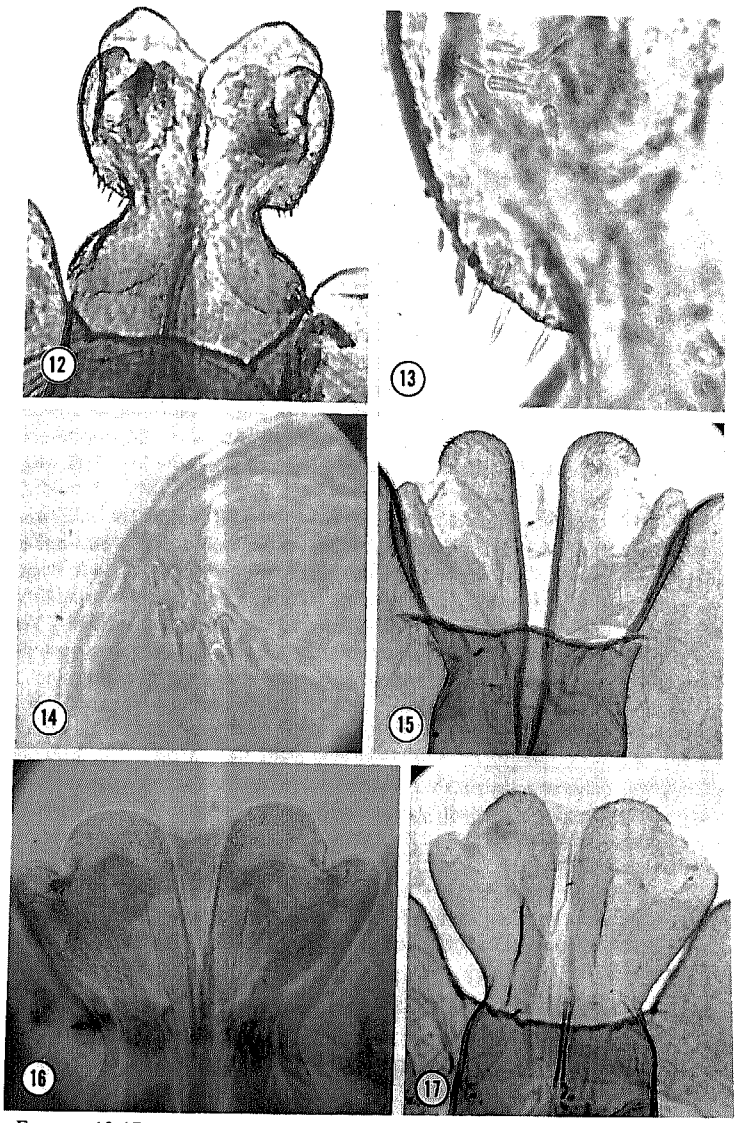
Head: Eyes large, contiguous dorsally; ocelli large. Dorsum of head brown; antennae brown.

Thorax: Pronotum dark brown; mesonotum lighter but margined with dark brown, scutellum dark brown; metanotum dark brown. Thoracic pleura brownish. (*Wings*): Fore wing with brown venation and membrane prominently marked with brown. Brown stain covering base of wing extending from base of CuA over anal area; a prominent dark brown mark just below bulla in the space between Sc and R_1 and a similar one in the space just below and coloring the membrane between the crowded crossveins there. Stigmatic crossveins anastomosed and the entire area tinged with brown. Crossveins in the spaces between the first three primary veins heavily bordered with brown; those through the disc of wing may be as heavily marked or less so. A small brown cloud may be present at the fork of MA. Hind wing with basal half of membrane below costal space strongly colored with brown; coloration may extend into costal space in some specimens; distal portion of venation may be pale. (*Legs*): Fore legs brown; darker brown band in distal third of femur followed by paler coloration extending to end of segment; tibia brown; tarsus with 1st and 2nd segments darker in basal half, 3rd, 4th, and 5th segments light brown; femur slightly longer than tibia; anterior margin of tibia with spines; tarsus 2½ times length of tibia; tarsal segments 1-4 subequal, each being about twice the length of the fifth. Middle and hind legs paler and with similar markings; femur with strong brown band in outer third and basal half of tibia similiarly marked; tarsus paler, tarsal joints strongly marked with brown; claws dissimilar, darker than tarsal segments.

Abdomen: Mostly brownish. 1st and 2nd tergites brown and 2-9 with prominent brown lateral triangles based on posterior margin of each segment; one leg of the triangle forming the lateral border of the segment; a large pale area fills middle of segments 2-9 but is divided medially by a narrow brown mark on 2-7; a large oval-shaped brown mark is also present lateral to the dark line in middle of tergites 2-5. Tergites 9 and 10 mostly brown. Sternite 1 uniformly dark brown; 2-9 with light brown tear-drop-shaped submedian marks. A brown dash present at anterior median edge of sternites 2-8. Forceps light brown; penes constricted at middle, expanding suddenly in outer half as shown in fig. 8; several small but heavy spines present just beyond constriction at or near edge of penes; a band of spines runs from margin medially across widest part of distal half of penes on dorsal side and extends inward about ⅓ of the width of the penes (fig. 14). Caudal filaments brownish; annulations dark brown.

Female imago (in alcohol): Body 17.4 mm., wings 15.7-17.1 mm.; caudal filaments 17.9 mm.

Head: Brownish, paler medial to compound eyes; dark brown longitudinal streak midway between compound eyes and mid line of head; antennae brown.



FIGURES 12-17. — Male genitalia. 12. *S. speciosum*; 13. *S. speciosum*, details enlarged to show spines at constriction of penes; 14. *S. speciosum*, dorsal band of spines at widest part of penes; 15. *S. interlineatum*; 16. *S. fuscum*; 17. *S. costalense*.

Thorax: Coloration as in male. (*Wings*): Fore wings with markings as in male except there is no brown cloud in the cubito-anal area. Hind wing with veins in outer half of wing colorless, basal portion of veins and crossveins in basal region dark brown. (*Legs*): As in male, except that tarsus of fore leg is only 1⅓ times longer than tibia.

Abdomen: Color pattern similar to that of male. Caudal filaments as in male.

Nymph (in alcohol): Body 15.8-19-3 mm., caudal filaments 5.1-7.6 mm.

Head: Brownish, antennae paler. Mandibles large, prominent; protrude laterally so that they are clearly visible from dorsal view.

Thorax: Brownish with a pair of mediolateral light brown spots on mesonotum. Lateral articulation of coxae with thorax represented by dark brown pigmentation. (*Legs*): Covered with short, broad spines which becomes less abundant distally. Fore femur with dorsal brown mark near base and a brown band in outer third; tibia with dorsal brown mark in basal third; tarsus with similar mark near middle. Middle and hind legs similarly marked. Tarsal claws of middle and hind legs slightly more than half to as much as 0.8 times the length of the tarsus. Tibia and tarsus (excluding tarsal claw) of mid and hind leg subequal; tibia of fore leg ¾ the length of tarsus.

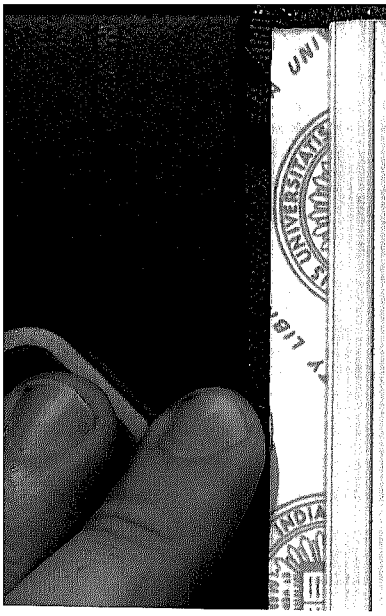
Abdomen: Brownish, marked with darker brown. Tergites 2-9 with small triangle at middle of anterior margin, its tip drawn out into a thin brown line extending to middle of segment; line extends most of the length of 10th tergite. Tergites 2-9 with four brown spots at anterior margin, a pair lateral to triangle on each side. Another pair of mediolateral brown spots present on tergites 2-10. Ventrally with a median brown line from anterior margin of sternite 2 through posterior margin of 8. The strength of line is variable and it may extend to end of sternite 9. In some specimens line may be represented only by median spots. Commonly with lateral brown lines extending from sternite 2 through 9; however, these may be obsolescent, absent, or reduced to small spots near posterior margin. The three ventral lines, when present together, may be very striking and may be fused at posterior border of 9th sternite. Subanal plate extended posteriorly as a pair of acutely pointed spines. Gills 1-3 with ventral flaps (figs. 22, 23), large; those on segments 4-7 single. Caudal filaments banded with brown in outer third. Some variants have a dorsal coloration in which the dark brown pigmentation is restricted to two wide longitudinal bands extending from the pronotum through tergite 9, leaving a wide, pale median line over thorax and abdomen. These specimens have only a single median stripe ventrally.

Specimens examined: ADULTS (pinned) — ONTARIO, Smoky Falls, Mattagami River, June 19, 1934, G. S. Walley, Coll., 1 m., CNC; Ottawa Gulf Club, Ottawa, June 15, 1924, J. H. McDunnough, Coll., 1 m., CNC. QUEBEC, Laniel, May 26, 1939, F. P. Ide, Coll., 2 m., FSCA. MASSACHUSETTS, Swift River, Pelham, May 7, 1939, J. R. Traver, Coll., 2 m., FSCA. MICHIGAN, Cheboygan Co., Douglas Lake, May 26, 1939, F. E. Lyman, Coll., 3 m., FSCA. ADULTS (in alcohol) — ALBERTA, Bigoray River, May 29, 1973, H. Boerger, Coll., 1 m., FSCA; same data, emergence traps, May 18-June 14, 1973, 5 m., 3 f., 29 subs.; Wandering River, 55° 12′ N, 112° 30′ W. H. E. Clifford, Coll., 1 m. sub., 1 n.,

GFE. QUEBEC, Jacques-Cartier Lake, June 18, 1938, C. G., Coll., FAMU. MAINE, Hancock Co., Humpback Brook, reared May 3, 5, 1973, T. Mingo, Coll., 4 m., 1 f., FAMU. MASSACHUSETTS, Swift River, Pelham, June 7, 1939, L. M. Bartlett, Coll., 7 m., GFE; same data, T. Dolan IV, Coll., 3 m., ANSP. NEW HAMPSHIRE, Lake Winn., 3 miles ?, May, 1906, J. H. Emerton, Coll. (is this Lake Winnisquam near N. Sandbornton?) (female wings on slide, label partly illegible).

NYMPHS (in alcohol) — ALBERTA, Bigoray River, May 10, 1973, H. Boerger, Coll., FSCA NO. 4440.3. QUEBEC, Jacques-Cartier Lake, June 12, 1938, C. G., Coll., FAMU. MAINE, Hancock Co., Humpback Brook Bridge, April 9, 1973, T. Mingo, Coll., (adults would have emerged from these specimens on April 9 or 10!) FAMU; Rocky Brook, Narraguagas River, April 9, 1973, T. Mingo, Coll., FAMU. MASSACHUSETTS, Hampshire Co., Gin River, Amherst, June 3, 1941, L. M. Bartlett, Coll., FAMU. MICHIGAN, Cheboygan Co., Douglas Lake, Nov. 26, 1904 (probably identified by J. G. Needham; specimens in very poor condition), CU. WISCONSIN, Eau Claire Co., Black Creek, Nov. 13, 1968, W. Hilsenhoff, Coll., FAMU; Florence Co., Pine River, May 4, 5, 10, 1968; Popple River, May 5, 15, Nov. 1, 1968; Forest Co., Pine River, March 28, May 6, Oct. 3, 21, 1968; Lincoln Co., Big Sams River, April 30, 1971; Marinette Co., Peshtigo River, April 8, 1969; Monroe Co., LaCrosse River, Oct. 31, 1968, all specimens in W. Hilsenhoff collections; Wood Co., Buena Vista, March 16, 1963, W. Hilsenhoff, Coll., FAMU.

Comments on Traver's Siphloplecton basalis ? specimens: I've had an opportunity to examine Traver's slides of wings, genitalia and legs of two imagoes identified by her as *S. basalis* (?) taken at Station 17 in North Carolina on March 24, 1929. The wings of the female (labeled as light ex. by Traver) are smaller than the Alberta and Maine specimens and, although color pattern is similar it is less intense in the North Carolina specimen. Traver discussed her specimens, which she collected seven miles northeast of Spero, in her 1932 paper (p. 185-186) and indicated points of difference between them and true *S. basale* from Canada. The slides of the male wing are definitely those of *S. basale*, as are the legs, in which the color pattern is the same as the northern forms. The male wing measures 12.9 mm. and falls clearly within the normal range of size variation. The preserved male is so badly faded that it is not suitable for comparison with other specimens. Her slide of the male genitalia shows them to be those of *basale* and provides conclusive proof that the species occurs southward into North Carolina. I am, therefore, considering Traver's North Carolina specimens to be true *basale*.



Siphloplecton signatum Traver

I have examined the holotype, allotype, paratype and nymphal specimens used by Traver (1932) in her description of *S. signatum*. The criteria given by her for separating *signatum* from *basale* are (p. 186):

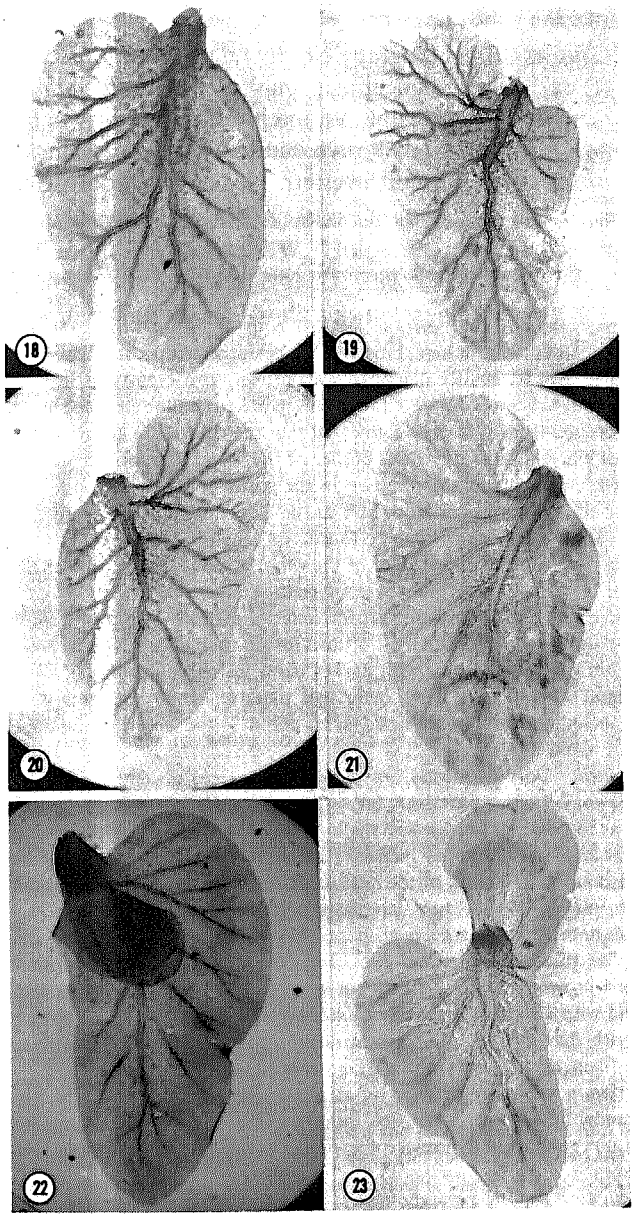
> "From *S. basalis*, which it resembles in size, it may be separated by the whitish abdomen and lighter color of the thorax [of the male]. The nymph has but a single brown median ventral streak, which character separates it from other known nymphs of this genus."

My examination of the slide of the holotype's (the only male collected or reared) fore wing showed that it clearly falls within the *basale's* size range, measuring 12.4 mm., and coloration. I cannot agree that the whitish abdomen and lighter colored thorax are sufficiently distinctive characteristics for establishing a new species in this genus. The male genitalia appear to be identical with those of specimens of *basale* from Alberta, Ontario, Michigan, and Maine. The color pattern on the abdomen of the lone male is so faded as to be indistinguishable. The female allotype and the paratypes likewise are assignable to *basale*. The nymphs, too, insofar as I can tell from these much faded and mutilated specimens, are those of *basale*. Further, the fact that Traver's immatures have but a single median ventral streak is not a distinctive trait for the condition can be found occurring among various populations of *basale*, as I have pointed out in the discussion of that species.

Traver (1932, p. 185) recorded *S. basale* (?) from Spero, North Carolina, after collecting two specimens, slides of which I have examined and confirmed as belonging to *S. basale* (discussed above) and decribed *S. signatum* from one male and four females taken at a lake near Liberty, N.C., both localities in the vicinity of Greensboro. The occurrence of the two forms in the same range, added to the facts mentioned above, convinces me that *signatum* is a synonym of *basale*.

To my knowledge no specimen of *Siphloplecton* identifiable as *signatum* has been taken since Traver's collections of 1930. I am, therefore, considering *signatum* to be a synonym of *basale*.

FIGURES 18-23. — Gills. 18-20. *S. fuscum*; 18. first gill; 19. second gill; 20. third gill. 21. *S. interlineatum*, second gill; 22-23. *S. basale*; 22. first gill, ventral folds in normal position; 23. second gill, ventral folds turned outward.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Siphloplecton simile new species (Fig. 7)

This species differs from the closely related *Siphloplecton basale* (Walker) in being conspicuously smaller and more intensely colored. The femora of the middle and hind legs are brown basally in *simile*, while they are only brown banded in *basale*. The species is know to occur only in northwestern Florida and south Georgia.

Description of male holotype (in alcohol): Body 11.4 mm.; wing 12.6 mm.; caudal filaments 23 mm.

Head: Compound eyes large, contiguous dorsally; vertex brown, antennae brown.

Thorax: Dark brown; pleurae marked with brownish-white. (*Wings*): Fore wings with all venation brown; crossveins in costal and subcostal spaces and spaces between R_1 and R_2 heavily margined with brown; also crossveins in disc of wing margined but to a lesser degree. Crossveins in area of bullae crowded and the membrane between them so deeply pigmented that the coloration forms a large brown spot near the middle of the costal border of the wing; stigmatic crossveins heavily margined, crowded and anastomosed in the costal space. The basal fifth of the wing membrane, extending from MA to the anal margin, is strongly tinged with brown. Hind wing with basal three-fourths of venation brown; outer portion pale. A brown stain covers the basal half of the wing, except for the costal angle which is paler. (*Legs*): Fore leg with base of coxa whitish; remainder of coxa, all of trochanter, femur, and tibia deep brown; anterior margin of tibia with spines; tarsus slightly paler. Tarsus of fore leg 2¼ times longer than tibia. Middle and hind legs mostly brown; femur brown with darker band just beyond middle; pale in outer fifth; basal fifth of tibia dark, outer half pale; all tarsal segments washed with brown, including fused 1st segment; tarsus about ¾ the length of the tibia plus the fused 1st tarsal segment.

Abdomen: Dorsally mostly brown with light areas on tergites 2-8. Tergite 1 dark brown; 2-9 with a prominent brown triangle with apex at anterolateral margin, extending to posterior border with the long leg of the triangle on the lateral edge of the tergite; a large, brown, median triangle extends from posterior border to anterior margin. The base of the median triangle fuses with the lateral triangles at posterior margin leaving large, lateral, pale areas on each of the tergites. Within each pale area there is a large, oval-shaped brown spot which more or less fuses with the median triangles on tergites 7-9. Tergite 10 dark medially, whitish laterally. Sternite 1 brown; sternites 2-8 pale but with a pair of brown spots near middle of each and with a median brown spot anteriorly. Sternite 9 pale medially but margined with dark brown. Forceps brownish, penes paler; penes of *basale* type. Caudal filaments brownish with darker brown annuli.

Description of female allotype (in alcohol): Body length 12.5 mm.; wing 13.3 mm.; caudal filaments 17 mm. Coloration and pattern very similar to that of male. Base of fore wing without brown coloration of male; hind wing without brown stain in membrane.

Variations: Among paratype males, wing length ranges from 10.9-13.5 mm.;

body length from 10.7-12.6 mm.; caudal filaments 19-24 mm. Paratype females' wing length varies from 11-12 mm.; body length 10.4-11.9 mm.; caudal filaments 13-19 mm. The fore femur may be banded with dark brown in the outer third and the median brown spot on sternites 2-7 may be elongated giving the appearance of a median ventral brown line. In the male fore wing the brown spot at the bullae may be relatively indistinct in some specimens and the 9th sternite may be brown medially.

Holotype male: FLORIDA, Santa Rosa Co., Blackwater River at Riley Landing, 3 miles N.W. Holt. March 4, 1972. W. L. Peters et al., Coll. 6Fla-221 FAMU: FSCA No. 4447.0.

Allotype female: Same locality as holotype, March 21, 1971, W. L. Peters et al., Coll. 5Fla-136 FAMU: FSCA No. 4449.0.

Paratypes: FLORIDA, same locality as holotype, April 24, 1971, 1 m., 5Fla-159 FAMU, same data as holotype, 8 m., FSCA Nos. 4447.1 and 4447.2; same locality as holotype, April 23, 1971, 1 f., 5Fla-155 FAMU; Okaloosa Co., Blackwater River, Florida A. and M. Univ. Biol. Sta. 4½ miles N.W. Holt, May 2, 1973, L. Berner, Coll., 1 f., FSCA No. 4408.3; same locality, May 3, 1973, W. L. Peters et al., Coll., 1 m., 7Fla-317 FAMU, FSCA 4448.0; same locality April 20, 1974, W. L. and J. G. Peters, Coll., 1 f., 8Fla-396 FAMU; April 21, 1974, W. L. and J. G. Peters, Coll., 2 f., 8Fla-398 and 8Fla-400 FAMU; April 17, 1975, W. L. and J. G. Peters, Coll., 1 m., 9Fla-464 FAMU; April 18, 1975, W. L. and J. G. Peters, Coll., 1 m., 9Fla-466. GEORGIA: Lowndes Co., Withlacoochee River, 4 miles W. Valdosta, State Hwy. 94, March 13, 1954, L. Berner, Coll., 1 m., reared, FSCA No. 3397.2; same locality, Feb. 3, 1956, 1 f., reared, FSCA No. 3778.0; same locality, Feb. 1, 1957, 3 m. (1 pinned), 4 f. (1 pinned) reared, FSCA Nos. 3917.1-3917.5.

Nymph: I am unable to distinguish nymphs of *S. simile* from those of other species of the *basale* group.

Siphloplecton brunneum new species (Fig. 9)

This species is closely related to *S. basale* and *S. simile* but differs from these two in the distinctive shape of its penes and in the coloration of the hind wing veins and the caudal filaments. The species is known to occur only in northwestern Florida.

Description of male holotype (in alcohol): Body 11 mm.; wing 11.9 mm.; caudal filaments 25 mm.

Head: Eyes large, contiguous dorsally. Head brown except for small whitish markings on the vertex and around the bases of the antennae. Antennae brown.

Thorax: Deep brown dorsally; pleurae extensively marked with brownish white. (*Wings*): Fore wings with dark brown venation and membrane tinged with brown. Markings of fore wings like those of both *basale* and *simile* except that the crossveins are much less heavily margined with brown than in those species; crossveins of costal, subcostal and subcostal-radial spaces much more strongly marked than

others. Crossveins at bullae are the most heavily margined but the brown borders of the crossveins do not form a prominent brown spot as in the related species. Membrane with basal fourth strongly stained with brown, the stain extending from MP to the hind margin of the wing. Hind wing with brown venation; membrane with strong brown stain in basal half, the stain extending to the outer three-fourths of the wing in the costal and subcostal spaces. (*Legs*): Fore legs deep brown; anterior margin of tibia with spines; tarsus almost three times the length of the tibia. Femur of middle and hind legs brown with a darker brown band in outer half; slightly paler near distal end; tibia and tarsus brown; tarsal segments with a very narrow brown ring at joints; tarsus slightly more than ¾ the length of the fused tibia plus the 1st tarsal segment.

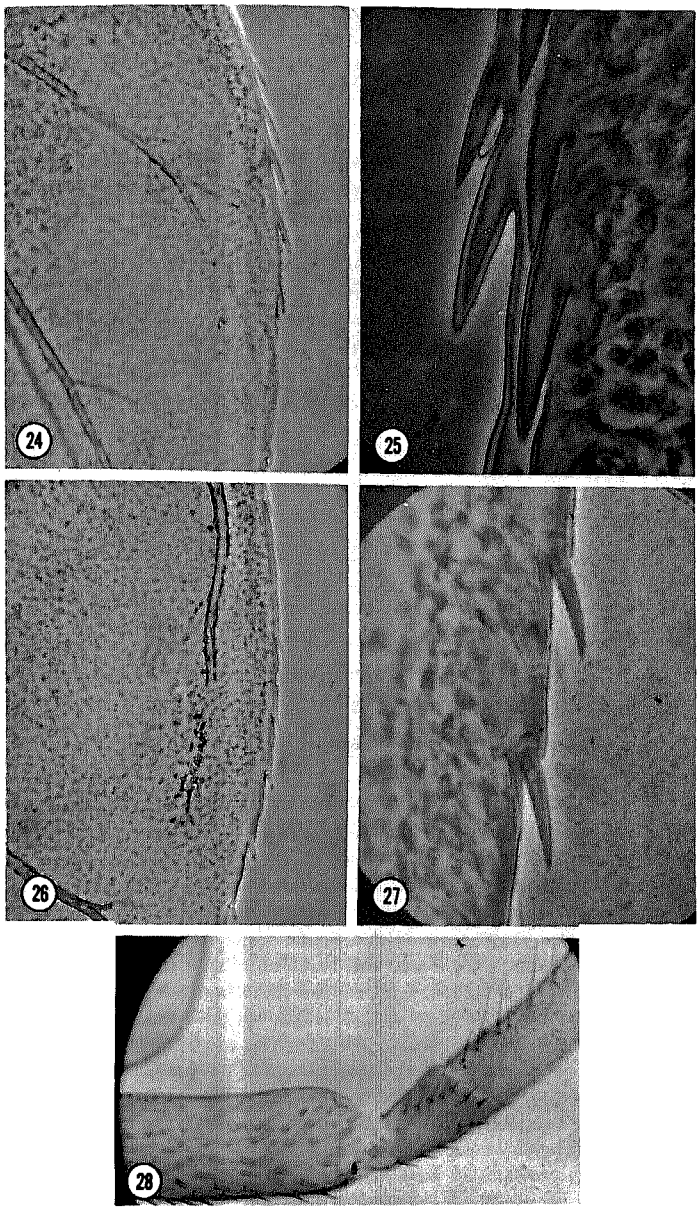
Abdomen: Tergite 1 brown; 2-6 brown but pale in the antero-medial region; lateral margins of tergites 2-10 dark brown with the marks on each becoming wider posteriorly. Oval-shaped, paired, brown spots in middle of tergites 2-7 are almost obscured by the brown coloration of the dorsum. Tergites 8-10 dark brown. Sternites 2-9 pale; each with a pair of brown spots in middle of segment, except on 9 where they are near anterior margin. Sternites 2-8 with anteromedial brown spot, elongating into a medial stripe on 6-9. Sternites 2-4 and 7-9 extensively whitened; sternite 9 with anterolateral brown triangles based on anterior margin. Forceps and penes brown; penes similar to those of *basale*, but distal lobes much more widely separated (fig. 9). Caudal filaments uniformly brown, except pale at joints.

Description of allotype female (in alcohol): Body 11.9 mm.; wing length 13.6 mm.; caudal filaments 17.5 mm. Coloration very similar to that of male. Eggs have been discharged from the allotype and laterally the middle abdominal segments are transparent. Ventrally, sternites 7-9 are whitish; 7 with a median brown line. Fore wings without dark brown stain in basal portions; otherwise as in male with strongly colored venation and brown tinted membrane; hind wing without brown stain of male hind wing. Fore femur with a trace of dark brown band in distal half, remainder brown. Middle and hind legs as in male. Caudal filaments colored as in male.

Variations: The paratypes are consistent in their coloration and resemble the type specimens closely. The body length of males ranges from 11.3-11.9 mm., that of females from 12.9-13.3 mm., caudal filaments of males 25-26 mm., of females 17.8-18.1 mm.

Holotype male: FLORIDA, Bay Co., Pine Log Creek at Fla. Hwy. 79, Feb. 15, 1971, P. H. Carlson, Coll. 18-15-II-71 FAMU; FSCA No. 4450.0.

FIGURES 24-28. — 24. *M. borealis*, fourth gill to show marginal spines, low magnification; 25. *M. borealis*, fourth gill; marginal spines greatly enlarged (phase contrast); 26. *S. speciosum*, fourth gill to show marginal setae; 27. *S. speciosum*, fourth gill; marginal setae greatly enlarged (phase contrast). 28. *S. speciosum*, maxillary palpus of nymph to show second segment.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Allotype female: FLORIDA, Oklaloosa Co., Blackwater River at Bryant Bridge, 3 miles N.W. Holt. March 4, 1972, W. L. Peters et al., Coll. 6Fla-222 FAMU; FSCA No. 4451.0.

Paratypes: Same data as holotype, 3 m., 1 f. 18-15-II-71 in FAMU collection; 4 m., 1 f, in FSCA, Nos. 4450.1 and 4450.2. FLORIDA, Walton Co., Seven Runs Creek at Hwy. 81 Jan. 9, 1971, P. H. Carlson, Coll. 17-9-I-71, FAMU collections 3 m.; FSCA No. 4454.0, 3 m. Santa Rosa Co., Blackwater River at Riley Landing, 3 miles. Holt, March 21, 1971, W. L. Peters et al., Coll., 5Fla-136 FAMU collections, 1 m.; FSCA No. 4453-0 2 m. Okaloosa Co., Blackwater River at Bryant Bridge, 3 miles. Holt, Jan. 30, 1971, W. L. Peters, et al., Coll., 5Fla-119 FAMU collections 1 m. Okaloosa Co., Blackwater River, Fla. A. & M. Univ. Biol. Sta. 4½ miles N.W. Holt, April 8, 1972, W. L. Peters et at., Coll., 6Fla-243 FAMU collections, 1 m. Okaloosa Co., Blackwater River at Peaden Bridge, 4½ miles N.W. Cannon Town. Jan. 29, 1971, P. Tsui and W. M. Beck Coll., 5-Fla-113 FAMU; FSCA No. 4452.0 1 m.

Nymph: I am unable to distinguish the nymphs of *S. brunneum* from those of other species of the *S. basale* group.

Siphloplecton speciosum Traver (Figs. 5, 12-14, 26-30, 38, 45)

References: Berner, 1950, p. 47, 51, 52, 56, 103-106, 130, figs.; 1959, p. 51; 1977, p. 15. Edmunds, Jensen, Berner, 1976, p. 151. Koss, 1968, p. 708. Needham, Traver, Hsu, 1935, p. 443, fig. Peters and Jones, 1973, p. 246. Schneider, 1966, p. 204. Traver, 1932, p. 191-194, figs.

Both sexes of this species are easily distinguished from all others in the genus by the lack of pigmentation in most of the wing membrane; the presence of non-margined crossveins; and the strongly marked bullae of the fore wing. *S. speciosum* has been taken in northern Florida and southern and central Georgia.

Description of male (in alcohol): Body 9-11 mm.; wing 9-11.5 mm.; caudal filaments 13-19 mm.

Head: Mostly brown; pedicel of antenna dark brown basally, pale distally, flagellum brown. Compound eyes large, contiguous dorsally.

Thorax: Fuscous except for whitish areas on mesonotum anterior to scutellum and on pleurae around wing bases and bases of meso- and metathoracic legs. (*Wings*): Fore wing hyaline except for small area between wing base and humeral brace; main veins brown for most of their length but those reaching outer margin become fainter near the wing border. All crossveins except the proximal 4 to 6 in the costal space pale; these few are brown near the Sc but pale as they reach the C; bullae of Sc and R_{2+3} dark brown and prominent; stigma opaque. Cubital intercalaries somewhat variable, sometimes with only three present rather than the usual four. Hind wing hyaline except for a small, light brown area at extreme base; C. Sc, Rs, R_1 and MA brownish in basal half, paler distally; all other venation pale. (*Legs*): Fore leg brown, femur with darker brown band in outer half, distal fifth

pale; tibia and tarsus brown with distal three tarsal segments paler; joints between tarsal segments 3 and 4 and 4 and 5 brownish. Middle and hind legs similarly colored with femur mostly brown and with dark brown band in outer half, distal fifth pale; basal half of tibia brown, outer half paler; tarsal segments pale with articulations and claws brown.

Abdomen: Segments 3-7 semihyaline. Tergites 1 and 2 brown; 3-7 with large, submedian, pale areas in anterior half of each tergite; each pale area with a large spot of brown pigment (spot apparent on tergite 2 of some specimens). Tergites 7-10 mostly fuscous; anterior portion of 7 pale; 10 whitish laterally. Sternite 1 fuscous, 2 lighter brown, 3-6 hyaline or semihyaline, 7-8 mostly white, 9 brown medially. Sternite 2 with large submedian oval brown spots in middle of segment. Sternites 3-7 with small brown spot at anteromedian margin. Genitalia light brown; of *basale* type but with more pronounced constriction at middle and with more spines near the constriction (figs. 12-14). Caudal filaments pale with brown annulations.

Description of female (in alcohol): Body 9-11 mm., wing 10-13 mm., caudal filaments 14-16 mm.

Head: Mostly brown in middle but paler next to compound eyes. Antenna brown.

Thorax: Colored as in male except slightly paler; scutellum may be whitish. Wings as in male. Legs colored as in male but tarsi darker.

Abdomen: Dorsally mostly brown but with small, submedian, pale areas at anterior margin of tergites 2-8; tergites 2-10 with submedian oval brown spots in middle of each segment (not obvious on all specimens). Median longitudinal brown dash at anterior margin of tergites 2-6. Tergite 10 white laterally. Ventrally similar to male. Caudal filaments as in male.

Specimens examined: FLORIDA, Gadsden Co., 4 miles S. River Junction, L. Berner, Coll., April 4, 1953, 4 f., 2 m., FSCA Nos. 3301.0 and 3301.2; Bear Creek, 8 miles S. Hwy. 268 and 1 mile N. Hwy, 65 C, Feb. 7-March 3, 1968, 6 f. subs., 2 f. (all reared), March 17, 1968, Feb. 1, 1969, n. FAMU; Rocky Comfort Creek, 6 miles S. Hwy, 268, Nov. 11, 28, 1969, 2 f. (reared), Jan. 22, Feb. 17, 22, March 1, 10, 15, 17, 29, Oct. 29, Nov. 11, 14, 21, 25, 28, 1968-1970, M. Pescador, P. Tsui, and J. Jones, Coll., nymphs, FAMU; Okaloosa Co., Shoal River at Hwy. 85, April 24, 1973, A. Gaufin, Coll., 2 f., FAMU; Blackwater River, Fla. A. & M. Univ. Biol. Sta., 4½ miles N.W. Holt, specimens collected in late March, throughout April, and into early May, 1971-1976, W. L. Peters et al., Coll., 13 m. 55 f., FAMU: Blackwater River at Bryant Bridge, 3 miles N.W. Holt, April 7-26, 1970-1974, W. L. Peters et al., Coll., 2 m., 8 f., FAMU. GEORGIA, Bibb Co., Echeconoee Creek, P. W. Fattig, Coll. April 14, 1931, m. paratype in FSCA, No. 35530; same locality, 1 m., 1 f. (reared), CNC; Fayette Co., Fayetteville, White Water Creek, P. W. Fattig, Coll., March 30, 1945, 1 f. FSCA No. 4017.0; Lowndes Co., Withlacoochee River near Valdosta, L. Berner, Coll. March 13, 1954, 3 m., 3 f. (reared) FSCA No. 3397.0.

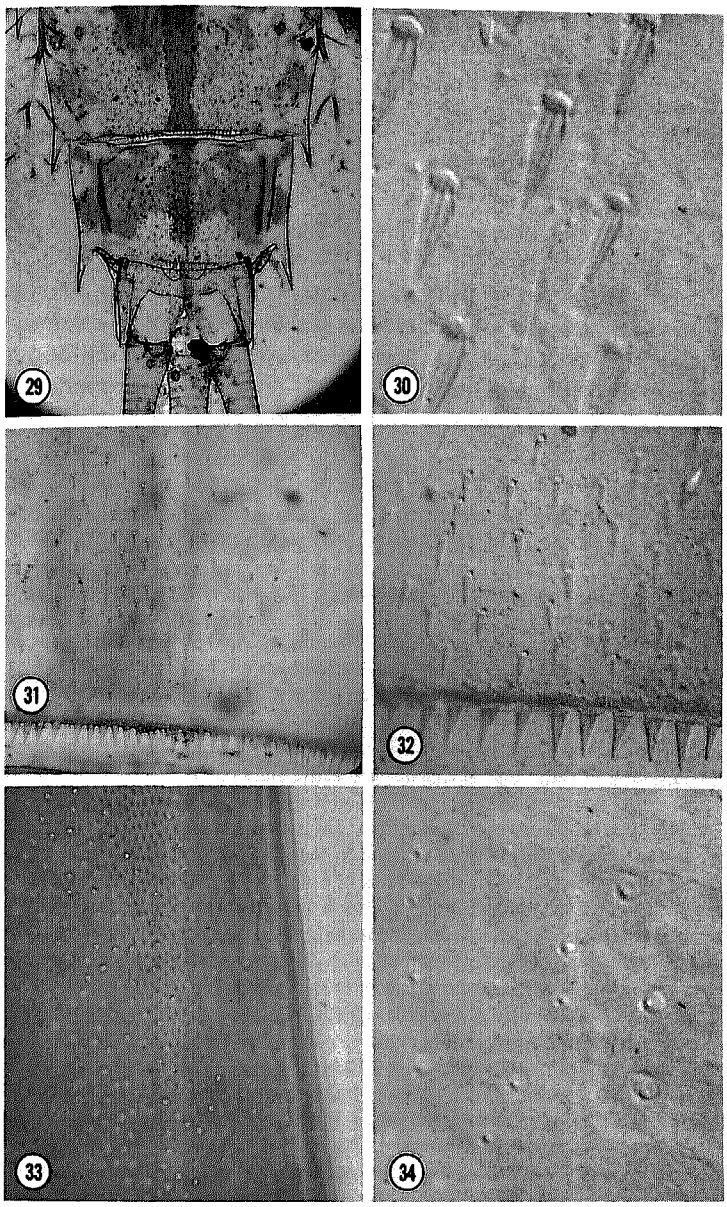
Nymph: The nymphs of *S. speciosum* are of the *basale* type and cannot be separated readily from the presumed immatures of *S. simile* or *S. brunneum*. The ventral color pattern of the nymphs was discussed above.

Siphloplecton basale complex, nymphs

Because characteristics that will make it possible to separate the nymphs of *Siphloplecton* other than into the *basale* and *interlineatum* complexes are not known, I am simply lumping collection records. These records are being included to provide all available information related to the distribution of the genus.

S. basale complex: ALABAMA, Baldwin Co., Styx River, Dec. 15, 1937, L. Berner, Coll., FSCA No. 1386-3. Covington Co., Blackwater Creek, 2 miles N.W. Wing, Jan. 29, 1971, J. G. Peters and M. L. Pescador, Coll., FAMU. FLORIDA, Bay Co., Pine Log Creek at Hwy. 79, Nov. 20 and Dec. 14, 1970, Feb. 15, 1971, P. H. Carlson, Coll., FAMU. Escambia Co., Perdido River, Jan. 14, 1969, W. T. Young, Coll., FSCA 4308.0 Gadsden Co., Bear Creek, 8 miles S. Hwy. 268, Jan. 21, 31, 1968, W. L. Peters et al., Coll., FAMU. Richlander Creek, 1 mile S. Hwy. 268, Feb. 25, 1968, W. L. Peters et al., Coll., FAMU. Rocky Comfort Creek, 6 miles S. Hwy. 268, Jan. 31, Feb. 7, March 3, 1968, W. L. Peters et al., Coll., March 14, 1973, J. M Hartley, Coll., FAMU. Holmes Co., Sandy Creek, Dec. 11, 1937, L. Berner, Coll., FSCA 427d. Okaloosa Co., Blackwater River, 1st bridge S. Alabama state line, Jan. 30, 1971, W. M. Beck, Coll., FAMU; Blackwater River, 4½ miles N.W. Cannon Town, March 21, Dec. 11-12, 1968, Oct. 26, 1969, W. L. Peters et al., Coll., FAMU: Blackwater River, 4½ miles N.W. Holt, Feb. 21-22, March 12, 18, Oct. 30, 1971, March 11, April 7-8, 1972, W. L Peters et al., Coll., FAMU; Blackwater River 6 miles W. Blackman, Kennedy Bridge, Jan. 31, March 20, Oct. 4, 1971, W. L. Peters et al., Coll., FAMU; Blackwater River, Cotton Bridge, 5½ miles N.W. Good Hope, Jan. 30, 1971, W. L. Peters et al., Coll., FAMU; Blackwater River 3 miles N.W. Baker, Hwy. 4, Nov. 27, 1968, W. L. Peters et al., Coll., FAMU; Blackwater River, 4 miles N.W. Baker, March 13, 1971, W. L. Peters et al., Coll., FAMU. Shoal River, Dec. 11, 1937, L. Berner, Coll., FSCA No. 428d; Yellow River, Hwy. 2, ½ mile E. River Grove, April 25, 1967, W. L. and J. G. Peters, Coll., FAMU. GEORGIA, Cherokee Co., Etowah River 6½ miles E.S.E. Ball Ground, Oct. 11, 1970, W. L. Peters et al., Coll., FAMU. Clarke Co., Sandy Creek at U.S. Hwy. 41, Apr. 9, 1977, J. O'Hop, Coll. Lowndes Co., Withlacoochee River near Valdosta, March 13, 1954, L. Berner, Coll., FSCA No. 3397.1. SOUTH CAROLINA, Oconee Co., Little River at Hwy. 11, 2 miles S.W. Salem, Dec. 24, 1973, P. H. Carlson, Coll., Jan. 23, 1968, H. Harris, Coll., FAMU.

FIGURES 29-34. — 29-30. *S. speciosum*; 29. nymphal exuviae; tergites 8 and 9 to show setal covering; 30. setae enlarged to show details (interference contrast). 31-32. *S. interlineatum*. 31. nymphal exuviae showing setae on tergite 6; 32. setae of tergite 6 enlarged (interference contrast). 33-34. *M. borealis*. 33. nymphal exuviae showing tergite 6; 34. tergite 6 enlarged to show nature of integument covering (interference contrast).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Siphloplecton interlineatum (Walsh)

(Figs. 3-4, 15, 21, 31-32, 37, 42, 46)

References: Berner, 1959, p. 51. Boerger and Clifford, 1975, p. 3022-3025, 3028 (misidentification). Burks, 1953, p. 4, 1953, p. 4, 150-151, fig. Clifford and Boerger, 1974, p. 1113, 1115, 1117, 1118, (misidentification). Daggy, 1941, p. 188, 190-194, figs.; 1945, p. 386, fig. Edmunds, 1962, p. 11. Edmunds and Allen, 1957, p. 320. Edmunds, Jensen, Berner, 1976, p. 151, fig. Hilsenhoff, 1975, p. 9. Krueger, 1969, p. 91-93. McDunnough, 1924, p. 128-129. Needham, Traver, Hsu, 1935, p. 442. Spieth, 1938, p. 3. Walsh, 1862, p. 368 (as *Baetis femorata*); 1863, p. 190. Wiens, Rosenberg, Snow, 1975, p. 21.

The male of *S. interlineatum* is distinguished easily from all other species in the genus except *S. costale* and *S. fuscum* by the shape of the penes or by the color pattern of the wings, distribution of pigment on the abdomen, and the presence on the anterior margin of the fore tibia of the male of broad spines each bordered with a brush of long hairs (fig. 42). *S. interlineatum* is distributed widely, being reported from the Northwest Territory, Manitoba, and Saskatchewan in Canada and from Illinois, Indiana, Minnesota, and Wisconsin in the United States.

Description of male (in alcohol): Body 13-14 mm.; wing 12-14 mm.; caudal filaments 21-24 mm.

Head: Brown; darkened around bases of ocelli; antennal pedicel mostly pale, except at base where it is dark brown, flagellum brown.

Thorax: Brown; pleurae paler than notum; scutellum paler than anterior part of mesonotum. (*Wings*): Fore wings with C, Sc, and R_1 light brown, other main veins paler or lightly tinted with brown; crossveins in costal, subcostal, and radial spaces margined with brown; those of radial space at the bulla connected by a brown bar; stigmatic area unstained or lightly colored and with some anastomosis of crossveins. A small brown stain present at fork of MA; another at extreme base of wing extending to CuP. Hind wing with C, SC, and R_1 light brown, other main veins lightly colored basally, pale distally. Crossveins in outer two-thirds of wing pale; membrane with brown stain in basal fourth, extending forward to the middle of wing in the subcostal space. (*Legs*): Femur of fore leg grayish brown and with brown band in outer half; tibia grayish in basal half, pale distally; outer margin of tibia with broad spines each bordered with brush of hairs; tarsus pale, claws brown; all articulations brown. Middle and hind legs pale; femur with a brown band in outer half; all articulations brown, tarsal claws brown.

Abdomen: Tergites 2-6 mostly pale; 7-10 dark brown. Pale tergites with brown lateral marks and medially with geminate brown streaks; 7-8 with prominent, pale lateral triangles based on anterior margin. Sternite 1 brown; 2 with a pair of brown spots near anterior margin; 3-7 unmarked; 8 with a pair of brown spots in middle of segment; 9 brown in anteromedial area and posterolaterally. Base of genitalia brown; penes as shown in fig. 15; forceps pale with articulations brown. Caudal filaments pale, articulations brown.

Description of female (in alcohol): Body 14-16 mm.; wing 14-15 mm.; caudal filaments 15-18 mm.

Head: Light brown with a pair of brown submedian lines on vertex and a median brown line posteriorly.

Thorax: Light brown, pleurae pale. (*Wings*): Main veins of fore wing paler than in male, otherwise pattern is very similar; no brown stain at base of fore wing. Hind wing as in male but generally lacking brown stain in membrane, although some specimens may have a faint spot or two. (*Legs*): As in male, except that fore tibia lacks brush-like spines.

Abdomen: Mostly brownish dorsally. A prominent pale area laterally on tergites 2-10; 2-5 with a brown median line; dark brown markings at lateral margins of tergites 2-9. Sternite 1 tinged with brown; 2-6 pale; 7-9 marked medially with brown; divided 10th sternite brown. Caudal filaments as in male.

Specimens examined: SASKATCHEWAN, South Saskatchewan River at Saskatoon, June 12, 1970, Dennis M. Lehmkuhl, Coll., 2 m, 1 f., all reared; June 2, 1970, 10 N, FSCA No. 4438.0, 50 N. DML. South Saskatchewan River at Lemsford Ferry, May 11, 1974, Dennis M. Lehmkuhl, Coll., 2 m. reared on June 7 and 8. MANITOBA, Assiniboine River, 1 mile upstream from Winnepeg, John F. Flannagan, Coll., 1 m., 4 f., all reared. CANADA, Aweme, June 12, 1923, R. M. White, Coll., 5 m. in alcohol, 1 m. pinned; same data except June 14, 1923, 1 m. pinned, CNC. ILLINOIS, Momence, May 8, 1940, Mohr and Burks, Coll., 2 f. Momence, Kankakee River, May 5, 1938, Ross and Burks, Coll., 2 f.; Havana, April 29, 1914, 1 m. INDIANA, Rogers, White River, April 16, 1936. Ross and Mohr, Coll., 1 N.

Siphloplecton costalense Spieth (Fig. 17)

References: Berner, 1950, p. 103; 1959, p. 51, Edmunds, Jensen, Berner, 1976, p. 151. Spieth, 1938b, p. 1-4, fig.

This species, described by Spieth in 1938, is very similar to *S. interlineatum* and to my new species, *S. fuscum*. Dr. Spieth differentiated *costalense* from *interlineatum* on the basis of a greater expanse of light areas on the thorax of *costalense* and also in its having dark maculation on the posterior sternites. He also pointed out (p. 3) that the distribution was interesting in that

> "Its nearest relative, *S. interlineatum*, lives in the upper Mississippi drainage. Traver has reported *S. signaum* [synonymized in this paper with *S. basale*] from North Carolina and *S. speciosum* from Georgia, both of which are quite distinct and easily differentiated from *S. costalense*. *S. basale*, the best known species of the genus, is northern in distribution but ranges into the southern highlands. Thus *S. costalense* is geographically separated from its nearest relative by more remotely related species. Such a type of distribution is fairly common in other groups, but so far as can be determined this is the first time it has been reported in the Ephemerida."

The distribution of *S. fuscum* is consistent with Dr. Spieth's observation.

The male of *S. costalense* may be distinguished from the male of *S. fuscum* in that the latter species lacks a brown stain at the base of the fore wing. Other colorational differences, such as those of the legs of *fuscum* also serve to distinguish the species from *costalense.*

S. costalense has not been reported since Spieth's original capture of a large series in Courtland, Virginia, on April 17, 1935. He made his entire series paratypes and of these, he presented me with two male specimens many years ago. I was also loaned another paratype for study from the Canadian National Collection and had available from the American Museum of Natural History three genitalia slides made by Dr. Spieth.

The fore tibia of *costalense* bears the same type of brush-like appendages seen on the fore tibia of *interlineatum* and which I believe occurs on the tibia of males of *fuscum.* The genitalia of all three species are similar.

For the sake of completeness, I am repeating Dr. Spieth's excellent description of the male and female (p. 1, 3):

> "IMAGO (Dried) male. — Eyes blackish; head fuscous except distal half of clypeo-frontal area, posterior edge of genae, the three ocelli and the antennal sclerites, all of which are light buff. Thorax fuscous except for four light areas as follows: (1) an area on the mesoscutellum; (2) a band which extends ventrally from the antero-lateral corners of the mesonotum, meeting at the mid-ventral line and including the prothoracic coxae; (3) a band which extends ventrally from the bases of the mesothoracic wings and also meets at the mid ventral line, and includes the mesothoracic coxae; (4) a similar band on the metathorax. All trochanters fuscous; all femora fuscous except for a light area medially and another one distally. Fore tibia dilute fuscous; meso- and metathoracic tibia fuscous in basal half and translucent buff distally. Tarsal joints of fore legs dilute fuscous with slightly darker joinings; tarsal joints of meso- and metathoracic legs translucent buff with darker joinings.
>
> "Longitudinal veins of fore wing fuscous; the MA from the junction of the Rs to fork and the CU_1 [CuA] most of its entire length darker than other longitudinal veins. Cross veins of anterior two-thirds of disk and costal region margined and pigmented with fuscous black. Other cross veins fuscous but lacking margination. Small fuscous black clouds between the R_1 and R_2 [R_{2+3}] in the stigmal area and at the forking of the MA. the wing membrane of the anal area posterior to CU_2 [CuP] is fuscous black. Hind wing with a fuscous black cloud extending diagonally

from base of wing to middle of costal area. Venation pigmented similarly to that of fore wing except that distal cross veins are transparent.

"First abdominal segment wholly fuscous; segments 2-6 semi-transparent with the following markings: (1) purplish ganglionic spots; (2) fuscous infuscations which extend anteriorly from base of tergites along medial and lateral areas; (3) two submedial fuscous spots on each tergite. Sternites 7 and 8 fuscous except for light-colored posteriorly directed triangular areas which are based laterally on anterior margins of tergites. Tergite 9 wholly fuscous except for a bare indication of a similar light triangular area. Segment 10 fuscous except for sides which are wholly light cream colored. Genital apparatus wholly fuscous; caudal cerci translucent pale fuscous with darker opaque joinings. Length 11 mm., fore wing 11.5 mm., hind wing 5 mm.

"IMAGO (dried) female. — Similar to male in maculation except that the fuscous black clouds which are found at the bases of the male's wings are completely lacking. In all other respects, except the usual differences between the sexes, similar to the male. Length 13 mm., fore wing 14 mm., hind wing 6 mm.

"VARIATIONS. — As is usual for the Ephemerida when a large series of individuals of any species from a given locality is considered, there is some variation in the color pattern. Some paratypes are darker that the holotype due not only to deeper intensities of the dark colors but also to the tendency of the dark areas to encroach upon the light ones. There are other paratypes where the reverse is true. The holotype was selected because it seemed to be average insofar as coloration is concerned."

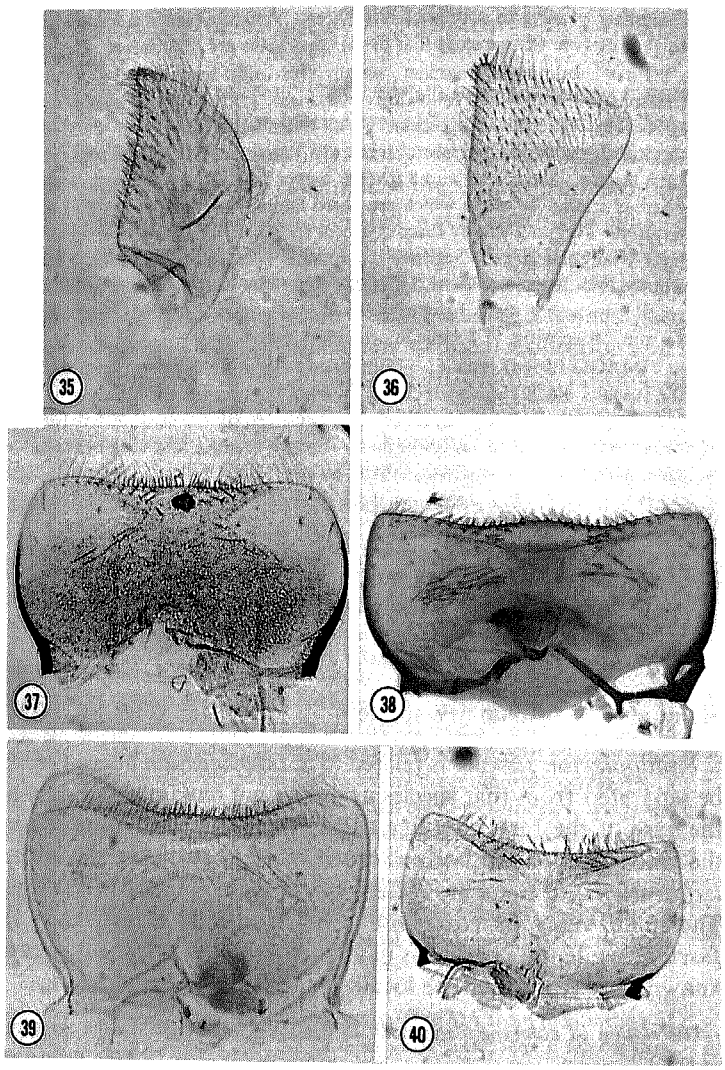
Siphloplecton fuscum new species (Figs. 16, 18-20)

Siphloplecton fuscum is related to *S. interlineatum* but can easily be separated from that species as it does not have a brown stain at the base of the fore wing like that of *interlineatum*. In addition, the coloration of the body is much more intense that that of *interlineatum* and there are differences in the coloration of the legs. The main veins of *costalense* wings are much darker than in *fuscum*, while the crossveins of *fuscum* are darker. The species is known only from the type locality in northwestern Florida.

Description of holotype male: Body 12 mm.; wing 12.5 mm.; caudal filaments 22 mm.

Head: Median area of vertex light brown; dark brown coloration between the large, contiguous eyes. Bases of ocelli dark brown. Pedicel of antenna dark brown, flagellum a little lighter.

Thorax: Fuscous; whitish areas on pleurae extending from wing bases to leg bases and onto coxae. (*Wings*): Fore wing hyaline; C, Sc, and R_1 brown at ex-



FIGURES 35-40. — 35. *M. borealis*, distal segment of labial palpus of nymph. 36. Same of *S. basale*. 37-40. Labrum of nymph. 37. *S. interlineatum*; 38. *S. speciosum*; 39. *M. borealis*, Norwegian specimen; 40. *M. borealis*, Alaskan nymph.

treme base, becoming pale distally; MA dark brown to the fork and slightly beyond; CuA dark as well as some of the basal crossveins attached to it. Crossveins of costal, subcostal, and radial spaces heavily margined with fuscous coloration; also those between R_{4+5} and MA similarly colored. Outer part of wing with pale venation. Stigmatic crossveins somewhat anastomosed. Stains in membrane of wing confined to subcostal bulla and crossveins above R_{2+3} bulla and to a small spot at fork of MA. Hind wing: Costal space hyaline; Sc and R_1 brown basally; crossveins of subcostal and radial spaces fuscous. Brown stain in membrane of basal half of subcostal space and extending into the radial space. Remainder of wing hyaline. (*Legs*): Fore legs missing. Middle and hind legs are similarly colored; trochanter and basal four-fifths of femur fuscous; distal fifth of femur pale; basal half of tibia fuscous; remainder pale; tarsal segments pale; articulations and claws brown.

Abdomen: Tergites 2-6 semihyaline; each with large submedian elongate brown mark; lateral margins brown, with the coloration widest at posterior margin of tergite; anterior margins of tergites 3-7 brown, producing a banded appearance. Tergites 7-10 mostly fuscous but a clear or whitish lateral triangle is based on anterior margins. Sternite 1 fuscous; 2 light brown with a pair of submedian, brown spots; sternites 3-6 hyaline but with faint, median, brown spot at the posterior margin of each segment. Sternites 7 and 8 mostly alabaster white: 7 with posterior margin fuscous and 8 with median area marked with broad brown band; sternite 10 fuscous. Genitalia similar to those of *interlineatum* but wider distally (fig. 16). Caudal filaments pale with annulations fuscous.

Description of allotype female: Body 13 mm.; wings 13.5 mm.; caudal filaments lost.

Head: Most of vertex pale except for pair of brown spots between compound eyes and dark brown epicranial suture. Pedicel of antenna brownish, flagellum darker.

Thorax: Pronotum fuscous; remainder of thorax light to medium brown. Pleurae mostly pale except for dark brown stripe extending from wing base to middle coxa. (*Wings*): Fore wing colored as in male. Hind wing without brown stain in membrane. (*Legs*): Fore leg mostly brown; femur with basal half brown, followed by fuscous band in outer half; extreme distal portion of femur pale; tibia mostly dark brown but paler distally; tarsus washed with brown, articulations dark brown. Middle and hind legs as in male except that femur is paler in middle.

Abdomen: Tergites 2-8 with large, lateral, brown triangles based on posterior margins and fusing posteriorly to produce wide brown margin; tergites 2-10 with median brown stripe; 9 and 10 mostly brown, 10 pale laterally; tergites 2-10 each with a pair of large oval brown spots in middle of segment. Sternites 1 and 10 brown; 2-7 pale; brown posteromedian spot on 2-6; median area of sternites 7 and 8 mostly brown; posterior portion of 9 brown. Caudal filaments lost.

Holotype male: FLORIDA, Okaloosa Co., Blackwater River, Florida A. & M. University Biological Station, 4½ miles N.W. Holt, March 23, 1973, W. L. and J. G. Peters, Coll. FAMU 7Fla-287. FSCA No. 4471.0.

Allotype female: FLORIDA, Okaloosa Co., Blackwater River at Bryant. Three miles N.W. Holt, March 11, 1972, W. L. and J. G. Peters and P. H. Carlson, Coll. FAMU 6Fla-230. FSCA No. 4471.1.

Nymph: As the adults were not reared, no nymphal exuviae are available for study but because the adults are clearly members of the *interlineatum* complex, I am assuming that all gills are single. Among the specimens Dr. Peters made available for this study, I found only one nymph with this characteristic. It was collected in Walton County, Florida, at Black Creek, McDaniel's Fish Camp, south of Highway 394, March 30, 1971, by P. H. Carlson and N. Farmer, FAMU 6-30-III-71.

Siphloplecton sp. ? No. 1 Traver

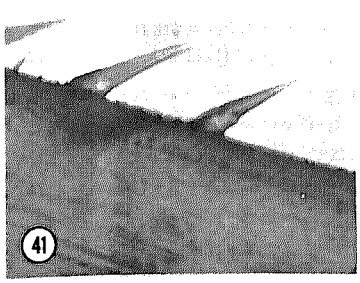
Included among Traver's collection of *Siphloplecton* nymphs were some taken at Big Alamance Creek, south of Greensboro, North Carolina, on October 19, 1929, which she designated as sp. ? No. 1. Her description of the nymphs revealed no characteristics which are distinctive, except for the fact that the gills are single. She speculated that they might be the immatures of *S. interlineatum* because the nymphs of that species were unknown in 1932. Certainly, the single gills make them members of the *interlineatum* complex, and, because of the proximity of the Greensboro collecting site to the type locality of *S. costalense* (Courtland, Virginia), I am suggesting that they are more likely the immatures of that species.

Metretopus alter Bengtsson

References: Bengtsson, 1930, p. 15-18, figs. Brekke, 1938, p. 69. Demoulin, 1951, p. 12-14. Illies, 1967, p. 216. Lestage, 1938, p. 170. Levanidova and Levanidov, 1965, p. 374. Tiensuu, 1939, p. 107. Tshernova, 1952, p. 260. Ulfstrand, 1968, p. 8.

What is the status of *Metretopus alter*? As nearly as I can determine, a collection of representatives of this species has not been taken in Europe since Bengtsson's initial catch at Raavand in northern Norway. The species has been listed from several localities,

FIGURES 41-46. — 41-42. Spines at edge of fore tibia of male adults. 41. *S. basale*; 42. *S. interlineatum*. 43-46. Tarsal claws, fore legs of nymph. 43. *M. borealis*, Alaskan specimen; 44. *M. borealis*, Norwegian specimen; 45. *S. speciosum*; 46. *S. interlineatum*.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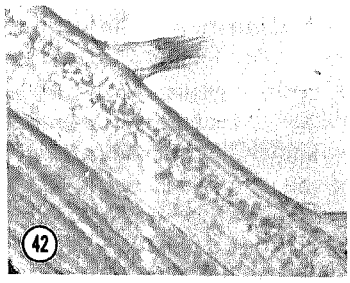
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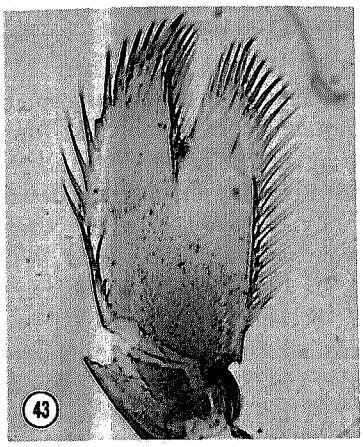
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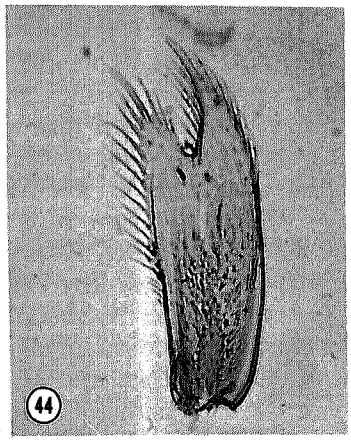
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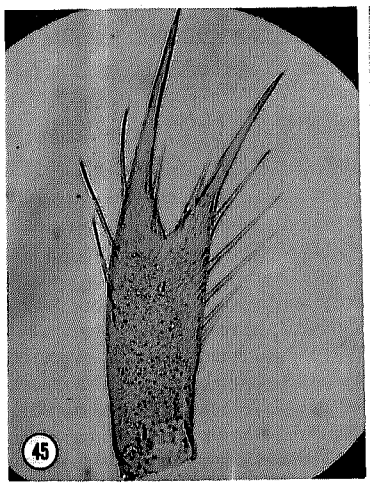
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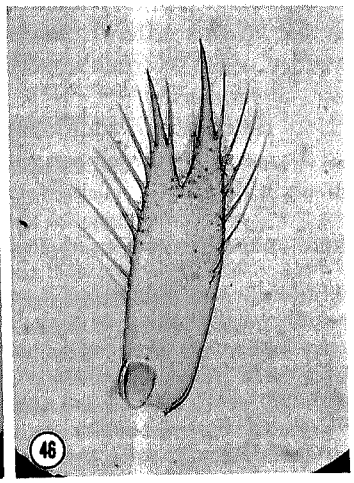
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but confirmation of the identification has not been made with certainty. Dr. John E. Brittain of the Zoological Museum, University of Oslo, wrote me "*Metretopus alter* (Bengtsson 1930 (1928) — Tromsø Mus. Årsh. 51) seems a doubtful species. To my knowledge it has only been recorded from the type locality in the county of Nordland." Ulfstrand (1968) considered *M. alter* to be a synonym of *M. borealis* but he gave no supporting evidence.

Tshernova (1952) has studied collections from the Amur River Basin and identified two male imagoes and about twenty nymphs as *Metretopus alter*. She separated the nymphs of *M. alter* from those of *M. borealis* by the shape of the fore claws. The distinguishing characteristic is in the length of the terminal spines, which are longer in *alter* than in *borealis*. Tshernova also found the nymphs of *alter* to be slightly larger (12 mm.) than those of *borealis* (10-12 mm.). The Amur River Basin collections were from Zabankal, Ingora River, July 2, 1947, 1 male; Chitz-Shargoldgen, August 11, 1947, 1 male; and the Shilka River, at the mouth of the Chernoy River, July 11, 1948, about 20 nymphs.

The very close resemblance between *Siphloplecton* and *Metretopus* is reemphasized on examination of Bengtsson's drawing of the male genitalia of *M. alter* (1928, fig. 9). The outline sketch could be mistaken easily for the genitalia of *S. basale*. Demoulin (1951, p. 13) remarked on this similarity when he pointed out that *M. alter* differs from other Metretopodidae in the shape of its penes, which is certain respects, resembles those of the American genus *Siphloplecton*.

Until collections of additional adult males of *M. alter* are made and the specimens closely scrutinized, the status of the species must remain in doubt.

Metretopus borealis (Eaton) (Figs. 6, 11, 24-25, 33-35, 39-40, 43-44)

References: Aro, 1928, p. 51, figs. (as *M. norvegicus*). Bengtsson, 1909, p. 16-17; 1913, p. 305-306, fig.; 1930, 15-17, fig. (all as *M. norvegicus*). Berner, 1959, p. 40. Brekke, 1938, p. 69. Burks, 1953, p. 148 (as *M. norvegicus*). Demoulin, 1951, p. 12-14. Eaton, 1901, p. 254-255, figs. (as *M. norvegicus*). Edmunds, 1957, p. 161; 1962, p. 11. Edmunds and Allen, 1957, p. 320. Edmunds, Jensen, Berner, 1976, p. 148, figs. Esben-Petersen, 1916, p. 11-12, figs. (as *M. norvegicus*). Hilsenhoff, 1975, p. 9. Illies, 1967, p. 216. Leonard and Leonard, 1962, p. 94-95, figs. (as *M. norvegicus*). Lestage, 1917, p. 437; 1921, p. 271; 1928, p. 255; 1938, p.

169 (all as *M. norvegicus*). Levanidova, 1968, p. 247 (as *Metretopus* sp.); 1972, p. 109, 115. McDunnough, 1925, p. 187, 189 (as *M. norvegicus*). Needham, Traver, Hsu, 1935, p. 435-436, figs. (as *M. norvegicus*). Tiensuu, 1935, p. 14 (as *M. norvegicus*); 1939, p. 106-107. Tshernova, 1940, p. 135, 1941, numerous references; 1952, p. 260; 1964, p. 134 (all as *M. norvegicus*). Ulfstrand, 1968, p. 8, 26, 29. Ulmer, 1919, p. 69; 1920, p. 136 (as *M. norvegicus*). Wiens, Rosenberg, Snow, 1975, p. 21 (as *Metretopus* sp.)

The following is a description of the adult stage of *Metretopus borealis* based on an extremely limited sample. The species, which was synonymized with *M. norvegicus* by Brekke (1938), has an holarctic distribution, as I pointed out previously. The scarcity of available specimens supports Lestage's (1938) and Leonard and Leonard's (1962) supposition that the species has its present distribution as a result of its being a glacial relict. The few North American records, mostly from Canada, reflect the sensitivity of the species to increased temperatures farther south. Dr. Tshernova's (1952) report of *M. borealis* (as *M. norvegicus*) from the Amur River Basin (Ingora River near Makarev) is consistent with the distribution pattern of the species, as is that of Levanidova (1972) who collected it in the Kamchatka Peninsula.

Edmunds (1957) pointed out that the European and Canadian populations of *M. borealis* are conspecific and apparently indistinguishable. My study of North American and Swedish male specimens confirms Dr. Edmunds conclusion. The nymphal fore claws of the specimens from Maine and Norway are very similar, while those of specimens from Alaska differ slightly. I do not know whether this minor difference represents one of specific rank or merely falls within the range of normal variability of the species.

Description of North American male (in alcohol): Body 10.5 mm.; wing 11 mm.

Head: Eyes large, contiguous. Antennae brownish.

Thorax: Uniformly brown dorsally except for scutellum which is darker; some pale areas on the pleurae. (*Wings*): Hyaline; stigmatic area opaque. Longitudinal veins brown tinged; crossveins colorless except those in basal costal space, which are light tan in the half adjacent to Sc; stigmatic crossveins anastomosed. Hind wing hyaline; longitudinal veins light brown; crossveins colorless except those between Sc and R_1, which have the same intensity of color as the main veins. (*Legs*): Fore legs missing. Middle and hind legs with femur light brown; remainder of legs pale except tarsal joints which are narrowly darkened.

Abdomen: Tergites 1 and 2 and 8-10 brown. Middle segments semihyaline, the posterior margins of tergites 3-7 bordered with brown; brown posterior border extends forward at lateral margin on each of these tergites to the middle of the seg-

ment. A pair of submedian brown spots in middle of tergite 3. Lateral margins of tergite 10 pale. Abdomen pale ventrally. Caudal filaments missing.

Specimen examined: NEW BRUNSWICK, Newcastle, July 6, 1928, W. J. Brown, Coll., No. 104, CNC.

Description of European male (in alcohol): Body 8 mm.; wings 11 mm.; caudal filaments 15 mm. (Eaton's [1901] measurements: body 10 mm.; wing 9 mm.; caudal filaments 12-13 mm.). Specimen in poor condition. The description of the North American male fits the Swedish specimen rather well. These additional points round out the description of the species: fore leg light brown; tarsal segments with joints dark brown; tibia is subequal in length to femur; tarsus two and three-fourths times the length of the tibia; tarsal segments 1-4 approximately of equal length; 5 about one-half the length of the other segments. Middle leg with femur equal in length to tibia and fused 1st tarsal segment; tarsal segments 2, 3, and 5 subequal; segment 4 slightly more than half the length of 5. Tibia plus fused segment 1 about 1.4 times longer than tarsal segments 2-5 together. Abdomen so twisted and distorted that color pattern cannot be seen clearly but it appears to be very similar to that of the North American male. Caudal filaments pale, without darkened annulations.

Description of Swedish female (in alcohol): Body 11-12.5 mm.; wing 12.5-13 mm.; caudal filaments 13 mm. (Eaton's [1901] measurements: body 10 mm.; wing 10 mm.; caudal filaments 10 mm.).

Head: Brown; dark brown area in midposterior part of vertex. Antennae brown.

Thorax: Brown; scutellum darker; pleurae with pale area. (*Wings*): Similar to those of male; main veins of fore wing slightly darker than those of preserved male. (*Legs*): Fore leg pale, joints between tarsal segments 2-5 dark brown. Middle legs missing; hind leg with coloration similar to that of fore leg. Fore leg with femur subequal in length to tibia and fused 1st tarsal segment; tarsal segments 2 and 3 almost equal and 4 and 5 also about equal in length, the combined tibia and 1st tarsal segment about 1⅓ times the length of tarsal segments 2-5 together. Hind leg with approximately the same size relationships for the various segments as fore leg.

Abdomen: Brownish; much lighter than thorax. Tergite 1 about same color as thorax, but 2-8 are mostly light brown. Tergites 2-9 with mid-dorsal brown line; posterior margins of 2-9 brown with a more intense coloration on posterior tergites; brown border extends anteriorly near lateral margins and medially on 5 and 6; tergite 10 pale laterally. Caudal filaments pale.

Male: SWEDEN, Ly. Ipm., Sorsele, Storvindeln vid Månnäs. Aug. 19, 1962, Lok. 75 Waldén, Coll., 1 m.

Females: SWEDEN, Ly. Ipm., Vindelälven Kraddsele, 18 km. SE Ammarnäs (Lok H) August 3-10, 1963. Ljusfälla nr 1 (Ulfstrand).

Comment: Bengtsson (1930), in differentiating *M. borealis* adults from those of *M. alter*, stated that in *borealis* the segments of the hind tarsus of both male and female are almost ⅓ longer than those of the middle. My measurements of the leg segments of

the New Brunswick male do not confirm this difference as the segments are virtually the same length in both middle and hind leg. Middle and hind legs of the female were not available for study. Bengtsson further stated that the subgenital plate of the female is emarginate in the middle of the hind border. The two females from Sweden lack such an emargination.

Specimens examined: Canada, ALBERTA, Carrot Creek at Hwy. 16 W, July 6, 1966, High Clifford, Coll., n., FSCA No. 4447.0. Whitemud Creek, 53°33′ N, 113°28′ W, July 5, 1977, ERW, Coll., 1 n. NEW BRUNSWICK, Northwest Miramichi River near Newcastle, July 7-13, 1961, T. Dolan, Coll., n., FAMU. United States, ALASKA, Birch Creek between Big Creek and Preacher's Creek, 66°00′ N, 144°50′W, Aug. 17, 1962, John Varley, Coll., n., GE. MAINE, S. Schoodie Brook, June 9, 1974, T. Mingo, Coll., n. SWEDEN, Ly. Ipm., Vindelälven, 5.8 km. uppstr. Vindelforsen, Ammaranäs, July 24, 1964, Lok. L ("rian"), S. Ulfstrand, Coll., n; same locality, Aug. 12, 1964, 1 f. sub. Ly Ipm., Vindelälven, Sennajokks Utflöde, 11 km. Ammaranäs, July 28, 1961, A. & S. Ulfstrand, Coll., n., GE. Ly. Ipm., Vindelälven, Kraddsele, 18 km. S. E. Ammaranäs, (Lok. H) Aug. 3-7, 1963, S. Ulfstrand, Coll., 2 f. sub., GE. Ly. Ipm., Vindelälven, 6 km. N. Ammaranäs, Lok nr. 29, July 28, 1961, A. & S. Ulfstrand, Coll., N., GE. Ly. Ipm., Tjulträsk, Vuomajokk ("vattenfallet"), 17 km. W. Ammaranäs, Lok O, Aug. 18, 1964, S. Ulfstrand, Coll., 1 m. sub., GE. NORWAY, Ossjöen, July 6, 1930, S. Sömme, Coll., n., FAMU. Finmark, Kautokeino, Suoppatjaure, July 16, 1974, J. Brittain, Coll., n., ZMO. Finmark, Alta, Stoengelse (Søndre), July 25, 1974, J. Brittain, Coll., n., ZMO. Hedmark, Engerdal, Istern, July 26 and Aug. 1, 1974. P. I. Kaummen, Coll., n., ZMO. Hedmark, Engerdal, Sømaa, July 27, 1974, P. Kaummen, Coll., n., ZMO. Troms, Nordreisa, Reisaelva, Aug. 21, 29, 31, 1973, n., ZMO. Tomassbehhen, VN 24 29, St. I, July 25, 1974, T. D., Coll., MT. Unkervatn, VN 611 652, St. II, Aug. 15, 1974, n.; VN 632 657, St. I., July 8, 1974, n.; VN 664 563, St. III, Aug. 25, 1974, n., T. D., Coll., MT. Elsvatn, VN 607 733, St. VI, July 23, 1974, n.; VN 608 736, St. III, July 12 and Aug. 22, 1974, n.; VN 612 734, St. II, Aug. 22, 1974, n.; VN 623 722, St. I., Aug. 22, 1974, n.; T. D., Coll., MT. Store Majavatn, St. Ib, July 24, 1974, T. D. Coll., n., MT. Lille Majavatn, VN 227, 355, St. I, June 29 and July 25, 1974, n., T. D., Coll., MT. Sefrivatn, VN 213 379, St. I., June 28, 1974, n.; VN 216 368, ST. V., July 4, 1974, n.; VN 243 470, St. I., July 29, 1974, n.; T. D. Coll., MT. Susna, VN 527 547, St. I., June 28, 1974, T. D., Coll., n.; MT. Kierringvatn, VN 223 391, St. I, July 3, 1974, T. D., Coll., n., MT. Skrifsteinbehhen, VN 563 761, St. I, July 16, 1974, T. D. Coll., n.; MT. Harrvassbehhen, VN 727 447, St. I, July 15, 1974, T. D., Coll., n., MT.

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