

The Genus *Brachycentrus* in
North America, with a Proposed
Phylogeny of the Genera of
Brachycentridae (Trichoptera)

OLIVER S. FLINT, JR.

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ABSTRACT

Flint, Oliver S., Jr. The Genus *Brachycentrus* in North America, with a Proposed Phylogeny of the Genera of Brachycentridae (Trichoptera). *Smithsonian Contributions to Zoology*, number 398, 58 pages, 104 figures, 1984.— The North American species of the genus *Brachycentrus* are revised on the basis of adult males and larvae. The genera *Eobrachycentrus*, *Adicrophleps*, *Amiocentrus*, *Micrasema*, and *Brachycentrus* are the recognized world genera of the family. Their relationships are discussed and a phylogeny proposed. In *Brachycentrus*, five subgenera (*Brachycentrus*, *Oligoplectrum*, *Sychnothrix*, *Oligoplectrodes*, and *Sphinctogaster*) are recognized, defined, and their phylogeny proposed. In North America, *Brachycentrus* sensu strictu contains only *B. nigrosoma* (Banks) (with new synonyms *B. notabulus* Milne and *B. adelus* Ross). *Oligoplectrum* is lacking in North America, but widespread in Europe. The new subgenus, *Sychnothrix*, is established for *Oligoplectrum echo* Ross, its only included species. *Oligoplectrodes* contains only *B. americanus* (Banks) in North America. The remaining ten recognized species are placed in *Sphinctogaster* (with new synonym *Brachycentriella* Iwata): *B. appalachia* new species, *B. chelatus* Ross, *B. etowahensis* Wallace, *B. fuliginosus* Walker, *B. incanus* Hagen, *B. lateralis* (Say), *B. numerosus* (Say), *B. occidentalis* Banks, *B. solomoni* new species, and *B. spinae* Ross. The North American subgenera and species (males and larvae) are keyed, described and illustrated with distribution maps provided for the species.

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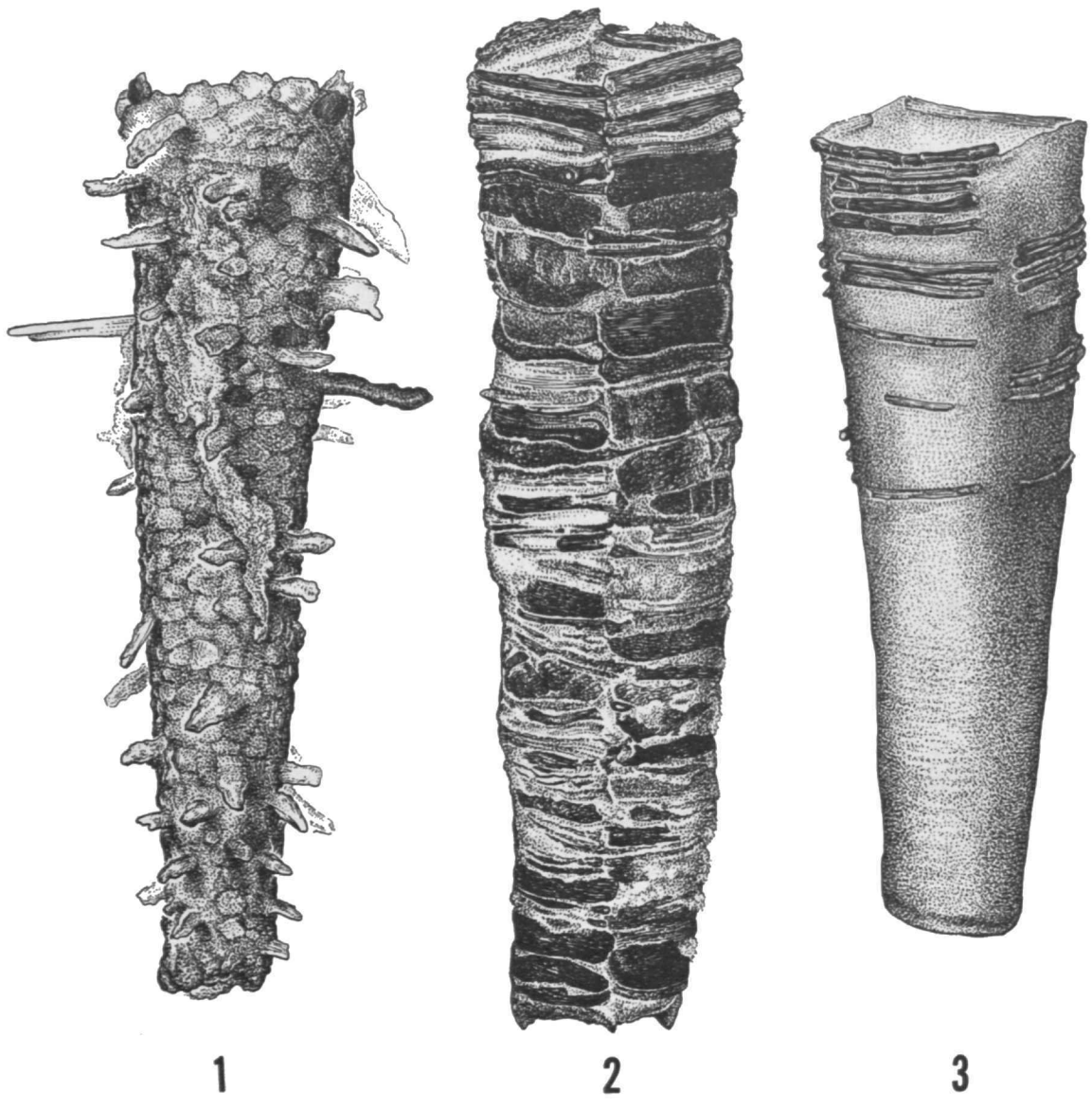
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FIGURES 1-3.—Larval cases: 1, *Brachycentrus etowahensis* Wallace; 2, *Brachycentrus spinae* Ross; 3, *Brachycentrus numerosus* (Say).

The Genus *Brachycentrus* in North America, with a Proposed Phylogeny of the Genera of Brachycentridae (Trichoptera)

Oliver S. Flint, Jr.

Introduction

The genus *Brachycentrus* Curtis, type-genus of the Brachycentridae, is widely distributed throughout the Holarctic Realm. They are primarily inhabitants of flowing waters, often rather large rivers, but some species inhabit streams a meter or less in width. The larvae construct rather characteristic cases, generally square in cross section and constructed of small rectangular pieces of plant material. The larvae usually attach the anterior end of the case to the substrate, and, extending the head and legs from the opening, assume a "filtering pose." In this pose the legs are extended and the ventral setal fringes on the femora, tibiae, and tarsi of the mid- and hindlegs filter the larval food from the flowing water. As far as is known this manner of food gathering is restricted in the Trichoptera to *Brachycentrus*.

Brachycentrus Curtis is widely distributed in North America, and the larvae are frequently collected in benthic samples. Adults, however,

are infrequently collected, at least in eastern North America. The reason for their scarcity in collections is that many species have a very short emergence period of only a week or so early in the spring, long before most collectors are in the field. If one does encounter a flight, however, they are often present in tremendous swarms, and when this happens they become the favored food of sport fishes and the basis for a series of artificial lures (Solomon and Leiser, 1977).

There is no current study of the North American fauna that treats more than three species (Ross, 1944). The remaining descriptions and illustrations are scattered throughout the literature. In spite of the frequent larval collections only four species are described in this stage (Ross, 1944; Denning, 1937). As a result of this condition, I have frequently encountered misidentifications of specimens that were the basis of published records. Consequently I am ignoring published distributions. In a few cases I have been able to verify or correct published records; these are then listed in the synonymy of the correct species.

This paper is an attempt to present a uniform treatment of the genus for North America, for both the larvae and adult males. To accomplish

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this, I have had to study all the genera currently placed in the family in order to establish a reasonable taxonomic hierarchy. Hence the genera and species not of North American *Brachycentrus* (sensu lato) are only treated superficially and are ignored after the basic taxonomic structure is established.

In spite of the amount of material I have had available for study, there are still a number of problems that I have not been able to resolve to my satisfaction. More collecting and rearing are needed, especially of some of the populations of *B. spinae* Ross in the southern Appalachians. No associated larvae are available for the species *B. fuliginosus* Walker and the association of *B. incanus* Hagen is only tentative.

HISTORICAL PERSPECTIVE.—The genus *Brachycentrus* was established in 1834, nearly 150 years ago, by Curtis for his species *B. subnubila*, described at the same time, and placed in the all inclusive family Phryganeidae. By the time the genus was thoroughly studied and revised by McLachlan in his monumental treatment of the European fauna (1876), it included three nominal species and two generic synonyms (*Pogonostoma* Rambur, 1842 and *Hydronauta* Kolenati 1848). McLachlan, in this work, made an attempt to divide the order into Families and Sections, which usually correspond to our current familial concepts. In his Section III of Sericostomidae he placed *Brachycentrus* Curtis *Oligoplectrum* McLachlan, *Micrasema* McLachlan, *Thremma* McLachlan, and *Helicopsyche* von Siebold. In his first additional supplement, published in 1884, McLachlan changed the name of Section III to *Brachycentrus*. In 1903 Ulmer recognized the Section of *Brachycentrus* as the Subfamily Brachycentrinae of the Sericostomatidae. The group was finally recognized by Ross (1944) as a full family. Throughout its history the same first three genera that McLachlan placed in the category have remained in it (*Thremma* and *Helicopsyche* are now placed in their own separate families). Additional genera have been proposed, and some synonymized, so that now I recognize a total of five genera in this taxon (*Adicrophleps*

Flint, *Amiocentrus* Ross, *Brachycentrus* Curtis, *Eobrachycentrus* Wiggins, and *Micrasema* McLachlan). The genus *Dolichocentrus* Martynov is not known to me and is so described that I can not relate it to any of the other genera with certainty, but all of the characteristics and figures given suggest that it may be a synonym of the subgenus *Oligoplectrum*.

The number of recognized species in the genus *Brachycentrus* has grown slowly. The first species, *Brachycentrus subnubilus*, was described by Curtis in 1834. McLachlan (1880) recognized four European species. Say, in 1823, described the first two North American species, but placed them in *Phryganea*. Hagen transferred these species in 1861 to the genus *Dasystema*, now treated as a synonym of the brachycentrid subgenus *Oligoplectrum*, and in 1868 again transferred the two species into *Brachycentrus*. Walker (1852) described *B. fuliginosus* which he placed in *Brachycentrus*. Since these early descriptions the size of the genus has increased in a rather erratic manner, with species being synonymized almost as fast as they are proposed. The Fischer *Catalogus Trichopterorum* (1970) and its *Supplement* (1973) list 26 names, one of which is a fossil in Baltic amber. However, Botosaneanu and Malicky (1978) treat *B. carpathicus* Dziedzielewicz as a synonym of *B. montanus* Klapalek, and *B. albescens* McLachlan and *B. maracandicus* McLachlan as synonyms of *B. subnubilus* Curtis, thereby reducing the number of potentially valid names to 23.

The type of *B. adoxus* McLachlan is a female from Russia that has never been examined critically, and remains a nomen dubium. I have studied the "type" of *B. signatus* (Fabricius), which is located in the British Museum (Natural History), and is said to originate in "*America septentrionali*," but has no locality data now. The genitalia have been cleared and are in quite good condition. The example belongs to the subgenus *Brachycentrus* Curtis, but appears to be the European *B. subnubilus* Curtis not the American *B. nigrosoma* (Banks). This would indicate either an incorrect original attribution of locality or possibly a later

specimen was substituted for the true type. Therefore, I refrain from synonymizing *B. subnubilus* Curtis, but leave the question to more careful study by my European colleagues, and in the meantime leave *B. signatus* a nomen dubium.

In North America the situation also has been confused. The types of three species are apparently lost: *B. lateralis* (Say), *B. numerosus* (Say), and *B. lutescens* (Provancher). Neotypes of the first two species have been established and the species are thereby recognizable (Ross, 1944). The last species, based on the original description, was placed in the synonymy of *B. lateralis* by Milne (1936), and, lacking the type, I am leaving it there. The types of another three species are females: *B. fuliginosus* Walker, *B. incanus* Hagen, and *B. nigrosoma* (Banks). Males have been associated with all three species, and all are recognized herein as valid. I am here synonymizing two names with *B. nigrosoma* (Banks) (*B. notabulus* Milne and *B. adelus* Ross) but describing two new species (*B. appalachia* and *B. solomoni*), thereby recognizing 13 species in North America.

ACKNOWLEDGMENTS.—First and foremost, I must acknowledge my indebtedness to Dr. Jay W. Chapin. While a student he did much of the basic groundwork of collecting and rearing the southeastern species, accumulating material from various sources, separating species, and preparing tentative keys and drawings. Unfortunately his current employment did not permit him to continue with the project.

Types of a number of species were made available by Dr. P.C. Barnard (BMNH), Ms. K.A. Jepson (MCZ), and Dr. J.D. Unzicker (INHS). Dr. F. Schmid made available his manuscript coverage of the genus as found in Canada. Dr. G.B. Wiggins also provided much information and material on the genus as it occurs in Japan. Dr. and Mrs. J.A. Louton and Dr. J.A. Woytowicz made special trips to the type-locality of *B. spiniae* Ross to collect fresh larvae as a result of my request for material.

The excellent illustrations of the larval heads, thoraces, and legs as well as the phyletic trees

were prepared by the staff artists, Mrs. Elaine R. Hodges and Mr. L. Michael Druckenbrod.

Material in the following collections were studied or are mentioned in the text, thanks to the efforts of the respectively named curators. Specimens deposited in the Smithsonian Institution are listed in the "Material Examined" sections without mention of repository.

ANSP	Academy of Natural Sciences of Philadelphia, Penn
BCE	Behrend College of Pennsylvania State University, Erie, Penn, Dr. E.C. Masteller
BMNH	British Museum (Natural History), London, England, Dr. P.C. Barnard
CUC	Clemson University, Clemson, SC, Drs. J.C. Morse and J.W. Chapin
FWI	Freshwater Institute, Winnipeg, Canada, Mr. D.G. Cobb
INHS	Illinois Natural History Survey, Urbana, Ill, Dr. J.D. Unzicker
LSU	Louisiana State University, Baton Rouge, La, Mr. R.W. Holzenthal
MCZ	Museum of Comparative Zoology, Harvard University, Cambridge, Mass, Ms. K.A. Jepson
MWQMD	Maryland Water Quality Monitoring Division, Annapolis, Md, Mr. W.L. Butler
ROM	Royal Ontario Museum, Toronto, Canada, Dr. G.B. Wiggins
SCHC	Dr. Steven C. Harris Collection, University, Ala
UDN	University of Delaware, Newark, Del, Dr. R.W. Lake
UGA	University of Georgia, Athens, Ga, Dr. J.B. Wallace
UMA	University of Massachusetts, Amherst, Mass, Dr. T.M. Peters
UMO	University of Maine, Orono, Me, Mr. T.M. Mingo
UMQ	University de Montreal, Montreal, Canada, Dr. P.P. Harper
UMSP	University of Minnesota, St. Paul, Minn, Dr. P.J. Clausen
UNH	University of New Hampshire, Durham, NH, Dr. D.S. Chandler
USNM	National Museum of Natural History Smithsonian Institution, (formerly the collections of the United States National Museum), Washington, DC
UTK	University of Tennessee, Knoxville, Tenn, Dr. D.A. Etnier
UWM	University of Wisconsin, Madison, Wis,

Dr. W.L. Hilsenhoff
 VPI Virginia Polytechnic Institute and State
 University, Blacksburg, Va, Dr. B.C. Kon-
 dratieff

Family BRACHYCENTRIDAE Ulmer

BRACHYCENTRINAE Ulmer, 1903:85.

TYPE GENUS.—*Brachycentrus* Curtis

ADULT.—Lacking ocelli. Maxillary palpi of male 2- or 3-segmented; of female 5 segmented. Head dorsally with three pairs of setal warts. Antennae shorter than forewing; scape not modified. Pronotum with two pairs of setal warts. Mesonotum with a pair of small scutal warts, often with a distinct median fissure; scutellum with a pair of lateral warts, often large, in which case their mesal margins are indistinct. Spurs 2,2,2 or 2,2,3 or 2,3,3 or 2,4,4; preapical spurs of mid- and hindtibiae, when present, arising $\frac{2}{3}$ of distance from base to apex. Wings rounded apically, not greatly elongate. Venation very variable, with a closed discal cell; always more complete, especially in the hindwing, in the female.

Male Genitalia: Ninth segment cylindrical, generally much narrowed dorsally. Tenth segment generally elongate, deflexed laterally, tip usually bifid; frequently with additional processes basally. Cerci generally ovoid; sometimes fused dorsomesally. Clasper elongate, obliquely positioned, directed posterodorsally; often with a modified second segment. Phallosome tubular, without strong connections to surrounding structures; with a small phallosomal sclerite.

Female Genitalia: Eighth sternum greatly enlarged, concave, forming most of a large receptacle used to hold the fully formed egg mass before oviposition. Ninth tergum with an anteroventral apodeme; sternum lacking (or intimately fused with the eighth sternum). Tenth segment fused to posterior margin of ninth tergum, without appendages. Vaginal sclerites elongate, connected indistinctly to apex of eighth sternum.

LARVAE.—Head hypognathous often with an anterolateral carina or ridge. Antennae very

short, inconspicuous. Mandibles toothed. Ventral apodeme rectanguloid, completely separating genae. Primary setae well developed; lacking secondary setae. Pronotum with a transverse groove near middle, often with posterior margin developed into a carina, with lateral ends often curved anteriorly. A short, membranous, prosternal horn present in two primitive genera. Foreleg short; femur very short and broad. Mesonotum covered with transverse plates, divided on midline; lateral halves frequently divided by a longitudinal sulcus. Metanotum with sa2 and sa3 bearing distinct sclerites and multiple setae; sa1 in two primitive genera represented by a single seta. Mid- and hindlegs elongate, rather sparsely setate; in *Brachycentrus* Curtis with setae ventrally on femora, tibiae, and tarsi developed into a specialized fringe. First abdominal segment lacking dorsal and lateral spacing humps; setae sparse. Abdominal gills variable: gills single, in stellate clusters, or absent. Lateral fringe poorly developed; hairs short, sparse, often restricted to a short cluster near posterior margin of each segment. Bifid processes often reduced or absent; always absent from segment 8. Ninth tergum with a multisetate sclerite. Anal prolegs fused laterally to abdomen; claw with a well developed accessory hook.

CASE.—Portable, tubular, straight, or rarely slightly curved. Generally quadrate in cross-section, less commonly round. Usually made of plant fragments placed very regularly on quadrate cases. Circular cases may use sand grains, or more irregularly placed plant fragments. All strongly lined with silk that in some instances becomes the exclusive material, in which situation the usual quadrate case is circular in cross-section.

DISCUSSION.—The family has been placed in the superfamily Limnephiloidea (Malicky, 1973; Schmid, 1980; Wiggins, 1977; etc.). The adults are recognizable by the combination of the following characteristics: ocelli absent, maxillary palpi reduced to two or three segments in the male, the shape of the setal warts of the head, presence of two pairs of warts on the pronotum and paired warts on the mesoscutum and scutellum, and number of spurs on the legs and the

position of the preapical pair when present. Because of the extreme variation of the venation and spur count in the family, it is difficult to construct a key to the families that does not result in the family keying out in two places (e.g., Ross, 1944; Schmid, 1980). The key to families in Wiggins (1978) does key the entire family out together and does work for all currently known genera. Couplet 18 for Brachycentridae, however, should be emended to read that the middle tibiae either lacks preapical spurs, or if present, then they are $\frac{1}{3}$ the length of the tibia from the apex.

The larvae are easily recognized by the following characteristics: they are eruciform case-makers, the pronotum bears a transverse groove at midlength, the mesonotum bears a pair of plates that are often divided longitudinally, and the first abdominal segment lacks the dorsal and lateral spacing humps. The larvae of the family are much more homogeneous than the adults, and keys are more easily developed to this stage (Ross, 1944; Wiggins, 1977; etc.)

PHYLOGENY.—The ancestral brachycentrid possessed the following characteristics in the adult state.

- Maxillary palpus* of δ , three-segmented
- Spur formula*, 2,4,4
- Forewing* R_1 , with a kink
- Forewing* R_{4+5} , forked at s
- Hindwing* R_4 and R_5 , both present in both δ and ♀
- Cerci* of δ , separate
- Clasper* of δ , two-segmented

The following are primitive states in the larva.

- Head carina*, present from anterior margin on genae
- Gular sclerite*, longer than wide
- Prosternal horn*, present
- Pronotum*, with a transverse groove mesally
- Metanotum*, sal present
- Mid- and hindfemora*, with two long ventral setae, with fringe of hairs between
- Mid- and hindtibiae and tarsi*, ventral margin setate, with enlarged apical seta
- First abdominal sternum*, with mesal pair of setae large, lateral pair very small
- Gills*, single filaments

Ecologically they were in all likelihood inhabitants of cold, small streams and springs. The larval food was living plant matter, probably mosses or liverworts.

Unfortunately too few pupae are described

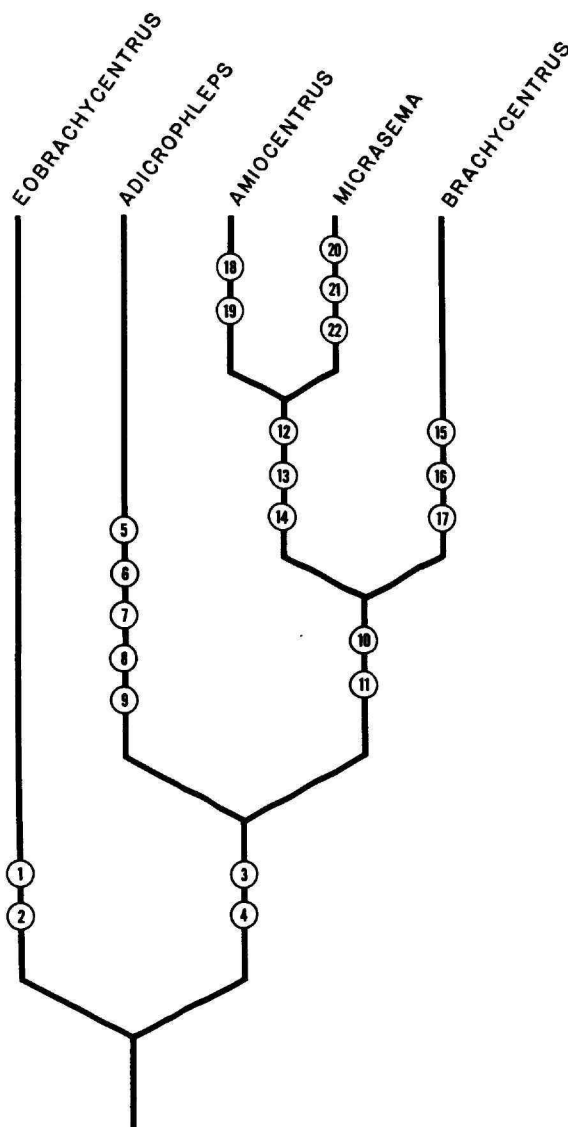


FIGURE 4.—Hypothetical phylogeny of genera of Brachycentridae.

fully enough to use this stage meaningfully in phylogenetic analysis.

The genus *Eobrachycentrus* possesses most of these primitive characteristics, but is specialized somewhat.

1. *Larval gills*: These are lost, probably as a result of its inhabiting cold, well-oxygenated, spring waters.

2. *Male clasper*: The second segment of the male clasper has migrated from its usual apical position to occupy an unusual position arising basally from the mesal face of the clasper.

The remaining genera show two synapomorphies.

3. *Hindwing*: The male has lost, at least apparently, R_5 .

4. *Tibial spurs*: The formula was reduced to 2,3,3.

From this stage *Adicrophleps* developed with numerous apomorphies. Several are reductions, however, and may well be the result of the basic reduction in size.

5. *Maxillary palpi*: In the male these were reduced to two segments.

6. *Wings*: The forewing lost the kink in R_1 and the hindwing lost the apical fork in Cu_1 .

7. *Cerci of the male*: These were fused mesally and had greatly changed form from the simple ovoid lobe.

8. *Spurs*: The formula for the spurs was further reduced to 2,2,2.

9. *Larval gills*: The gills were lost, possibly for the same reason given above (see 1).

The sister group of *Adicrophleps* shows two synapomorphies.

10. *Larvae temperature tolerance*: The larvae become more tolerant of warm waters, and thus were able to enter larger streams and exploit other sources of food.

11. *Larval metanotum*: In the larvae sal is lost.

From this stage a major dichotomy occurs. One line leads to *Amiocentrus* and *Micrasema*, which retain many of the more primitive character states as larvae, but become more specialized as adults. The other line leading to *Brachycentrus* becomes more specialized in the

larval stage, but retains more of the primitive adult characteristics.

The *Micrasema* line is defined by the following synapomorphies.

12. *Reduction in size*: This reduction in size probably is correlated with reduction in venation, spurs, and possibly palpi.

13. *Forewing*: In the male, R_{4+5} is petiolate, forking beyond s .

14. *Spurs*: The spurs are reduced to 2,2,2.

The genus *Brachycentrus* is defined by several very striking larval apomorphies.

15. *Metepimeron*: The posteroventral angle of the metepimeron is produced far across the venter and bears a row of long, stiff bristles.

16. *Legs*: The mid- and hindlegs have become greatly modified to serve as a structure to filter the larval food from passing water. To this end the setal structure on the ventral margin of the femur, tibia, and tarsus is greatly modified.

17. *Anal proleg*: The membranous ventral region of the anal proleg has developed a small, gill-like process.

The *Micrasema* line contains the two genera *Amiocentrus* and *Micrasema*. The former has several apomorphies.

18. *Maxillary palpus*: The male palpus is reduced to two segments.

19. *Tarsi*: The apex of the tarsus of the mid- and hindlegs of the larva is produced into an elongate lobe.

The large genus *Micrasema* has not been analyzed in detail, especially in the larval stage, but clearly contains three or four groups of species (Ross and Unzicker, 1965; Botosaneanu, 1974), probably deserving of at least subgeneric status. The genus as a whole is defined by several apomorphies.

20. *Wings*: In the forewing the vein R_1 has lost the characteristic kink found in most other genera.

21. *Larval pronotum*: The transverse groove on the larval pronotum curves anteriorly and generally reaches the anterior margin.

22. *Larval abdomen*: Abdominal segment eight of the larva bears an enlarged lateral hump.

Key to the Genera of Brachycentridae

ADULTS

1. Spurs 2,4,4, *Eobrachycentrus*
Spurs 2,2,2 or 2,2,3 or 2,3,3 2
2. R₁ of forewing with a kink at level of chord 3
R₁ straight or slightly sinuate to margin 4
3. Maxillary palpus of male 2-segmented; spurs, 2,2,2 . . . *Amiocentrus*
Maxillary palpus of male 3-segmented; spurs generally 2,3,3, rarely
2,2,3 or 2,2,2 *Brachycentrus*
4. Forewing with R₄₊₅ forked at s *Adicrophleps*
Forewing with R₄₊₅ forked distinctly beyond s *Micrasema*

LARVAE

(after Wiggins, 1977)

1. Ventral margin of femora, tibiae and tarsi of mid- and hindlegs bearing a row of modified short, spinous setae, apex of tibia produced into a process bearing such setae *Brachycentrus*
Ventral margins of these legs not bearing a specialized setal fringe, apex of tibia bearing a large, sharp spine but not otherwise modified 2
2. Larva with a short, membranous, prosternal horn; metanotum with seta sa1 present 3
Larva lacking prosternal horn and metanotal seta sa1 4
3. Mesonotum with lateral plate partially divided, posterior margin raised and darkly pigmented *Eobrachycentrus*
Mesonotum with lateral plate divided into 3 separate sclerites, posterior margin not modified *Adicrophleps*
4. Apex of tarsus of mid- and hindlegs with a distinct lobe in addition to a large subapical seta *Amiocentrus*
Apex of tarsus bearing only a large seta *Micrasema*

Genus *Brachycentrus* Curtis

Brachycentrus Curtis, 1834:215 [type-species, *Brachycentrus subnubila* Curtis, monobasic].

Pogonostoma Rambur, 1842:489 [type-species, *Pogonostoma vernum* Rambur, monobasic; synonym of *B. subnubila* Curtis].

Hydronauta Kolenati, 1848: 34, 92 [type-species, *Hydronauta albicans* Kolenati, nec Zetterstedt; selected Fischer 1970, synonym of *B. subnubila* Curtis].

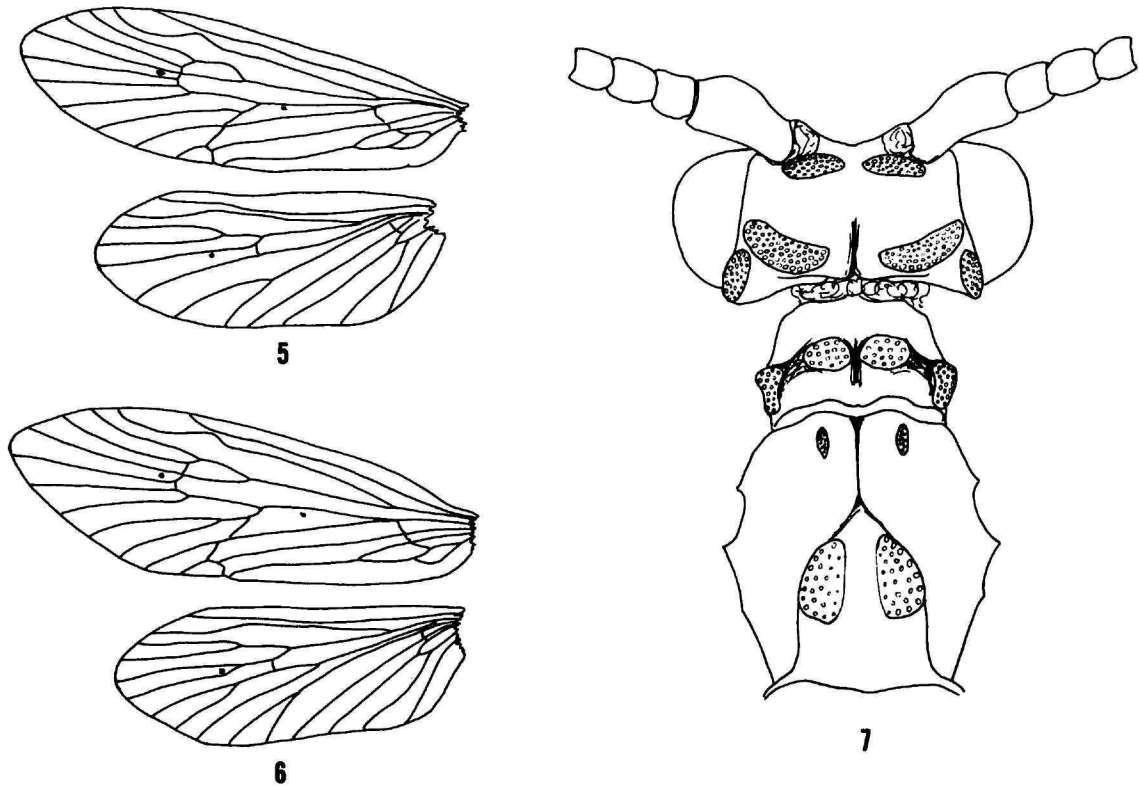
Oligoplectrum McLachlan, 1868:297 [type-species, *Phryganea maculata* Fourcroy, selected McLachlan, 1876].

Sphinctogaster Provancher, 1877:262 [type-species, *Sphinctogaster lutescens* Provancher, monobasic; probable synonym of *B. lateralis* Say].

Oligoplectrodes Martynov, 1909:294 [type-species, *Oligoplectrodes potanani* Martynov, first included species].

Brachycentriella Iwata, 1927:215 [new synonymy; type-species, *Brachycentriella japonica* Iwata, monobasic].

ADULT.—Size medium to large, forewing male 4–10 mm, female 4.5–13 mm. Maxillary palpi of male 3-segmented, densely hairy, curved upwardly in front of face; of female 5-segmented. Head internally with well developed dorsal tentorial arms (general structure of tentorium much like Snodgrass, 1935, figure 58B). Spurs 2,2,2 or 2,3,3 (*B. americanus* commonly lacks preapical



FIGURES 5-7.—Adult structures of *Brachycentrus nigrosoma* (Banks): 5, fore- and hindwings of male; 6, fore- and hindwings of female; 7, head, pronotum, and mesonotum.

spur of midleg), preapical spur when present $\frac{2}{3}$ distance from base to apex. Forewing with a distinct kink in R_1 above chord; male with R_{2+3} , R_{4+5} , M_{1+2} , and Cu_1 all forked apically; female with these forks plus M_{3+4} forked. Hindwing of male with R_s bearing three obvious apical veins (but position of nygma indicates R_5 has angled posteriad and fused to M); M unbranched; in female R_s distinctly bearing four apical veins, M branched into three apical veins. Fifth abdominal sternum with anterolateral glandular opening, with surrounding cuticle modified.

LARVA.—Prosternal horn lacking. Pronotal groove with posterior margin sharply defined, arcuate, lateral ends not closely approaching anterior margin of notum. Mesonotum divided mesally, each lateral plate distinctly divided by a

longitudinal sulcus; $sa1$ represented by a single seta. Metanotum with $sa2$ and $sa3$ represented by multisetate sclerites, $sa1$ absent. Metepimeron produced ventrally and bearing a row of long, stiff setae. Mid- and hindlegs, especially their femora, much longer than in other genera; femora with a uniform, ventral row of specialized spinous setae, tibiae with apex produced into a process and together with ventral margin bearing a row of spinous setae; tarsi with ventral margin bearing a row of short, spinous setae. Lateral fringe generally consisting of a series of tufts of short hair at the posterior margins of segments 3-7, with a cluster of bifid processes anterior of the hairs on each segment. Gills single or in stellate clusters (these are often lost). Anal proleg bearing a small gill-like process ventrolaterally.

DISCUSSION.—The adults agree on the three-segmented male maxillary palpi, venation in both male and female and general structure of head and thorax. The spur count of 2,3,3 (occasionally 2,2,3) is unique to the genus when present, but in smaller species is reduced to 2,2,2. The structure of the genitalia varies so greatly among the subgenera that it does not offer any clear-cut generic characters.

The larvae are very well characterized by the distinctive and unique modifications of the metepimeron, the mid- and hindlegs, and the anal proleg.

PHYLOGENY.—The monophyletic nature of the genus is established by three strong larval apomorphies.

15. *Metepimeron*: The posteroventral angle is produced across the venter and bears a row of long, coarse setae. This structure is unique in the family and a distinct specialization.

16. *Mid- and hindlegs*: These legs are distinctly longer than the foreleg and possess on the ventral margins of the femora, tibiae and tarsi filtering fringes of short, stiff setae and the inner margin of the tibia is produced apically. These structures are limited to this genus in the family, and are considered apomorphic.

17. *Anal prolegs*: In *Brachycentrus* there is a distinct membranous lobe on the venter of each anal proleg, which is lacking in all the other *Brachycentridae* and generally throughout the order. I consider its presence as apomorphic.

The lineage is divided into two clusters of subgenera, one comprising the subgenera *Oligoplectrum* and *Brachycentrus* the other cluster the subgenera *Sychnothrix*, *Oligoplectrodes* and *Sphinctogaster*. The monophyletic nature of the first cluster is established by three apomorphies.

18. *Gills*: The gills are borne in stellate clusters, at least on the anteriormost gill bearing segments. This is a unique form in the family and very uncommon elsewhere in the order. It is clearly apomorphic.

19. *Filtering fringe*: On the mid- and hindlegs the fringe on the femur is composed of larger, evenly spaced setae, separated by a fanlike array of mostly shorter setae. In the other cluster of subgenera all the setae are about of equal size, which is more easily derived from a fringe of long setae, the probable ancestral condition. The

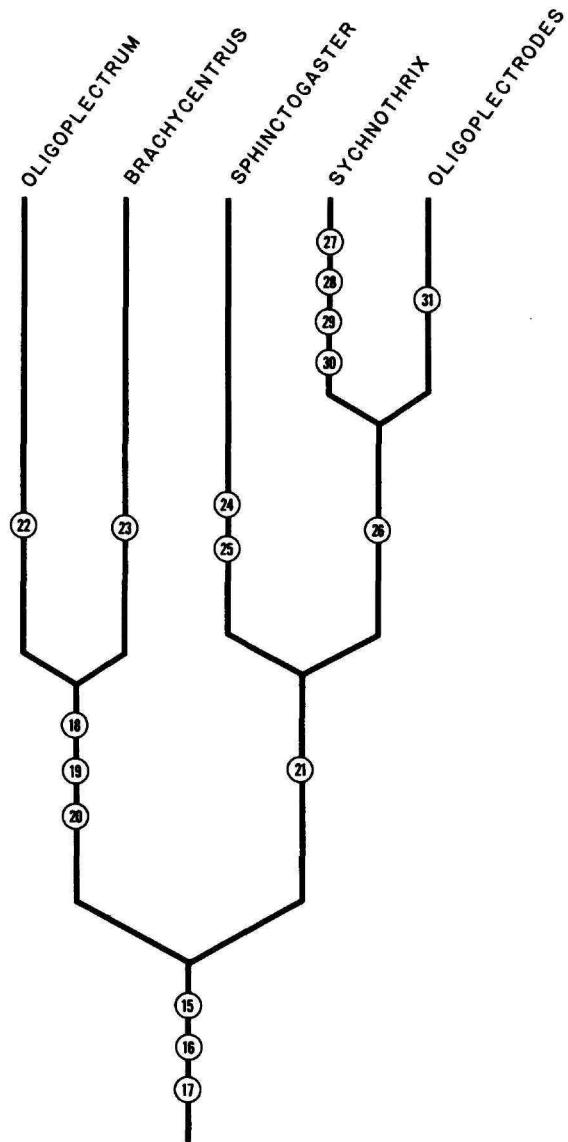


FIGURE 8.—Hypothetical phylogeny of subgenera of *Brachycentrus*.

fanlike arrays are probably a further specialization from the more uniform fringe.

20. *Coxae*: The mid- and hindlegs have two rows each of cuticular, trianguloid processes. This structure is lacking in the rest of the family and is clearly a specialization.

The second cluster of genera shares one apomorphy.

21. *Femoral setae*: The ventral margin of the femora of the mid- and hindlegs bears a single, very large, apical seta. In general, throughout the family the ventral margins of the femora bear two setae, one at the apex, the other near midlength, thus I believe the reduction to a single seta is apomorphic.

The subgenus *Oligoplectrum* is defined by one adult specialization.

22. *Tibial spurs*: In the adult the tibial spurs are 2,2,2, whereas the primitive number in the family is 2,4,4 and in most other subgenera, including its sister *Brachycentrus*, it is 2,3,3. The count 2,2,2 is a specialization by reduction.

The subgenus *Brachycentrus* is not easily defined, except on the form of the male genitalia.

23. *Male genitalia*: The form of the genitalia are very characteristic, undoubtedly the result of a long series of changes which could be considered a "derived" state, although it is often difficult to recognize the plesiomorphic state. The short tenth tergum and laterally directed apical point of the claspers are two derived characteristics, as is the slight basomesal fusion of the cerci.

Returning to the other cluster of subgenera, it is divided into two series. One series, containing only the subgenus *Sphinctogaster*, is defined by two specializations.

24. *First abdominal sternum*: The larval sternum bears two pairs of large, long, submesal setae. In all other genera and subgenera of the family there is only one submesal pair. I consider the presence of a second pair of setae the apomorphic condition.

25. *Claspers*: The claspers of the adult male lack articulated lobes or large lobes longer than wide. They may possess narrow, long expansions, but these are quite different in appearance. I consider the large lobes to be the second clasper segment or the remnants of it, which

is the primitive condition. Consequently the lack of all remnants of this segment is the derived condition.

The other series, containing *Sychnothrix* and *Oligoplectrodes* seems to be defined by one characteristic in the male genitalia.

26. *Cerci*: In general, and especially primitively, the cerci are well separated on the dorsal midline. In this series the cerci are broadly fused mesally forming a hoodlike structure, which is the derived state.

The subgenus *Sychnothrix* is defined by several apomorphies in the adult and larval stages.

27. *Femoral setae*: The larval mid- and hindfemora possess a row of 3-6 setae on both the inner and outer faces. The situation in virtually all species of related subgenera is the possession of only 1 seta in each row. I believe that the larger numbers here are apomorphic.

28. *Head setae*: The primary setae of the larval head (seta 17 is especially noteworthy) are very short. All the related subgenera have these setae very long; the short form is a distinct specialization.

29. *Tenth tergum*: In the male this is generally, and primitively an elongate, bilobed structure. Here it is quite complex with a pair of larger lateral lobes surrounding a mesal rodlike process with another mesal, rodlike process overlying all. This is a distinctly unique specialization.

30. *Clasper*: Here the male clasper bears a large lobe from the posteriolateral face near midlength. Assuming that this is the remnant of the second segment, a more distinctly separated lobe from an apical position would be primitive.

The subgenus *Oligoplectrodes* possesses one distinctive characteristic.

31. *Head*: The head of the larva possesses a carina on the genae from the anterior margin, passing mesad of the eye before ending. Related subgenera lack such a well-developed carina, which would appear to be derived within the genus. However, a carina in this position appears to be basic in the family and its appearance here may be a retention of the plesiomorphic condition.

Key to the North American Species of *Brachycentrus*

ADULT MALES

1. Tenth tergum very short in lateral aspect, barely as long as broad; clasper in posteroventral aspect with tip divided into a pointed lateral lobe and a rounded mesal lobe *B. nigrosoma*
- Tenth tergum distinctly longer than broad; clasper with tip otherwise formed 2

- 2. Cerci completely fused dorsomesally 3
 Cerci divided dorsomesally although they may be touching basally 4
- 3. Clasper with a large, lobate, mesal process from near apex in lateral aspect; tenth tergum with a bifid structure just above tergites *B. americanus*
 Clasper with a large angulate process from ventral margin near midlength; tenth tergum with a single mesal process above tergites between which is a mesal rodlike process *B. echo*
- 4. Tenth tergum lacking macrochaetae 5
 Tenth tergum with macrochaetae apically 9
- 5. A distinct sclerotized area between base of tenth tergum and cerci which bears a brush of short setae 6
 No such sclerotized, hirsute lobe 8
- 6. Tenth tergum distinctly divided apicomesally *B. fuliginosus*
 Tenth tergum only barely emarginate apicomesally 7
- 7. Apex of clasper in lateral aspect rounded; tenth tergum in lateral aspect with tip rounded *B. lateralis*
 Apex of clasper tapering to a point; tenth tergum with tip distinctly angled dorsad *B. incanus*
- 8. Apex of clasper in posteroventral aspect concave, with sharp apical and subapical points *B. chelatus*
 Apex of clasper strongly angled and produced mesad, tip slightly notched at most *B. occidentalis*
- 9. Tenth tergum with 3 or more macrochaetae on each lobe 10
 Tenth tergum usually with 1 macrochaeta on each lobe (rarely a small second one may be present on one side) 11
- 10. Apex of clasper in posteroventral aspect deeply concave, with a distinct ventral shelflike lobe and a much narrower dorsal shelf hidden by ventral one *B. spinae*
 Apex of clasper without any dorsal shelf, in posteroventral aspect with a narrow, elongate lobe subapically *B. appalachia*
- 11. Mesal margin of clasper in ventral aspect with a small, but distinct, subapical lobe *B. solomoni*
 Mesal margin of clasper in ventral aspect lacking any subapical lobe 12
- 12. Apical portion of clasper in lateral aspect rather short and broad, being about as broad as long *B. etowahensis*
 Apical portion of clasper distinctly elongate and slender, being at least twice as long as broad *B. numerosus*

LARVAE*

- 1. Mid- and hindfemora with 2 major setae on ventral margin; filtering fringe in fanlike arrays *B. nigrosoma*

* Larvae of *B. fuliginosus* are unknown.

- Mid- and hindfemora with 1 major seta on ventral margin; filtering fringe nearly uniform in length 2
2. First abdominal venter with 1 pair of submesal setae 3
First abdominal venter with 2 pairs of submesal setae 4
3. Head with anterolateral carina *B. americanus*
Head lacking such a carina *B. echo*
4. Mid- and hindtibiae with 1 large basomesal seta 5
Mid- and hindtibiae with a row of 3–5 basomesal setae 7
5. Head brown, with indistinctly paler muscle scars *B. occidentalis*
Head contrastingly marked with brown stripes on a yellow background 6
6. Mid- and hindtibiae fuscous for basal third, pale apically, tarsi fuscous *B. appalachia*
Mid- and hindtibiae and tarsi pale with a narrow, fuscous dorsal stripe *B. lateralis*
7. Head uniformly dark brown or fuscous, rarely paler over muscle scars 8
Head distinctly banded or spotted with fuscous and yellow marks 9
8. Head in frontal aspect nearly circular in outline, evenly and finely granulate (in part) *B. spinae*
Head in frontal aspect elongate, sides subparallel, front rugose *B. chelatus*
9. Femora of mid- and hindlegs with 2 or more major setae on both inner and outer faces *B. etowahensis*
These femora with only 1 enlarged seta on these faces 10
10. Head with 5 distinct longitudinal, fuscous bands, often with mesal band touching inner bands of genae near apex of frontoclypeus *B. incanus*
Head with mesal band broadly confluent with inner bands of genae for apical third of frontoclypeus, thus head appears to bear 4 elongate pale spots 11
11. Frontoclypeus with a cluster of pale muscle scars near apex; mid- and hindfemora generally pale with fuscous dorsal and ventral margins *B. numerosus*
Frontoclypeus lacking pale spot at apex; mid- and hindfemora generally infuscate or with dorsal half broadly brown 12
12. Pale dorsal marks of the head restricted to anterior half of frontoclypeus and a discrete oval spot, completely surrounded by fuscous posteriorly on genae *B. solomoni*
Pale dorsal marks of head more elongate, marks of frontoclypeus generally noticeable to apex, and marks of genae reaching from midlength of head often to occipital region *B. spinae*

Subgenus *Brachycentrus* Curtis

Brachycentrus Curtis, 1834:215.

Pogonostoma Rambur, 1842:489.

Hydronauta Kolenati, 1848:34, 92.

ADULT.—Spurs 2,3,3.

Male Genitalia: Ninth segment in lateral aspect with sternum strongly produced anteriorly. Cerci, in dorsal aspect, trianguloid, meeting at a

point basally on midline. Tenth tergum short, in dorsal aspect only slightly bilobed. Claspers elongate, inner margin strongly angulate; apex in posterior aspect shallowly divided (like a fish-tail) and produced into a small, pointed, laterally directed lobe and another small, rounded mesal lobe.

LARVA.—Head and thoracic sclerites brown, marked with conspicuous, pale, round, muscle scars. Mid- and hindfemora with two strong setae on ventral margin; filtering fringe composed of evenly spaced larger setae separated by a fanlike array of shorter setae. First abdominal sternum with a single pair of very large and conspicuous setae. Gills arising in small, stellate, clusters of filaments (or often totally lost).

TYPE-SPECIES.—*Brachycentrus subnubila* Curtis (monobasic).

DISCUSSION.—The adult males are easily recognized by the short tenth tergum, and distinctive, fish-tail like appearance of the apex of the clasper in posterior aspect. The larvae are equally distinctive on the basis of color, setal arrangement of the mid- and hindfemora and first abdominal sternum, and stellate gills.

The subgenus is distributed across northern Europe and Asia, including Japan, and in the eastern United States. The descriptions and figures of all the species are remarkably similar, creating doubts in my mind about the validity of some of the described species. The following species fall into this subgenus: *B. caucasicus* (Martynov) (Caucasus), *B. montanus* Klapalek (eastern Europe), *B. nigrosoma* (Banks) (eastern United States), and *B. subnubila* Curtis (Europe and western Asia). In addition, the larvae described by Iwata (1927) as *B. subnubila* are clearly a species of this subgenus, as are those described by Akagi (1957) as BA, thus establishing the presence of this subgenus in Japan.

BIOLOGY.—As far as can be ascertained, nothing has been written on the biology of the North American species. Morse et al. (1980) give many characteristics of Upper Three Runs Creek, South Carolina, a site at which *B. nigrosoma* was one of the dominant aquatic insects. Based on my few observations of this species it may be

found in streams as small as three meters wide to very large rivers, generally in shallower water, often on the solid substrate that supports a lush growth of *Podostemum*. The larvae construct typical cases, of small plant fragments, that are square in cross-section (see Figure 2).

Brachycentrus (Brachycentrus) nigrosoma (Banks)

FIGURES 5–7, 9–16

Sphinctogaster nigrosoma Banks, 1905:12.

Brachycentrus nigrosoma (Banks).—Banks, 1907b:42.—Ross, 1944:303.—Flint, 1966:386 [lapsus for *B. nigrosoma*].

Brachycentrus notabulus Milne, 1936:112, 123.—Fischer, 1970:109.—Denning, 1971:209 [new synonymy].

Brachycentrus nigrosoma (Banks).—Fischer, 1970:108.

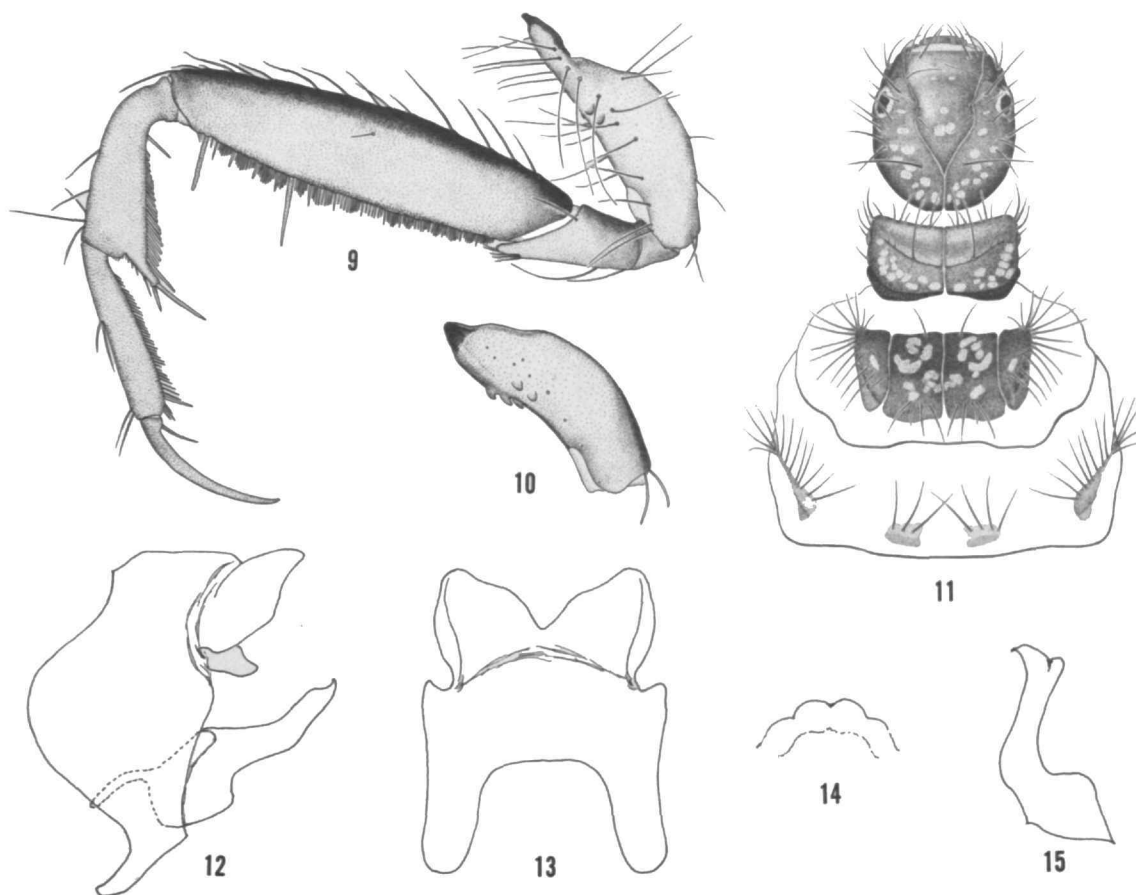
Brachycentrus adelus Ross, 1947:165.—Fischer, 1970:99 [new synonymy].

Although closely related to the European *B. subnubila* Curtis, this is a distinctive species in the North American fauna both as an adult and larva. The larva possesses a distinctively different filtering fringe on the femora of the mid- and hindlegs. There are only two greatly enlarged setae, borne on the ventral margin, and the filtering setae are arranged in the manner of longer setae separated by a fanlike array of shorter setae. The gills are either lacking, or, when present, consist of stellate clusters of short filaments on the posterior margin of the abdominal terga.

The genitalia of the male are also quite distinctive. The cerci are short, and almost triangular in dorsal outline; the tenth tergal lobes are very short and only slightly bilobed in dorsal aspect; and the apex of the claspers in posteroventral aspect is slightly divided, almost like a fishtail in appearance.

ADULT.—Length of forewing, ♂ 7–8 mm, ♀ 9–10 mm. Color grayish-brown, body fuscous; forewing maculate with paler brown flecks. Male abdomen with posterior margin of seventh sternum bulging and produced, but not into a free process.

Male Genitalia: Ninth segment with a narrow, rounded ventromesal lobe from anterior margin. Cerci short; in dorsal aspect broadly divergent,



FIGURES 9-15.—*Brachycentrus nigrosoma* (Banks): 9, larval hindleg; 10, larval coxa of midleg, setae removed; 11, larval head and thorax; 12, male genitalia, lateral; 13, male ninth tergum and cerci, dorsal; 14, male tenth tergum, dorsal; 15, male clasper, posteroventral.

almost triangular. Tenth tergum very short, in dorsal aspect with a small mesal excision. Clasper with basal region small, in lateral aspect tapering to a sharp point; in posteroventral aspect with inner margin sharply angled, tip shallowly bifid, with a sharp lateral point.

LARVA.—Length to 9 mm. Sclerites brown, muscle scars of head and thoracic nota distinctly paler; legs brown, femora darker along dorsal margins. Coxae of mid- and hindlegs with two rows of cuticular processes; femora of mid- and hindlegs with two enlarged setae on ventral mar-

gin; ventral fringe consisting of evenly spaced larger setae separated by fanlike arrays of shorter setae. A single pair of large submesal setae on first abdominal sternum; remaining setae of first and second sterna much smaller. Lateral fringe continuous from anterior of third segment to posterior of sixth segment. Gills, when present (often missing), arising in small stellate clusters from along posterior margins of abdominal terga.

TYPE MATERIAL.—Holotype, female, MCZ, *S. nigrosoma* Banks, "Type," "Ithaca, N.Y.," "Col-

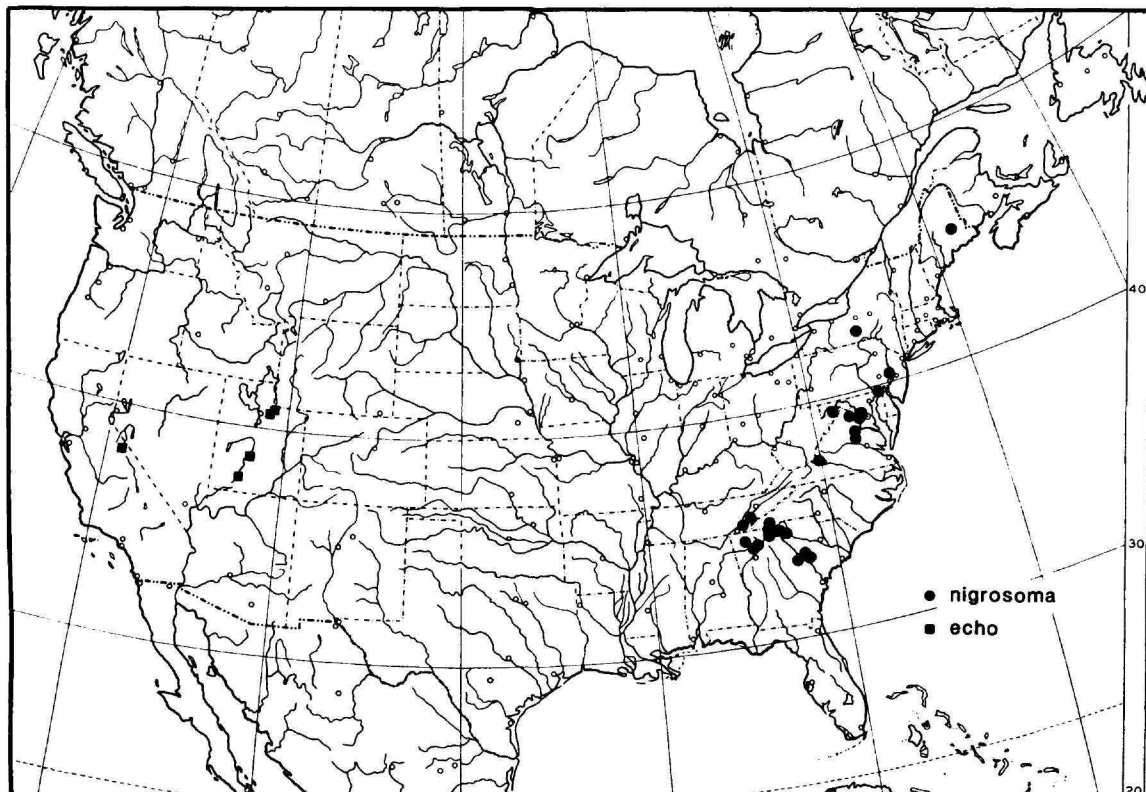


FIGURE 16.—Distributions of *Brachycentrus nigrosoma* (Banks) and *B. echo* (Ross).

lection N. Banks," "Type 11683," "Sphinctogaster nigrisoma Bks. Type." Pinned, abdomen cleared, studied.

Holotype, male, MCZ, *B. notabulus* Milne, "Glencarlyn, Va. 25 April," "Collection N. Banks," "22274 M.C.Z. Holotype *Brachycent. notabulus* Milne ♂," "A25V35 Slide." Pinned, abdomen cleared, studied.

Holotype, male, ANSP, *B. adelus* Ross, published as: "Ralph Stover Park, Bucks County, Pennsylvania; May 1, 1937; (J.W.H. Rhen [sic])." Holotype not seen; two topotypic paratypes (INHS) studied.

MATERIAL EXAMINED.—USA, GEORGIA, Mud Creek, north Dillard, 10 Sep 1958, Flint and Wiggins, 7 larvae, 1 pupal case with sclerites. Dalton, 1 Apr 1949, W.E. Ricker 1♂ (INHS). Small creek at Jct. 53 and 183, near Dawsonville,

1 Apr 1949, W.E. Ricker, 1♂ (INHS). Cherokee Co., Etowah River, 5.5 mi. SE Ball Ground, 12 Apr 1971, Wallace and Woodall, 1♂ (INHS). Richmond Co., Little McBean Creek, Rt. 56, 17 Feb 1976, R.J. McKay, 10 larvae (ROM); same, but 20 Mar 1970 emerged from pupa collected 11 Mar 1970, Wallace & Sherberger, 1♂ (UGA). Stephens Co., Panther Creek, 2 mi. from junction with Tugallo River, 15 Apr 1969, J.B. Wallace, 12♂ (UGA).

MAINE, Penobscot Co., Penobscot River, Winn, 18 Oct 1979, T.M. Mingo, larvae (UMO, USNM).

MARYLAND, Plummer's Island, 28 Apr 1905, 9♂. Cecil Co., Octararo Creek, Rt. 1, 20 Jun 1981, W.L. Butler, 8 larvae (MWQMD).

NEW YORK, Ithaca, 1♀ (holotype *B. nigrosoma*, MCZ).

NORTH CAROLINA, Nantahala National Forest, Cullasaja River, near Highlands, 3300 ft., 27 Jun 1957, J.F. Hanson, 1 larva.

PENNSYLVANIA, Bucks Co., Ralph Stover Park, 1 May 1937, J.W.H. Rehn, 2♂ (paratypes, *B. adelus*, INHS).

SOUTH CAROLINA, High Falls, 16 Oct 1965, L. McCaskill, 1 larva (CUC). Seneca, 18 Sep 1965, A. Kallandelen, 1 larvae (CUC). Aiken Co., Boggy Gut Creek, 12 Feb 1977, Herlong and Prichard, 6 prepupae (CUC). Aiken Co., Hollow Creek at US 278, 4 Sep 1977, S.M. Prichard, 1 larva (CUC). Aiken Co., Upper Three Runs Creek, Savannah River Plant, 11 Mar 1977, Herlong and Prichard, 20♂, 20♀ (CUC); same, but Tinker Creek, 11 Mar 1977, 18♂, 1♀ (CUC); same, but Jun 1977, 30 larvae (CUC); same, but 19 Sep 1976, 4 larvae (CUC); same, but 16 Oct 1976, 36 larvae (CUC). Barnwell Co., Upper Three Runs Creek, Savannah River Plant, 28 Apr 1979, McEwan and Powell, 1 larva (CUC); same, but 1 Sep 1979, 1 larva (CUC); same, but Lower Three Runs Creek, 34 collections at about weekly intervals between 28 Apr 1979 and 16 Feb 1980, McEwan and Kelley, many hundreds of larvae, prepupae and pupae (CUC); same, but Mill Creek, 12 Feb 1977, Herlong and Prichard, 1 larva (CUC); same, but 26 Feb 1977, 3 prepupae (CUC). Oconee Co., Little River, old Hwy. 11 bridge, Salem, 3 Sep 1975, S.J. Nichols, 1 larva (CUC). Oconee Co., South Toxaway Creek, at S-37-90, 4 Apr 1976, J.W. Chapin, 2♂, 1♀ (CUC). Oconee Co., Ramsey Creek, US 76, 15 Jan 1976, Chapin and Menking, 2 larvae (CUC).

TENNESSEE, Blount Co., Little Tennessee River, Rt. 129, S Maryville, 13 Aug 1977, S.M. Prichard, 1 larva (CUC). Meigs Co., Big Sewee Creek, Tn. 58, 15 Sep 1982, D.A. Etnier, 69 larvae (UTK).

VIRGINIA, Glencarlyn, 25 Apr, 1♂, 4♀ (holotype, allotype and paratypes *B. notabulus*, MCZ). Great Falls, 20 Apr, 5♀ (MCZ). Craig Co., John's Creek, W.C. Snodgrass's land, 30 Apr 1977, T. Grimes, 18♂, 27♀ (VPI). Fauquier Co., Broad Run, Thorofare Gap, 3 Mar 1963, O.S. Flint,

Jr., 6 larvae; same, but 26 Mar 1963, 50 prepupae; same, but 27 Mar 1962, 50 prepupae; same, but 16 Apr 1967, 10 empty pupal cases, 5♂; same, but 17 Apr 1963, 100s ♂♂ ♀♀; same, but 19 Apr 1962, Flint and Spangler, 2♂ metamorphotypes, 50 pupae; same, but 22 Jul 1961, O.S. Flint, Jr., 6 larvae. Hanover Co., South Anna River, Rt. 657, 21 Mar 1978, J.R. Voshell, Jr., 5 pupal cases with sclerites (VPI); same, but emerged in lab 7 Apr 1978, 5♂, 1♀, 1♂ pupa, cases (VPI). Spotsylvania Co., Pigeon Run, W Rt. 208 at Jct. with North Anna River, 13 Apr 1969, G.M. Simmons, Jr., 14♂, 2♀ (VPI); same, but 18 Apr 1970, 40♂, 2♀ (VPI).

WEST VIRGINIA, Cacapon River, Capon Bridge, 1 May 1944, Frison and Ross, 7♂ (paratypes *B. adelus*, INHS).

Subgenus *Oligoplectrodes* Martynov

Oligoplectrodes Martynov, 1909:294.

ADULT.—Spurs 2,2,3 or commonly 2,3,3, or rarely 2,2,2.

Male Genitalia: Ninth segment in lateral aspect with sternum distinctly and broadly produced anteriorly. Cerci elongate, in dorsal aspect fused on midline. Tenth tergum elongate, deeply divided mesally. Claspers elongate, inner margin slightly curved, with a large mesal lobe subapically.

LARVA.—Head and thoracic sclerites brown, essentially unmarked. Head with a distinct carina from anterior margin on genal halves, passing mesad to eye before ending. Mid- and hind-femora with a large seta on ventral margin, another on inner surface near apex, and a third on outer surface near base, dorsal margin with apical and subbasal setae distinctly enlarged; setae of filtering fringe virtually uniform in structure and length. A single pair of large, submesal setae on first abdominal sternum, lateral pair small and inconspicuous. Gills single.

TYPE-SPECIES.—*Oligoplectrodes potanani* Martynov (first included species).

DISCUSSION.—The adult males are readily recognized by the fused cerci, elongate tenth ter-

gum, and large mesal lobe subapically from the clasper. The larvae are also quickly recognized by the carina on the head, three enlarged setae on the mid- and hindfemora, and single submesal pair of setae on the first abdominal sternum and single gills.

The subgenus is distributed over eastern Asia and North America. I place the following nominate species in *Oligoplectrodes*: *B. americanus* (Banks) (North America), *B. kozlovi* Martynov (Himalayas), *B. potanani* Martynov (Siberia, northern China, Japan) and *B. punctatus* Forsslund (northwestern China). I have seen, courtesy of Dr. G.B. Wiggins, larvae and adults identified as *B. potanani* from Hokkaido, Japan.

BIOLOGY.—The single North American species of this genus has been studied extensively by Gallepp (1974, 1977), Gellep and Hasler (1975), Shapas and Hilsenhoff (1976), and Mecom and Cummins (1964). (I do not know for certain if the larvae in this last paper are correctly identified, but it seems probable that the other authors correctly identified theirs.) These authors have provided a great deal of information on the behavior, especially the food gathering, of the larvae of this species. Shapas and Hilsenhoff (1976) conclude that it is an opportunistic omnivore, ingesting large quantities of diatoms.

Gallepp (1977) records that it is found primarily in the upstream few kilometers of Lawrence Creek, and is replaced downstream by *B. occidentalis*. A cold water preference by the larvae of the species would seem to explain the mostly northern distribution of *B. americanus*.

The larval case type varies greatly. Gallepp and Hasler (1975) report that after hatching the larvae build a tapering case, square in cross-section, of plant matter (see Figure 2), but during winter and spring frequently change to a case cylindrical in cross-section constructed of silk (see Figure 3). Most collections I have seen from the far north are in cases primarily of this last type.

It should be noted that this species is, perhaps, the only one in the genus in North America in which the adults have a long flight period extending over most of the summer.

***Brachycentrus (Oligoplectrodes) americanus*
(Banks)**

FIGURES 17-23

Oligoplectrum americanum Banks, 1899:210.

Brachycentrus americanus (Banks).—Milne, 1936:112.—Ross, 1944:266.—Fischer, 1970:100.—Denning, 1971:210.—Wiggins, 1977:56.—Roy and Harper, 1979:158.

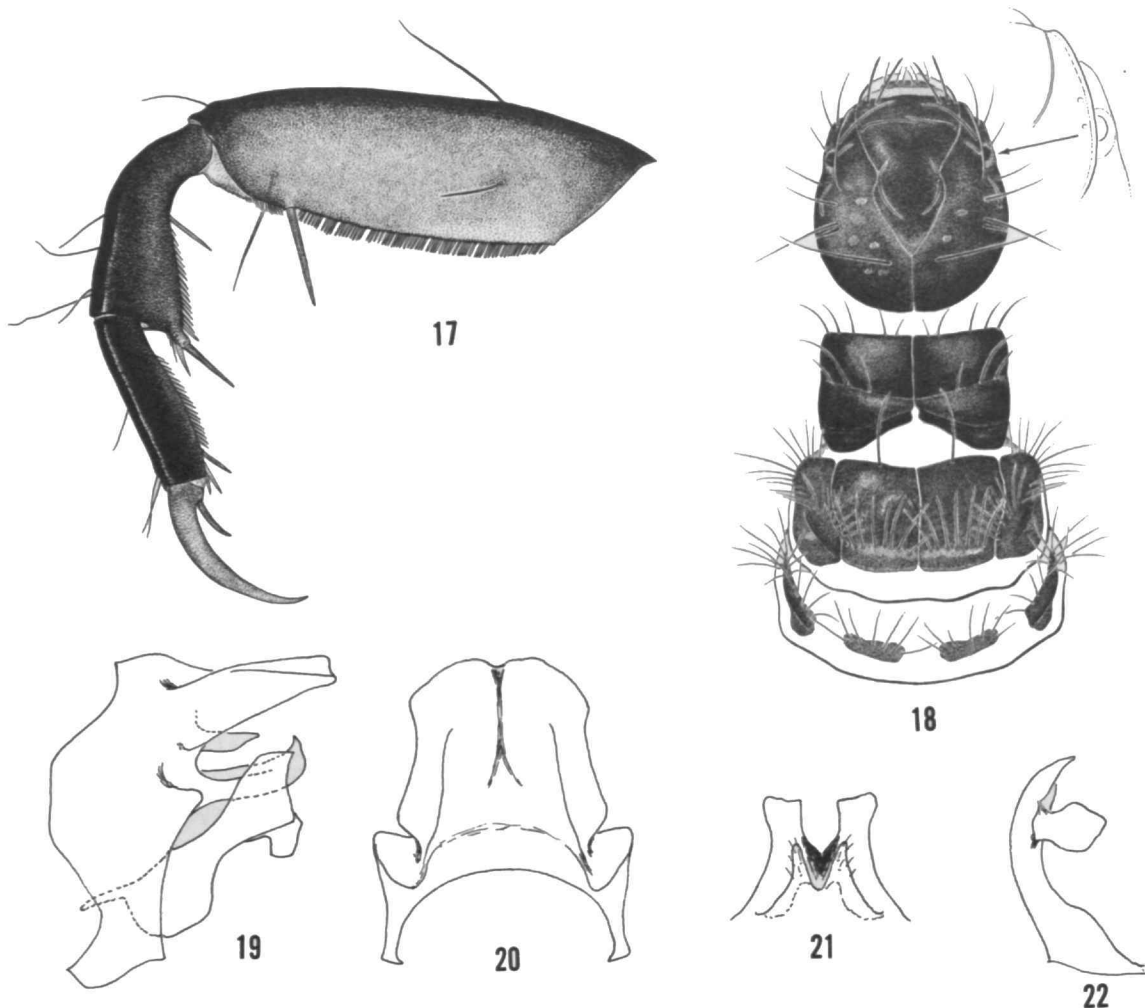
Brachycentrus similis Banks, 1907a:124.—Ross, 1938:42.

This species is very distinctive, both as a larva and an adult. One larval structure is unique, namely the short carina on the gena just mesad of the eye. This structure, in conjunction with the uniformly brown sclerites, two enlarged setae on the first abdominal sternum, and presence of three enlarged setae on the femora of the mid- and hindlegs, permits ready and positive identification of the larva.

The genitalia of the adult male are equally diagnostic. The cerci are fused mesally, there are paired, rodlike processes between the cerci and tenth tergites, and the clasper bears a large, ovoid flap from near its apex. The tibial spurs of this species are unusually variable (Parker and Wiggins, pers. comm.) with the majority being 2,2,3, but certain populations being mostly 2,3,3 or even 2,2,2, and frequently different on the two sides of the same individual.

ADULT.—Length of forewing, ♂ 7–10 mm, ♀ 11–13 mm. Color brown, body slightly darker; forewing extensively maculate with pale flecks, especially around the apex. Male abdomen without sternal process.

Male Genitalia: Ninth segment with a distinct, rounded, ventromesal lobe from anterior margin. Cerci elongate, fused mesally. Tenth tergum elongate with an upturned tip in lateral aspect; in dorsal aspect with a U-shaped mesal incision, lateral arms truncate, no macrochaetae; with a pair of elongate, rodlike processes between cerci and tenth tergum. Clasper with basal area small; apex appearing concavely truncate in lateral aspect with a distinct apicoventral lobe; in posteroventral aspect apex produced into a sharp



FIGURES 17-22.—*Brachycentrus americanus* (Banks): 17, larval hindleg; 18, larval head and thorax with detail of frontal carina; 19, male genitalia, lateral; 20, male ninth tergum and cerci, dorsal; 21, male tenth tergum, dorsal; 22, male clasper, posteroventral.

point, with a large, subapical, rounded lobe.

LARVA.—Length to 12 mm. Sclerites dark brown, slightly paler at muscle scars on head; legs uniformly dark brown. Femora of mid- and hindlegs with three enlarged setae, dorsal setae at apex and subbasally also distinctly enlarged. A single submesal pair of large setae on first abdominal sternum; remaining setae on first and second sterna very small. Lateral fringe reduced to a scattering of short hairs on posterior halves of segments 3-7. Gills single.

TYPE MATERIAL.—Holotype, male, MCZ, *O. americanus* Banks, "Type," "Franconia, N.H.," "Collection N. Banks," "Type 11705," "Oligoplectrum americanum Bks. Type." Pinned, abdomen cleared, studied.

Lectotype, male, MCZ, *B. similis* Banks, "Type," "Tabernash, Col. Aug. E.S. Tucker," "Collection N. Banks," "Type 11684," "Lectotype *B. similis* ♂ Bks. Ross 1937." Pinned, abdomen cleared, studied.

MATERIAL EXAMINED.—USA, ALASKA, Po-

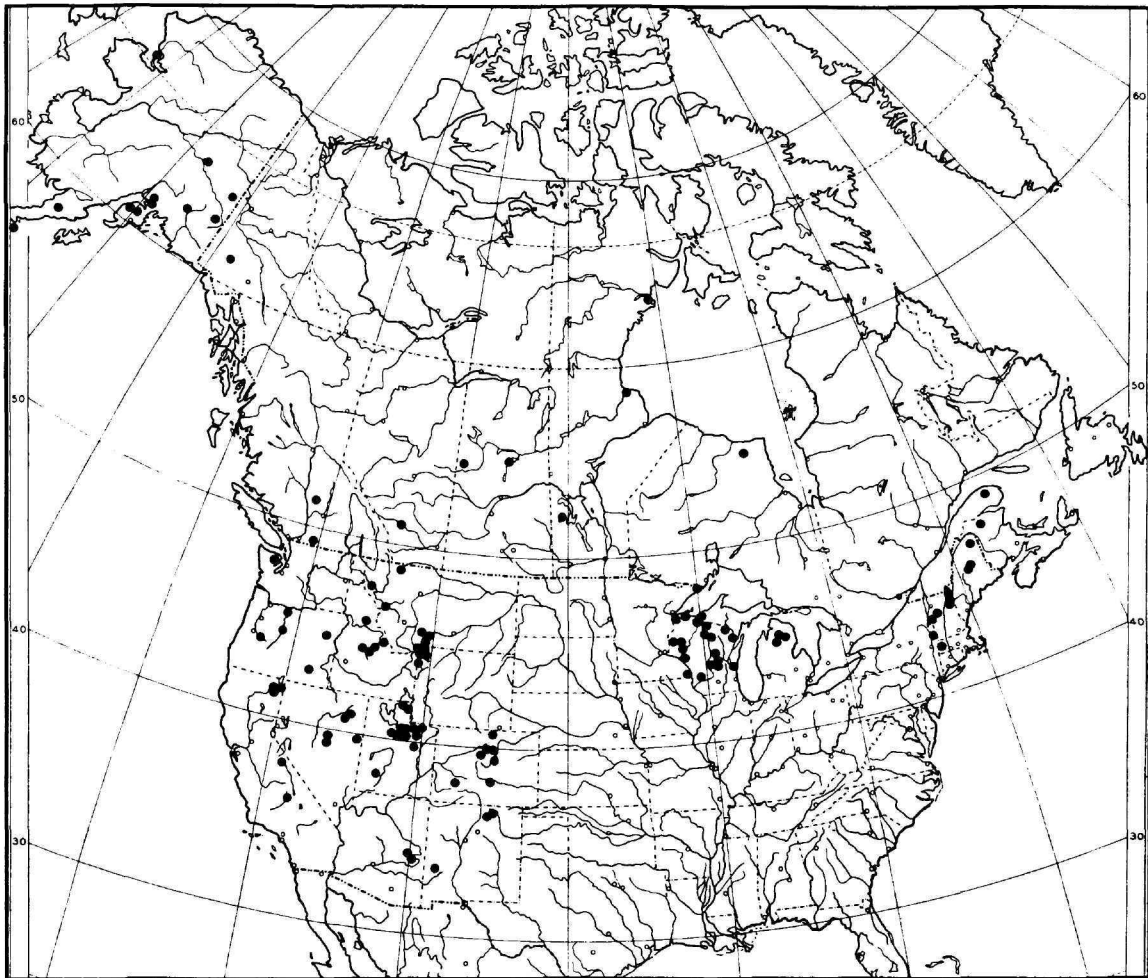


FIGURE 23.—Distribution of *Brachycentrus americanus* (Banks).

poff Island, 9 Jul 1899, T. Kincaid, 1♀. Palmer, 10 Jul 1963, 2♀. Anchorage, 15 mi. NE station 55, 9 Jul 1948, Sailer and Sommerman, 1♀; same, but 11–15 Aug 1948, 37♀; same, but 17–22 Aug 1948, 8♀. Valdez-Fairbanks Hwy., M.P. 139, 12 Aug 1947, A.H. Storm, 7 larvae. Bear River, Alaska Peninsula, 2 Aug 1958, J.D. Fiske, 5 larvae; same, but 11 Jun 1958, 1 larva. Chena River, Fairbanks, 11 Aug 1966, P.J. Frey, 3 larvae. 1 mi. E Northway Airport, 25 Jun 1954, R. Coleman, 2 larvae. Hidden Creek, Sterling Hwy. M.P. 59, 9 Jul 1954, R. Coleman, 1 larva. Alaska Hwy. M.P. 54, near Jack Wade, 26 Jun

1954, R. Coleman, 4 larvae. Beaver Creek, Sterling Hwy., Kenai Peninsula, 5 Jun 1977, D.A. Etnier, 30 larvae (UTK). Hidden Creek at Skilak Lake road, Kenai Peninsula, 7 Jun 1977, D.A. Etnier, 65 larvae, 8 pupae (UTK). Russian River at campground, Kenai Peninsula, 7 Jun 1977, Etnier and Bogardus, 1♂ genitalia and larval sclerites from decayed pupa (UTK). Kotzebue, 2 Jul 1957, T. Emerson, 10 larvae (INHS).

ARIZONA, Little Colorado, Sheeps Crossing, 6 Jul 1961, 25 larvae (INHS). Apache Co., North Fork White River, Hwy. 473, 19 May 1970, R.W. Baumann, 2 larvae. Apache Co., Little

Colorado River, Hwy. 373, Greer, 9 Apr 1968, Koss and Baumann, 2 larvae.

CALIFORNIA, Kern River Power Tunnel, 14 May 1939, 2 larvae. Modoc Co., South Fork Pit River, 5 mi. E Likely, 5 Sep 1969, A.B. Gurney, 1♂, 4♀. Mono Co., Convict Creek, 7200 ft., 16–24 Jul 1963, H.D. Kennedy, 6♂, 11♀; same, but Jul 1963, 1 larva, 1 pupa; same, but 24 Jul 1958, J. Maciolek, 15 larvae. Plumas Co., Benner Creek, 7 mi. N Chester on Juniper Lake Road, 28 Aug 1963, L.J. Erwin, 10 larvae. Shasta Co., 14 mi. SE Burney, 24 Aug 1959, E. Ordway, 4♂. Shasta Co., Hat Creek, 2.9 mi. S Old Station, 5 Jul 1977, J.W. Chapin, 3 larvae (CUC). Siskiyou Co., Shadow Creek, 7 mi. E Cecilville, 5 Sep 1968, Gurney and Buxton, 1♀.

COLORADO, Tabernash, Aug, E.S. Tucker, 1♂ (lectotype *B. similis*, MCZ). Boulder, 9 Aug, T.D.A. Cockerell, 1♀ (lecto-allotype *B. similis*, MCZ). Four Mile and Boulder Creek, Boulder, 10 Jun 1906, 6 larvae. Custer Co., 10 mi. SW Wetmore, 10 Aug 1971, G.F. Hevel, 1♂, 4♀. Eagle Co., Eagle River, Gypsum, 10 Aug 1973, Baumann and Stark, 7♂, 9♀. Jefferson Co., Lookout Mountain, 7000 ft., 3 Jul 1922, 1♂, 1♀. Jefferson Co., Elk Creek, Hwy. 285, 8 Aug 1973, Bauman and Stark, 1♂. Larimer Co., North Fork Big Thompson River, E Glen Haven, 13 Jul 1977, Morse and Chapin, 3 larvae (CUC). San Miguel Co., Telluride, 8745 ft., 8–11 Jul 1977, D.C. Ferguson, 6♂, 6♀.

FLORIDA. The record of *B. americanus* from Florida (Denning, 1971) is far to the south of its known range in eastern North America. It undoubtedly represents a mislabeled specimen, and the record of the species from Florida should be deleted.

IDAHO, Salmon River, Challis, 26 Aug 1969, A.B. Gurney, 1♂. Snake River, 13 Aug 1928, E.O. Essig, 3♀. Boise National Forest, S. Fork Salmon River Camp, 5000 ft., 13 Aug 1953, C.P. Alexander, 2♂, 1♀. Custer Co., 5 mi. NW Stanley, 6300 ft., 28 Jul 1977, J.F.G. Clarke, 1♀. Idaho Co., Buffalo Hump, 23 mi. SW Elk City, 8300 ft., 16 Aug 1971, Gurney and Brusven, 3♂. Lemhi Co., Lemhi R., 31 Jul 1964, S.D. Smith, 20 larvae, 1 pupa (ROM).

MAINE, Aroostook Co., Rocky Brook, 10 mi. S. Estcourt Station, 20 Oct 1978, T.M. Mingo, larvae (UMO). Piscataquis Co., Baxter State Park, McManus Brook at Perimeter Road, 16 Aug 1979, T.M. Mingo, larvae, 2 pupae (UMO, USNM); same, but Nesowadnehunk River, Kidney Pond Bridge, 23 May 1979, T.M. Mingo, larvae (UMO); same, but 14 Jun 1979, larvae (UMO); same, but Little Nesowadnehunk River, 7 Aug 1979, T.M. Mingo, larvae (UMO).

MASSACHUSETTS, Pittsfield, 31 Jul, R.A. Browne, 1♂ (MCZ).

MICHIGAN, Au Sable River, Mio, 21 May 1936, Frison and Ross, 200 larvae (INHS). Au Sable River, Lovell, 22 May 1936, Frison and Ross, 30 larvae, prepupae and pupae (INHS). Manistee River near Grayling, 22 May 1936, Frison and Ross, 6 larvae (INHS); same, but 17 Jun 1935, T.H. Frison, 25 larvae (INHS). Gogebic Co., Duck Creek, US 45, S Watersmeet, 28 Jun 1982, M.G. DeViedma, 15 larvae.

MINNESOTA, Cook Co., Cascade River, 1938, C. Rief, 1 larva (UMSP). Houston Co., Beaver Creek, Valley State Park, 16–22 Jul 1972, 1♀ (UMSP); same, but 11–17 Jul 1971, 1♂, 4♀ (UMSP).

MONTANA, Bozeman, Experiment Station, 10 Aug 1925, 1♂ (UMSP). Glacier National Park, Flathead River at Starvation Creek, 28 Aug 1953, R. Coleman, 6 larvae; same, but Akakota Creek at Round Prairie truck trail, 28 Aug 1953, R. Coleman, 12 larvae. Yellowstone National Park, near Gardiner, 16 Aug 1962, P.J. Spangler, 28♂, 6♀; same, but Soda Butte Creek, 3 Jul 1978, D.C. Proper, 4 larvae; same, but Gallatin River and Rt. 191, 16 mi. NE Gallatin entrance, 22 Aug 1953. R. Coleman, 6 larvae. Gallatin Co., Gallatin National Forest, South Fork Madison River, Rt. 20, 12 Jul 1977, Chapin and Morse, 4♂, 30 larvae and pupae (CUC). Missoula Co., Miller Canyon Creek, 29 Aug 1968, R.W. Baumann, 1♂. Park Co., Armstrong Spring Creek, 5 mi. S., Livingston, 8 Jul 1977, D.C. Proper, 2♂, 1♀. Sanders Co., Thompson River, Clark Memorial Campground, 22 Jun 1977, Chapin and Morse, 7 larvae (CUC).

NEVADA, Elko Co., Lamoille Creek, Ruby

Mts., SE Elko, 16 Jun 1978, C.M. Murvosh, 2 larvae (ROM). Elko Co., South Fork Humboldt River, Twin Bridges off Hwy. 46, 5200 ft., 17 Jun 1978, C.M. Murvosh, 1 larva (ROM). Lander Co., Big Creek, Big Creek Campground, 2 Aug 1968, R.W. Baumann, 1♂. Lander Co., Big Creek, 14 mi. S Austin, 6400 ft., 21 Jun 1978, C.M. Murvosh, 3 larvae, 1 prepupa, 1 pupa (ROM). Lander Co., Kingston Creek off Hwy 8A, Smokey Valley, S Austin, 6100 ft., 22 Jun 1978, C.M. Murvosh, 10 larvae (ROM). Nye Co., Peavine Creek, W Hwy. 8A, N Tonopah, Toiyabe National Forest, 22 Jun 1978, C.M. Murvosh, 5 larvae (ROM). White Pine Co., Snake Creek, S Baker and Lehman Caves National Monument, 25 May 1978, C.M. Murvosh, 3 larvae (ROM).

NEW HAMPSHIRE, Franconia, 1♂ (holotype *B. americanus* (Banks), MCZ). White Mountains, [illegible word], 1♂, 1♀ (MCZ). Fabayan, 3 Aug 1958, O.S. Flint, Jr., 1♂, 1 pupa. Jefferson, 7 Jul 1963, light trap, 1♂, 2♀ (UNH); same, but 20 Jun 1964, 18♂, 10♀ (UNH); same, but 10 Jul 1964, 4♂, 12♀ (UNH); same, but 14 Jun 1966, 2♂, 2♀ (UNH); same, but 2 Jul 1966, 2♂, 4♀ (UNH); same, but 22 Jul 1966, 1♂ (UNH); same, but 24 Jul 1966, 3♂ (UNH); same, but 8 Aug 1966, 3♂, 3♀ (UNH). Colebrook, 26 Jun 1962, 18♂, 15♀ (UNH); same, but 17–24 Jul 1957, 2♂ (UNH).

NEW MEXICO, Cimarron Canyon, Sangre de Cristo Mountains, 7900 ft., 9 Jul 1962, E. and I. Munroe, 1♂, 1♀. Catron Co., 5 mi. E Glenwood, 29 Jun 1953, W.W. Wirth, 4 larvae. Colfax Co., 5 mi. W Ute Park, 13 Jul 1974, E.L. Todd, 14♂, 9♀. Colfax Co., Ute Park, 17–18 Jul 1974, E.L. Todd, 13♂, 25♀. Colfax Co., 2 mi. SE Eagle Nest, 15–16 Jul 1974, E.L. Todd, 4♂, 6♀.

NEW YORK, Camden Valley Creek, near Cambridge (S Saratoga Springs), summer 1979, C. Rodrigues, 7 larvae (ROM).

OREGON, Baker Co., Spring Creek, 1–16 Aug 1969, J.H. Baker, 3♂. Harney Co., 10 mi. SE Frenchglen, 1 Sep 1979, W.H. Rowe, 16♀, 9♀. Jefferson Co., Metolius River, 1 mi. N Camp Sherman, 28 Jun 1977, J.W. Chapin, 10 larvae (CUC). Lane Co., Oakridge, 24 Aug 1979, W.H. Rowe, 5♀. Wasco Co., Beaver Creek, MP77 Rt.

26, 27 Jun 1977, J.W. Chapin, 15 larvae (CUC).

UTAH, Beaver Canyon [no further data], 3♂, 1♀. Park City, 17 Jun 1891, 6 larvae. Logan River, 8 Jul 1952, D.J. King, 50 larvae. Timpanogos Cave National Monument, 27 Sep 1963, D.H. Huntzinger, 1♀; same, but 6 Aug 1963, 1♀. Wasatch National Forest, Shingle Creek Campground, 20 Aug 1953, R. Coleman, 6 larvae. Beaver Co., Beaver River at mouth Beaver Canyon, 4 Aug 1969, R.W. Baumann, 3♂. Cache Co., Logan, 13 Aug 1973, G.F. Knowlton, 3♂, 10♀. Cache Co., Logan Canyon, China Row, 9 Sep 1974, G.F. Knowlton, 1♂. Cache Co., Logan Canyon, Ricks Spring, 29 Aug 1964, A.V. Nebeker, 1♂. Cache Co., Logan River, 5 mi. below Ricks Spring, Logan Canyon, 5500 ft., 15 Oct 1961, A.V. Nebeker, 6 larvae. Carbon Co., Mud Creek, near Clear Creek, 30 Jul 1973, R. and W. Baumann, 4♂, 1♀, 5 larvae. Duchesne Co., Duchesne River, Duchesne, 3 Aug 1973, Baumann and Stark, 1♂. Emery Co., Huntington Creek, Huntington Canyon, 31 Jul 1973, R. and W. Baumann, 5♂, 5 larvae. Emery Co., Lowry Fork, near Joes Valley Reservoir, 31 Jul 1973, R. and W. Baumann, 1♂. Salt Lake Co., Mill Creek Canyon, 6000 ft., 28 Aug 1961, 8 larvae. Summit Co., Hayden Fork, Sulphur Forest Camp, 20 Aug 1961, D.W. Argyle, 8 larvae. Summit Co., Little Lyman Lake, Little Lyman Lake Camp, 21 Aug 1973, R. and W. Baumann, 1♂. Summit Co., East Fork Bear River, Hwy. 150, 21 Aug 1973, R. and W. Baumann, 4♂, 2♀, 4 larvae. Summit Co., Weber River, 1 mi. NW Peoa, 28 Jul 1973, B. Stark, 3♂, 3♀. Tooele Co., Clover Creek, 30 Apr 1960, D.W. Argyle, 5 larvae. Utah Co., Provo River, Upper Falls, 14 Aug 1973, R.W. Baumann, 1♂, 4♀. Utah Co., Soldier Creek, Hwy. 50, Tucker, 12 Aug 1973, Baumann and Stark, 7♂, 3♀. Utah Co., Thistle Creek, Thistle, 30 Jul 1973, R. and W. Baumann, 6 larvae.

VERMONT, Waits River, West Topsham, 21 June 1941, Frison and Ross, 1♂ and 1♀ metamorphotypes (INHS). Addison Co., small stream at foot of Moss Glenn Falls, Rt. 100, S Warren, 26 Jul 1969, T. Yamamoto, 4 larvae (ROM).

WASHINGTON, Jefferson Co., fork Quilcene

River, Quilcene, 8 Aug 1971, A.B. Gurney, 1♂, 3♀.

WISCONSIN, Namekagon River, Spring Brook, 6 Jun 1936, Frison and Ross, 25 larvae (INHS). Manitowish River, Boulder Junction, 2 Oct 1937, T.H. Frison, 2 larvae (INHS). Westfield, 9 Apr 1937, Frison and Mohr, 15 larvae (INHS). Coloma, 1 Jul 1933, Frison and Mohr, 130 larvae (INHS). Adams Co., Carter Creek, 25 Jun 1970, 30 ♂♀ (UWM). Adams Co., Big Roche Creek, 27 May 1977, 15 larvae (UWM). Barron Co., Dorits Creek, 2 May 1979, 10 larvae (UWM). Bayfield Co., East Fork Cranberry, 7 Jul 1970, 75 ♂♀ (UWM). Bayfield Co., Pine Creek, 6 Oct 1979, 1 larva (UWM). Buffalo Co., Spring Creek, 6 Jun 1978, 4 larvae (UWM). Douglas Co., Ox Creek, 10 May 1979, 1 larva (UWM). Douglas Co., Brule River, 6 Oct 1979, 15 larvae (UWM). Dunn Co., Otter Creek, 1 May 1979, 5 larvae (UWM). Florence Co., White Popple River, 24 Aug 1970, 4 ♂ (UWM). Forest Co., Armstrong Creek, 23 Jun 1981, 1 larva (UWM). Iron Co., Vaughn Creek, Ashland, 22 Jun 1979, 5 larvae (UWM). Langlade Co., West Branch Eau Claire River, 19 Jul 1968, 2♂ (UWM). Langlade Co., East Branch Eau Claire River, spring 1979, 4 larvae (UWM). Marinette Co., Sidney Creek, 12 Jun 1978, 3 larvae (UWM). Marquette Co., Togatz Creek, 13 Aug 1970, 30 ♂♀ (UWM). Marquette Co., Lawrence Creek, 20 Jun 1973, 15 larvae (UWM). Oneida Co., Bearskin Creek, spring 1979, 50 larva (UWM). Polk Co., McKenzie Creek, 17 Aug 1970, 25 ♂♀ (UWM); same, but 6 Jun 1978, 1 larva (UWM). Portage Co., Little Plover River, 7 May 1979, 5 larvae (UWM). Richland Co., Melancthon River, 11 Jun 1970, 1♂, 2♀ (UWM). Sheboygan Co., Nichols Creek, 5 Nov 1979, 8 larvae (UWM). Vilas Co., Deerskin River, 23 May 1979, 3 larvae (UWM). Waushara Co., Mecan River, 27 May 1977, 25 larvae (UWM).

WYOMING, Yellowstone National Park, Old Faithful, 12 Aug 1927, J.M. Aldrich, 1♂; same, but Mammoth, 15 Aug 1962, P.J. Spangler, 1♂; same, but Madison River, 21 Aug 1955, K.M. Fender, 3♂, 3♀; same, but Madison Jct., 19 Aug 1962, P.J. Spanger, 10♂, 3♀; same, but Firehole

River, 21 Aug 1962, P.J. Spangler, 3 larvae; same, but Gibbon River, 1965, E.R. Vincent, 20 larvae; same, but Gardner River, Indian Creek Campground, 12 Jul 1961, G.B. Wiggins, 100 larvae and pupae (ROM), same, but Soda Butte Creek, 2 Aug 1940, T.H. Frison and Jr., 5 larvae (INHS); same, but Black Sand Basin, 22 Jun 1977, Chapin and Morse, 50 larva (CUC); same, but 12 Jul 1977, 25 larvae (CUC). Grand Teton National Park, Cottonwood Creek, 5 Aug 1940, T.H. Frison and Jr., 50 larvae (INHS).

CANADA, ALBERTA, Calgary, 25 Jul 1902, 1♂ (MCZ).

BRITISH COLUMBIA, 111 Mile Creek, near crossing Cariboo Hwy., 25 June 1956, R. Coleman, 15 larvae. Coppermine Creek, Manning Park, 9 Aug 1950, H.H. Ross, 1 larva (INHS).

MANITOBA, Churchill, 14 Jul 1952, H.E. Welch, 4 larvae (ROM). Goose Creek, Churchill, 31 Jul 1980, 2 larvae (ROM). South Duck River, SD2-1, 27 Jul 1980, D.G. Cobb, 1♂ (FWI).

NEW BRUNSWICK, Kedgewick Ouest, 1 Sep 1962, D.R. Whitehead, 7 larvae.

NORTHWEST TERRITORIES, stream at S end Husky Lakes, 5 Sep 1955, J.G. Hunter, 30 larvae (ROM). Sagvacjuac, Chesterfield Inlet (63°30'N, 90°50'W), 3 Jul 1977, B. deMarch, 1 larva (ROM).

ONTARIO, Kenora District, Kiruna Lake, small stream in muskeg (54°30'N, 84°55'W), 22 Jul 1981, E. Fuller, 12 larvae (ROM); same, but 2 Aug 1981, 8 larvae (ROM).

QUEBEC, Rivière Ste. Anne, Parc Mt. Albert, 2 Aug 1974, D. Roy, ♂♂, ♀♀ (UMQ).

SASKATCHEWAN, mossy stream on Hwy. 224, ~4.5mi. N Meadow Lake Provincial Park, Goodsoil, 16 Aug 1970, ROM field party, 5 larvae (ROM). Lac Le Ronge Provincial Park, 10 Mile Creek, 18 Jun 1959, C.E. Cushing, 10 larvae (ROM).

YUKON TERRITORY, Judas Creek Camp, MP 872 Alaska Hwy., 12 Aug 1950, Hansen and Beer, 7 larvae (INHS).

Subgenus Sychnothrix, new subgenus

ADULT.—Spurs 2,3,3, but smaller males often 2,2,3.

Male Genitalia: Ninth segment with ventral area not produced anteriorly. Cerci in dorsal aspect mostly fused mesally. Tenth tergum elongate, with two accessory processes on midline. Claspers elongate, semierect; with a large lateroventral lobe.

LARVA.—Head with a distinct color pattern. Primary setae of head very short (e.g., no. 17). Mid- and hindfemora with a single large seta on ventral margin, and 3–5 extra setae on anterior and posterior faces; setae of filtering fringe virtually uniform in structure and length; apical and subbasal setae on dorsal margin distinctly enlarged. With 1 submesal pair of setae on first abdominal venter. Gills single.

TYPE-SPECIES.—*Oligoplectrum echo* Ross (here designated).

DISCUSSION.—The adult males are characterized by their almost totally fused cerci, elongate tenth tergum with an extra pair of processes mesally, and claspers with a large lateroventral lobe. The larvae may be recognized by the smooth head with short primary setae, presence of a single, stout, ventral seta on the mid- and hindfemora which bear a row of such setae on the anterior and posterior faces, a single pair of setae submesally on the first abdominal venter, and single gills.

The subgenus contains only a single species, *B. echo* (Ross) known from western United States.

BIOLOGY.—This monotypic subgenus is very poorly known biologically, as Wiggins (1977) provided the only data. He states that the larvae are stream inhabitants, and in one locality able to inhabit a site smelling strongly of hydrogen sulphide with a water temperature of 34.4° C. Their gut contents were of organic matter, especially diatoms.

The larval case is constructed of small sand grains, and is slender and tapering but not curved (Wiggins, 1977, plate 2.6c).

***Brachycentrus (Synchnothrix) echo* (Ross), new combination**

FIGURES 16, 24–29

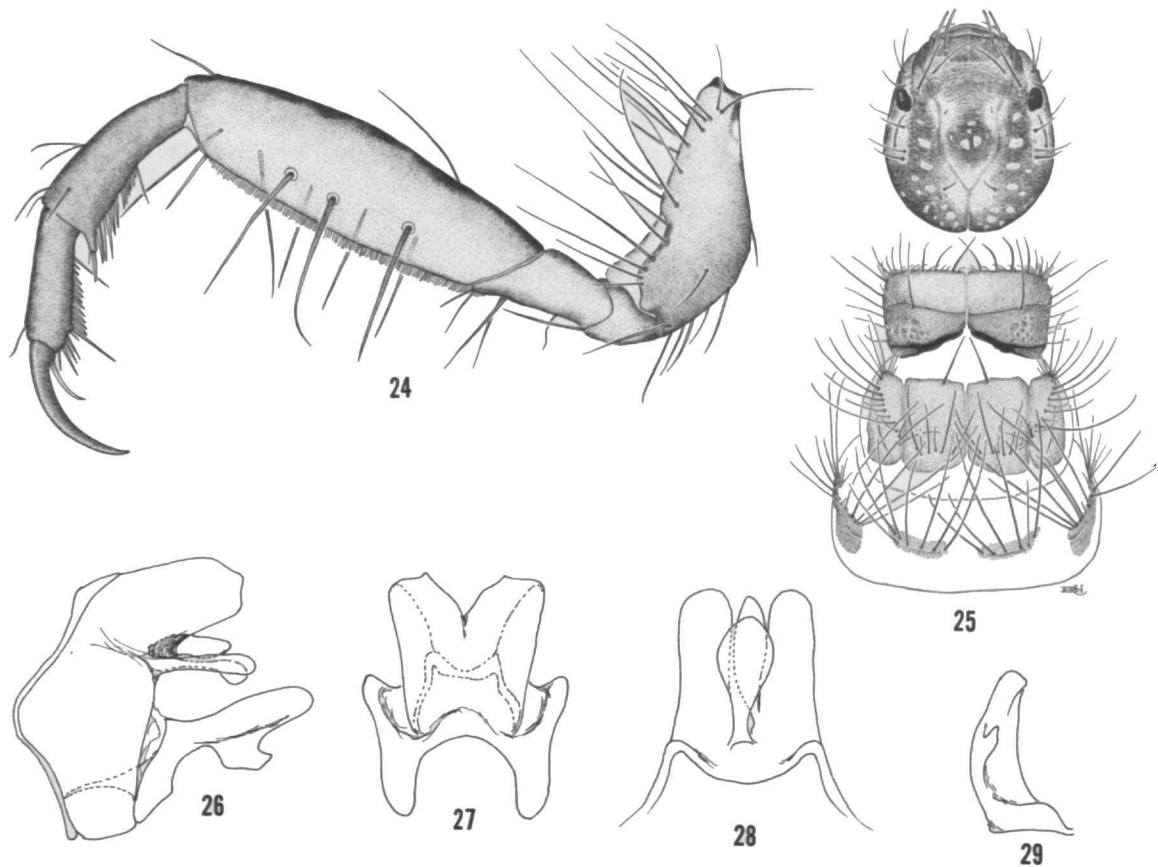
Oligoplectrum echo Ross, 1947:164.—Wiggins, 1965:1094; 1977:62.

The adult males of this species are easily recognized by their genital structure, especially the tenth tergum and lateroventral lobe of the clasper. The tenth tergum is very unusual with what would appear to be a rather typical bilobed tergum, but then there is a single lobe above the tergum on the midline and a second lobe between the two halves. There is, here and there in the family, a pair of lobes above the tenth tergum (e.g., *B. americanus* (Banks)), but no species with lobes on the midline. It is tempting to speculate that perhaps the paired lobes of *B. americanus* have rotated 90° and now lie on the midline. Some support for this idea is provided by a close examination of the lobes. The more ventral one arises from either the right or left tergal half, not from precisely the middle, and the base of the dorsal lobe also appears to be ever so slightly asymmetrical.

The larvae are typical *Brachycentrus* Curtis in structure, but construct a slender, tapered, sand-grain case. This type of case is uncommon in *Brachycentrus* Curtis, being known only in *B. maculatus* (Fourcroy) and *B. etowahensis* Wallace. It is interesting that *B. echo* (Ross) and *B. etowahensis* are also the only two species with rows of setae on the faces of the mid- and hindfemora. The case structure coupled with the non-carinate head, single pair of submesal, first sternal setae, and rows of setae on the anterior and posterior faces of the mid- and hindfemora provide easy recognition of the larvae.

ADULT.—Length of forewing, ♂ 5.5–6.5 mm, ♀ 7.5–8 mm. Color in alcohol, brown. Male abdomen with seventh sternum bearing a broad posteromesal lobe, about as long as broad.

Male Genitalia: Ninth segment without an anteroventral lobe. Cerci elongate, mostly fused dorsomesally, with ventrolateral margin strongly sclerotized and with a basal sclerotized bar. Tenth tergum elongate, composed of a pair of lateral sclerites, rounded apically, between which lies a single more rodlike lobe and which is surmounted by another mesal, clavate lobe. Clasper with basal area small, straight, lateroventral margin produced into a large, distinct lobe; apex bluntly pointed in ventral aspect.



FIGURES 24–29.—*Brachycentrus echo* (Ross): 24, larval hindleg; 25, larval head and thorax; 26, male genitalia, lateral; 27, male ninth tergum and cerci, dorsal; 28, male tenth tergum, dorsal; 29, male clasper, posteroventral.

LARVA.—Length to 7.5 mm. Sclerites yellow brown; head with darker areas posteriorly on frontoclypeus and genae with a distinct paler area around area of junction of dorsal ecdysal lines, muscle scars distinctly paler; legs yellow brown with dorsal margin of mid- and hindfemora fuscous. Femora of mid- and hindlegs with a single apical seta on ventral margin; anterior and posterior faces with rows of 2–5 stout setae; apico- and basodorsal setae large, others lacking; ventral margin with a uniform setal fringe. Tibiae with a single basoventral seta. One pair of large, submesal setae on venter of first abdominal segment. Lateral fringe present posteriorly on seg-

ments 3–7. Gills single, in dorsal and ventral rows.

TYPE MATERIAL.—Holotype, male, INHS, published as “Hot Creek, Mono County, California; May 1, 1937; H.J. Rayner.” Type not seen; topotypes studied.

MATERIAL EXAMINED.—USA, CALIFORNIA, Mono Co., Hot Creek, 35 mi. N Bishop, 16 Jul 1966, G.B. Wiggins, 5♂, 1♀, 5 larvae, 2 pupae.

UTAH, Heber, 14 Aug 1943, Knowlton & Maddock, 1♂ paratype. Garfield Co., Assay Creek, Hwy. 89, 16 Jul 1959, R.W. Baumann, 4♂. Sevier Co., Clear Creek, Clear Creek, Hwy. 89 at Sevier, 21 Jul 1968, R.W. Baumann, 1♂.

Summit Co., Yellow Pine Creek, 7 mi. E Kamas, 28 Jul 1973, B. Stark, 1♂. Summit Co., Weber River, 1 mi. NW Peoa, 28 Jul 1973, B. Stark, 24♂, 4♀.

Subgenus *Sphinctogaster* Provancher

Sphinctogaster Provancher, 1877:262.
Brachycentriella Iwata, 1927:215.

ADULT.—Spurs 2,3,3.

Male Genitalia: Ninth segment in lateral aspect with sternum barely or not at all produced anteriorly. Cerci in dorsal aspect elongate, ovoid, completely separated mesally. Tenth tergum elongate, variously formed. Claspers elongate, semi-erect; apex variously formed, but never produced into a laterally developed lobe nor with a large mesally directed lobe.

LARVA.—Head and thoracic sclerites either uniformly brown or marked with a distinct color pattern. Mid- and hindfemora with a single, large seta on ventral margin, another on anterior face near apex, and a third on posterior face near base (*B. etowahensis* Wallace has several extra setae), setae of filtering fringe virtually uniform in structure and length; setae of dorsal margin of similar lengths. With two submesal pairs of setae on first abdominal sternum stout and conspicuous. Gills single.

TYPE-SPECIES: *Sphinctogaster lutescens* Provancher (monobasic).

DISCUSSION.—The adult males are recognized by the separated cerci, elongate tenth tergum, shape of the clasper which lacks an apicolaterally directed point and mesal lobe. The larvae are quite variable in appearance, but often have a distinctive color pattern, and are the only ones with two pairs of large setae submesally on the first abdominal sternum.

The subgenus is widespread in North America, being especially rich in species east of the Mississippi, and is also found in eastern Asia. I place the following species in this subgenus: *B. appalachia* new species (eastern North America), *B. bilobatus* Martynov (eastern Siberia), *B. chelatus* Ross (southeastern United States), *B. etowahensis*

(southeastern United States), *B. fuliginosus* Walker (northeastern North America), *B. incanus* Hagen (eastern North America), *B. lateralis* (Say) (eastern North America), *B. numerosus* (Say) (eastern North America), *B. occidentalis* Banks (western North America), *B. solomoni* new species (northeastern North America), *B. spinae* Ross (eastern United States). Through the kindness of Drs. G.B. Wiggins and K. Tanida, I have seen a type of *Brachycentriella japonica* Iwata. This monotypic genus is based on larvae, and the type is a species belonging to this subgenus (also BC of Akagi (1962) is almost assuredly the same). In addition the USNM collections have adults from Japan of a species of this subgenus that are currently being described by Wiggins.

BIOLOGY.—Considerable data have accumulated on the biology of certain species in this subgenus, most of it due to the activities of Gallepp (1977), Gallepp and Hasler (1975), and Shapas and Hilsenhoff (1976) on *B. occidentalis* Banks, and Lloyd (1915, 1921), Murphy (1919), and Sibley (1926) on *B. solomoni* (under the name of *B. nigrisoma* [sic]).

The larvae all are inhabitants of lotic waters, but occur in a great variety of flows. Personal observation has shown that two new species may occupy the same stream but in different areas (e.g., *B. appalachia* and *B. solomoni* in the Beaverkill). The emergence time of these two species often is such that one flies after the other (Ross, 1944; Say, 1823). In this situation it seems that frequently the larvae of one species are commonly encountered at the same time that the adults of the other species are being abundantly collected. As a consequence, one can easily be misled into misassociating adult and larval stages if metamorphotypes are not used.

Murphy (1919) reports that larval food for *B. solomoni* is mostly diatoms for the first two weeks, with green algae and plant matter added from the third week. They obtain these foods by actively grazing on the stones of the substrate. After the sixth week they attach their cases to the current-swept boulders and begin to filter feed. At this time they begin to become strongly

carnivorous, feeding on all sorts of small animals that they can grasp. Miscellaneous reports on food of mature larvae generally indicate an omnivorous diet with many small animals being consumed.

Most species of the subgenus construct the typical cases, square in cross-section (as in Figure 2), but *B. etowahensis* Wallace produces a very distinctive, cylindrical case of sand grains with projecting sand grain spines (Figure 1). The cases of *B. occidentalis* Banks at maturity are frequently cylindrical and constructed of flat rock fragments. Along the eastern seaboard, at least, cases of mature larvae of *B. numerosus* (Say) are almost

wholly silken and circular in cross-section (Figure 3).

***Brachycentrus (Sphinctogaster) lateralis* (Say)**

FIGURES 30-37

Phryganea lateralis Say, 1823:161.

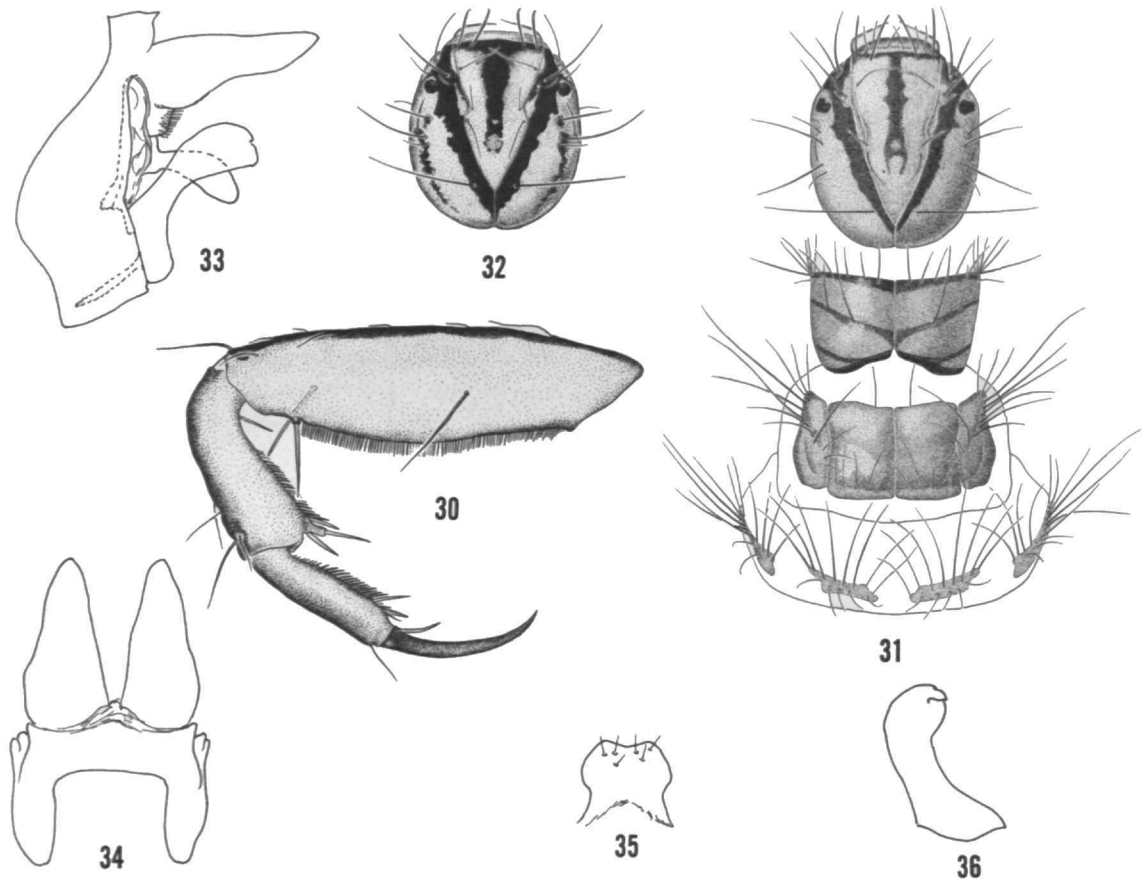
Brachycentrus lateralis (Say).—Hagen, 1868:272.—Ross, 1944:265.—Fischer, 1970:103.

Sphinctogaster lutescens Provancher, 1877:262.

Brachycentrus lutescens (Provancher).—Ulmer, 1907:91.—Milne, 1936:123.—Fischer, 1970:104.

Brachycentrus incanus Hagen.—Leonard and Leonard, 1949:28 [in error].

The identity of *B. lateralis* (Say) was established



FIGURES 30-36.—*Brachycentrus lateralis* (Say): 30, larval hindleg; 31, larval head and thorax; 32, larval head, five-banded form; 33, male genitalia, lateral; 34, male ninth tergum and cerci, dorsal; 35, male tenth tergum, dorsal; 36, male clasper, posteroventral.

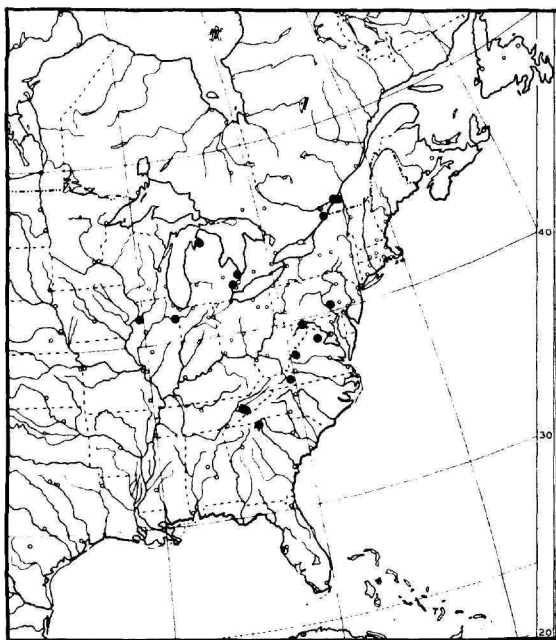


FIGURE 37.—Distribution of *Brachycentrus lateralis* (Say).

by Ross (1944) with the designation of a neotype, and full description of male, female, and larva. In describing *Sphinctogaster lutescens*, Provancher (1877) stated the holotype to be a male; Ross (1944) called it a female. Milne (1936) synonymized *B. lutescens* (Provancher) with *B. lateralis* Say; as this seems quite probable, I leave the name in synonymy.

The male genitalia place this species in close relationship to *B. incanus* Hagen. The tenth tergum is shorter, in dorsal aspect being wider than long, and in not having its apex angled dorsad. The clasper has a definite, though small, ventral area and the tip is blunter in lateral aspect, and in posteroventral aspect it is shorter and more nearly C-shaped with the apical point far from the lateral margin.

The larva is very distinctive in appearance, with its golden-yellow head bearing three (or rarely, five) narrow, longitudinal, black bands. A series of larvae from the Cacapon River, West Virginia, shows all gradations from three bands with a few dark granules posterior to the eye,

through several degrees of completeness of this band, to the completely five-banded state. The mesal band, however, is always narrow, especially at the anterior of the frontoclypeus. The possible larvae of *B. incanus* Hagen are very similar, but they have five longitudinal black bands which are much broader than those of *B. lateralis* (Say), and several long setae on the ventral margin of the mid- and hindtibiae. Although the head coloration of *B. appalachia*, new species has five longitudinal, black bands and thus is similar to some examples of *B. lateralis* (Say), the species differs strikingly in the coloration of its legs.

ADULT.—Length of forewing, ♂ 6–8 mm, ♀ 9–11 mm. Color: male, body fuscous, forewing fuscous with pale flecks; female (and rarely males), body stramineous with fuscous head, tegulae, and a mesal, longitudinal band on meso- and metanotum, forewing pale grayish, with a slightly darker anterior margin. Male abdomen with seventh sternum bearing a broad postero-mesal lobe about as long as broad.

Male Genitalia: Ninth segment without a sternal lobe. Cercus elongate, tapering apicad; cerci separated dorsomesally, mesal margins divergent posteriad. Tenth tergum elongate in lateral aspect with dorsal margin convex; in dorsal aspect almost twice as wide as long, tip very slightly excised mesally. Clasper with a distinct basal area in lateral aspect, tip bluntly rounded; in posteroventral aspect distinctly curved, mesal margin concave, apical point borne from near mesal margin.

LARVA.—Length to 11 mm. Sclerites bright golden yellow; head with a narrow, mesal, fuscous mark on frontoclypeus usually not reaching apex of frontoclypeus, with a narrow fuscous band on each gena adjacent to frontoclypeal suture (rarely with an additional dark band from eye to occiput); legs golden yellow, dorsal margins of femora of mid- and hindlegs with a black band. Femora of mid- and hindlegs with three enlarged setae; apico- and basodorsal setae barely enlarged over other dorsal setae; ventral margin with a uniform setal fringe. Mid- and hindtibiae with a single subbasal seta on ventral margin.

Two submesal pairs of setae on first abdominal venter equal in size, but slightly larger than homologous setae on second segment. Lateral fringe present from third through seventh segments. Gills single, arising in dorsal, lateral, and ventral rows.

TYPE MATERIAL.—Neotype, male, INHS, *P. lateralis* Say, published as "Momence, Illinois: May 4, 1937, Ross & Mohr." Type not seen; topotypes with same data studied.

Type, *S. lutescens* Provancher, location unknown if in existence; no data given, but probably Quebec. Type not seen.

MATERIAL EXAMINED.—USA, ILLINOIS, Momence, 4 May 1937, Ross and Mohr, 1♂ (INHS); same, but 17 May 1937, Ross and Burks, 3♂, 9♀ (INHS); same, but 14 Jul 1936, B.D. Burks, 5 larvae (INHS); same, but 31 Aug 1936, Ross and Burks, 10 larvae (INHS); same, but Kankakee River, 7 May 1940, B.D. Burks, 5♂ metamorphotypes, 1 pupa (INHS); same, but 27 Oct 1938, Ross and Burks, 5 larvae (INHS); same, but 21 Dec 1938, Mohr and Burks, 20 larvae (INHS).

[ILLINOIS], Black Hawk, 2 May 1864, Walsh, 1♂ (MCZ).

MARYLAND, Allegany Co., North Branch Potomac River, Oldtown, 16 Aug 1982, W.L. Butler, 3 larvae (MWQMD).

MICHIGAN, Port Huron, Jun, H.G. Hubbard, 1♂. Detroit, H.J. Hubbard, 29♂, 2♀ (MCZ). Det. [?Detroit, Michigan], 26 May 1874, S. and H., 4♂, 1♀ (MCZ). Antrim Co., Manistee River, Rt. 618, 25 Oct 1966, N. Andresen, 1 larva (ROM).

PENNSYLVANIA, Harrisburg, 30 Apr, 3♂, 4♀ (MCZ).

SOUTH CAROLINA, Oconee Co., Chattooga River, Rt. 28, 18 Feb 1977, J.W. Chapin, 6 larvae (CUC); same, but 23 Mar 1978, 3 larvae (CUC); same, but 4 Apr 1976, 1♂ (CUC); same, but 9 Apr 1978, 1 prepupa, 1 pupa (CUC); same, but 10 Apr 1976, 3♂ metamorphotypes (CUC); same, but 14 Apr 1978, 2♂ (CUC); same, but 9 Sep 1976, 2 larvae (CUC); same, but 10 Nov 1976, 1 larva (CUC).

TENNESSEE, Blount Co., Little River, Rt. 73, Townsend, 14 Aug 1977, S. Prichard, 12 larvae

(CUC); same, but at Melrose Dam, 15 Apr 1981, W. Pennington, 1 prepupa, 4 pupae (UTK); same, but 30 Mar 1979, L. Snodderly, 5 larvae (UTK); same, but 1 mi. NW Melrose, 12 Apr 1977, Bryant, 2♂ (UTK); same, but Walland, 24 Apr 1973, Etnier and Poly, 9♂ (UTK). East Tennessee, Citico Creek, ~3 mi. upstream from Little Tennessee River, 23 Apr 1966, D.A. Etnier, 3♂, 4♀ (UTK). Little Tennessee River at Citico Beach Rd., 15 Apr 1972, D.A. Etnier, 35♂, 7♀ (UTK).

VIRGINIA, Rappahannock River, Remington, 21 Mar 1940, Frison et al., 1 larva (INHS). Floyd Co., Little River, Rt. 615, north Floyd, 2 May 1978, C.M. and O.S. Flint, Jr., 5♂, 4♀; same, but 12 Apr 1974, D. Simonet, 1♂ (VPI); same, but 16 Apr 1977, J. Ray, 2♂ (VPI); same, but 21 Apr 1977, C.R. Parker, 15♂ (VPI). Bath Co., Jackson River, below Rt. 603 bridge, Jan 1973, R. Strickler, 1 larva.

WEST VIRGINIA, Cacapon River, Capon Bridge, 1 May 1944, Frison and Ross, 1♂ (INHS); same, but 0.5 mi. upstream of U.S. 50 bridge, 29 Oct 1971, Simmons and Hatcher (SCUBA diving, on *Vallisneria*), 6 larvae (CUC, USNM).

CANADA, ONTARIO, Cardinal, 14 Jun 1953, E.M. Walker, 5♂, 7♀ (ROM).

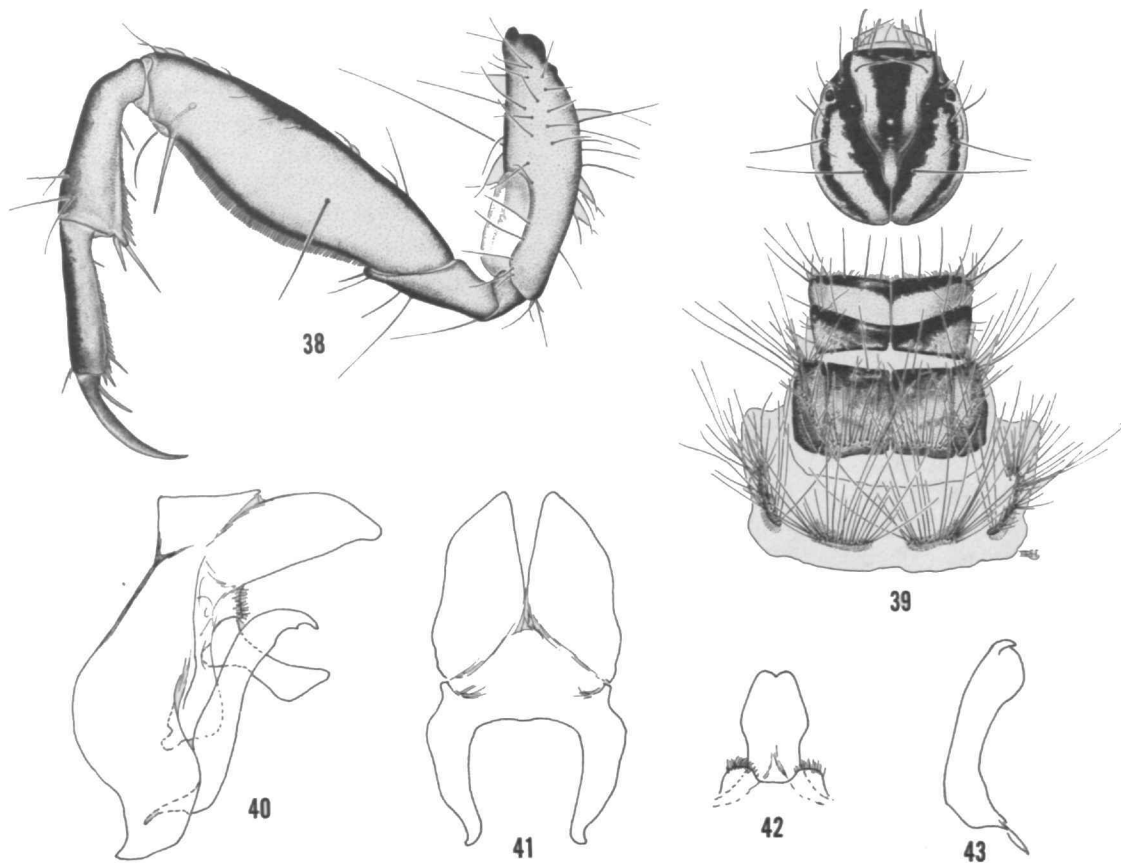
QUEBEC, Laprairie, 9 Jun 1926, F.P. Ide, 1♂ (MCZ); same, but 29 May 1957, 7♂ (ROM). Isle Ste. Hélène, Montreal, 2 Jun 1965, 1♂ metamorphotype (ROM); same, but 22 Aug 1964, 5 empty cases (ROM); same, but 28 Aug 1964, 1♂ decayed pupa with sclerites, 12 empty cases (ROM). Lachine Rapids [St. Lawrence River, near Montreal], 15 May 1965, F. DeLorme, 5 larvae (UMQ).

Brachycentrus (Sphinctogaster) incanus Hagen

FIGURES 38–44

Brachycentrus incanus Hagen, 1861:272.—Denning, 1941:202.—Fischer, 1970:102.

The name is based on a female type from Washington, D.C. Denning (1941) associated a male from a Washington suburb in Maryland



FIGURES 38-43.—*Brachycentrus incanus* Hagen: 38, larval hindleg; 39, larval head and thorax; 40, male genitalia, lateral; 41, male ninth tergum and cerci, dorsal; 42, male tenth tergum, dorsal; 43, male clasper, posteroventral.

with this female. This association seems quite probable, and I am accepting this usage of the species name.

The male genitalia show *B. incanus* Hagen to be closely related to *B. lateralis* (Say). The tenth tergum of *B. incanus* Hagen in lateral aspect is angled upward at the apex, and appears to be longer in dorsal aspect. The clasper is nearly straight and without the basal lobe as is seen in *B. lateralis* (Say) in lateral aspect. In posteroventral aspect the clasper is much straighter with the apical point borne from near the lateral margin.

The larvae have not been definitively associated with the adult stage. Both a male and larvae

have been collected from the same stream in Wisconsin, but on different dates. In coloration of the head, these larvae cannot be separated from *B. appalachia*, new species: that is they have five, rather broad, fuscous bands. But their legs are generally pale with only a dark, narrow, dorsal band similar to the larvae of *B. lateralis* (Say). On the ventral margin of the mid- and hindtibiae are found two long setae, a situation different from that of either *B. lateralis* (Say) or *B. appalachia*, new species.

ADULT.—Length of forewing, ♂ 8-9 mm, ♀ 8-11 mm. Color (old material, much faded) of body fuscous; wings light brownish-gray indis-

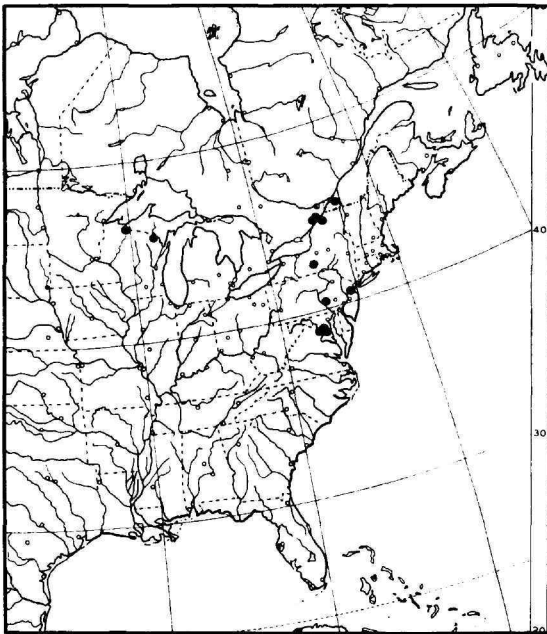


FIGURE 44.—Distribution of *Brachycentrus incanus* Hagen.

tinctly maculate. Male abdomen with seventh sternum bearing a broad process about three times as wide as long.

Male Genitalia: Ninth segment without sternal lobe. Cercus elongate, tapering apicad, cerci separated dorsomesally, but approximate to midline. Tenth tergum elongate, in lateral aspect with tip slightly upturned, with basolateral area bearing a small cluster of setae; in dorsal aspect distinctly longer than wide, tip slightly excised mesally. Clasper with no basal area in lateral aspect, extending directly posterodorsally, tip pointed; in posteroventral aspect almost straight, mesal margin slightly concave, with an apicolateral point.

LARVA (Putative).—Length to 11 mm. Sclerites golden yellow; head with a median, fuscous band on frontoclypeus that distinctly widens anteriorly, and often touches the genal bands posteriorly; with a fuscous, genal band adjacent to frontoclypeus, generally with dark expansions near apex of frontoclypeus that often touch the tip of mesal band; a longitudinal, fuscous band from eye to occipital margin; dorsal, and to a lesser

degree ventral, margins of legs with narrow fuscous bands. Femora of mid- and hindlegs with 3 enlarged setae; apico- and basodorsal setae distinctly enlarged over other dorsal setae; ventral margin with a uniform setal fringe. Mid- and hindtibiae with ventral margins bearing 2 large setae: one subbasally, the other near midlength. Two submesal pairs of setae on first abdominal venter, distinctly longer than homologous setae on second venter. Lateral fringe continuous from third through sixth segments. Gills single, arising in dorsal, lateral, and ventral rows.

TYPE MATERIAL.—Holotype, female, MCZ: "Washington v. Sacken April 59," "Type 10955," "Lectotype *B. incanus* Hag. Ross 1937 ♀," "*B. incanus* *Hag." Pinned, abdomen cleared, studied.

Allotype, male, USNM, "Cabn Jn [Cabin John] Apr 21. Md," "Collection HSBerber," "*Brachycentrus incanus* Hagen, Bks. [det.]," "Allotype *Brachycentrus incanus* Hagen by Denning, 1940." Allotype pinned, abdomen cleared, and illustrated here (see Figures 40–44).

MATERIAL EXAMINED.—USA, DISTRICT OF COLUMBIA, Washington, Apr 1859, O. v. Sacken, 1♀ (holotype, MCZ).

MARYLAND, Cabin John, 21 Apr, H.S. Barber, 1♂ (allotype USNM).

NEW JERSEY, Brunswick, 21 Apr, 1♂, 1♀ (MCZ).

NEW YORK, Ogdensburg, May 1955, 7♂, 4♀ (USNM). Ithaca, 1905, 1♂ (UMA).

PENNSYLVANIA, Harrisburg, 30 Apr, 1♂, 3♀ (MCZ).

VIRGINIA, Great Falls, 15 Apr, N. Banks, 1♂, 2♀ (MCZ); same, but 20 Apr, 1♂, 2♀ (MCZ).

WISCONSIN, Florence Co., Woods Creek, 28 May 1969, 1♂ (UWM); same, but 9 Nov 1967, 10 larvae (UWM, USNM). Iron Co., Potatoe River #2, 6 Oct 1979, 7 larvae (UWM, USNM).

CANADA, ONTARIO, Maitland, 2 Jun 1931, L.J. Milne, 1♂, 1♀ (MCZ). Prescott, 10 Jun, Cockrell, 2♂, 2♀ (MCZ).

QUEBEC, Laprairie, 29 May 1957, F.P. Ide, 7♂ (ROM).

Brachycentrus (Sphinctogaster) fuliginosus
Walker

FIGURES 45-49

Brachycentrus fuliginosus Walker, 1852:82.—Betten and Mosely, 1940:177.—Leonard and Leonard, 1949:7.—Fischer, 1970:101.

Brachycentrus lateralis (Say).—Harper, Pilon and Perron, 1975:40 [misidentification].

The type of this species is a female fully figured and redescribed by Betten and Mosely (1940). As it probably is impossible to definitively recognize the species from the type, I follow the usage established by Ross in Leonard and Leonard (1949) of associating the name with the males figured here.

The male is quite distinctive, and shows the species to be a member of the *lateralis* subgroup, closest to *B. occidentalis* Banks. In *B. fuliginosus* Walker the tenth tergum is deeply divided apicomesally. The clasper has virtually no basal area, but extends posterodorsad from near the ventral margin, and is nearly C-shaped in posteroventral aspect with the pointed tip directed toward the base.

The larvae are unknown to me. The larvae described by Denning (1937) under this name are those of the related *B. occidentalis* Banks.

ADULT.—Length of forewing, ♂ 7-8 mm.

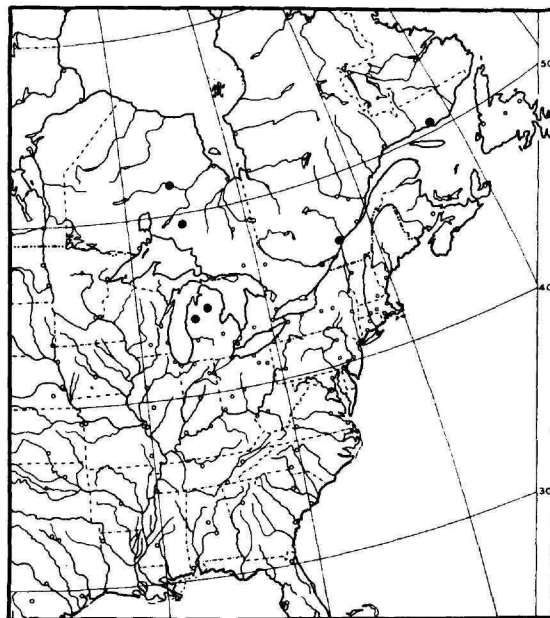
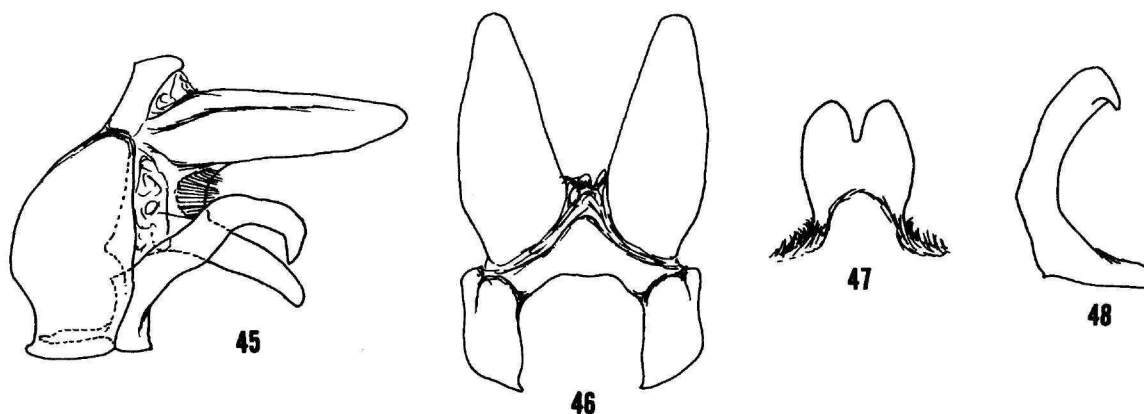


FIGURE 49.—Distribution of *Brachycentrus fuliginosus* Walker.

Color of material in alcohol, dark brown, body very dark. Male abdomen with seventh sternum slightly produced posteromesally, rarely produced into a small free point.

Male Genitalia: Ninth segment without ster-



FIGURES 45-48.—*Brachycentrus fuliginosus* Walker: 45, male genitalia, lateral; 46, male ninth tergum and cerci, dorsal; 47, male tenth tergum, dorsal; 48, male clasper, posteroventral.

nal lobe. Cercus long, tapering apicad; cerci separated dorsomesally. Tenth tergum long, with basolateral area bearing a row of setae; in dorsal aspect deeply divided apicomesally, lateral arms rounded apically. Clasper with a very small basal area, directed posterodorsad from near base; in posteroventral aspect almost C-shaped, with tip pointed and directed at base.

LARVA.—Unknown.

TYPE MATERIAL.—Holotype, female, BMNH, published as "St. Martin's Falls, Albany River, Hudson's Bay. Presented by G. Barnston Esq." Type not seen; illustrated and redescribed by Betten and Mosely (1940).

MATERIAL EXAMINED.—USA, MICHIGAN, Lake Co., Pere Marquette River, J.W. Leonard (L47-240), 1♂, 1♀ (INHS); same, but 28 May 1937, 1♂ (INHS). Manistee River near Grayling, 21 May 1936, Frison and Ross, 2♂ (INHS).

CANADA, QUEBEC, Louiseville, 19 Jun 1974, L. LeSage, 5♂ (UMQ); same, but 13 Jun 1972, 1♂ (UMQ). Riviere Nabisipi, 24 Jun 1962, G. Shooner, 1♂ (UMQ).

ONTARIO (Central), Nagagami River, Sta. 52, 23 Jun 1903, W.J. Wilson, 1♂ (UMSP).

Brachycentrus (Sphinctogaster) occidentalis
Banks

FIGURES 50–56

Brachycentrus occidentalis Banks, 1911:355.—Ross, 1938:42.—Fischer, 1970:110.

Brachycentrus fuliginosus Walker.—Denning, 1937:27 [misidentification].

This species is a member of the *B. lateralis* (Say) subgroup, most closely related to *B. fuliginosus* Walker. The adult male of *B. occidentalis* Banks is distinguished by the tenth tergum, which is undivided apicomesally and the apex of the clasper which is drawn out into a very long, mesally directed point.

Unfortunately the larvae of several species of this subgroup are unknown. Among the known larvae, however, only the dark, round-headed form of *B. spinae* Ross has a similarly uniformly brown head, but it is almost circular

in outline, and the tibia of the mid- and hindlegs have 3 or more setae on the inner, basal margin.

ADULT.—Length of forewing, ♂ 7–8 mm, ♀ 9–10 mm. Color grayish-brown; body nearly fuscous, tibiae and tarsi pale brown; forewing pale brownish-gray, veins distinctly darker. Male abdomen with a posteromesal process from seventh sternum about as broad as long.

Male Genitalia: Ninth segment without a sternal lobe. Cercus elongate, ovoid; cerci divided dorsomesally with inner margins divergent. Tenth tergum elongate, apex truncate in dorsal aspect. Clasper with a long basal area, dorsal section angled posteriad; apex tapering to a point; in posteroventral aspect apex produced into a long, tapering point.

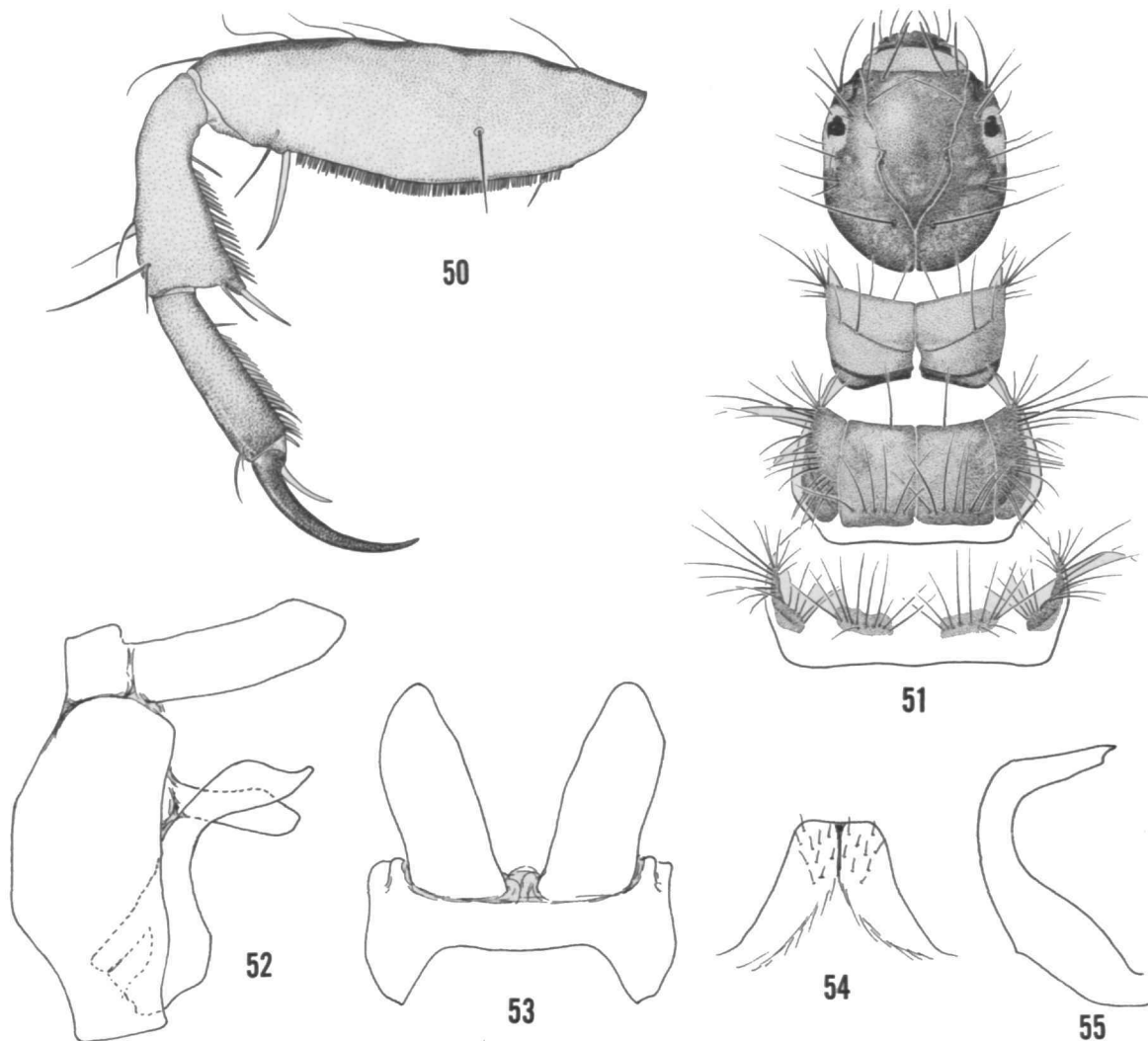
LARVA.—Length to 10 mm. Sclerites light to dark brown, slightly paler over muscle scars on head; legs brown, dorsal margins of femora infuscate. Femora of mid- and hindlegs with three enlarged setae; apicodorsal setae slightly enlarged over, and basodorsal seta indistinguishable from, other dorsal setae; ventral margin with a uniform setal fringe. Tibiae of mid- and hindlegs with a single, ventral, sub-basal seta. Two ventral pairs of submesal setae on first abdominal segment equal in size, but slightly larger than homologous setae on second segment. Lateral fringe from third through seventh segments. Gills single, arising in dorsal, lateral, and ventral rows.

TYPE MATERIAL.—Lectotype, male, MCZ, "Type," "Bon Accord Brit. Col. 14 May," "Collection N. Banks," "Type 11685," "Lectotype *B. occidentalis* Bks. Ross 1937 ♂," "*Brachycentrus occidentalis* Type Bks." Pinned, abdomen cleared, studied.

MATERIAL EXAMINED.—USA, ALASKA, Upper Gulkana River, 1955, G.O. Schumann, 20♂ (INHS).

ARIZONA, East Fork White River below Greer, 17 May 1964, S.G. Jewett, Jr., 6 pupae. Apache Co., Little Colorado River, Hwy. 373 at Greer, 7 Apr 1968, R.W. Baumann, 2 larvae, 1 prepupa (ROM).

COLORADO, stream at Boulder, J. Hender-



FIGURES 50-55.—*Brachycentrus occidentalis* Banks: 50, larval hindleg; 51, larval head and thorax; 52, male genitalia, lateral; 53, male ninth tergum and cerci, dorsal; 54, male tenth tergum, dorsal; 55, male clasper, posteroventral.

son, 2 larvae. Del Norte, Rio Grande, 28 Jun 1955, C.P. Alexander, 2♂, 1♀ (UMA). Montrose Co., Black Canyon of Gunnison National Monument, 6 Sep 1962, E.B. Reed, 5 larvae. Rio Grande Co., South Fork, 8000 ft., 20 Jun 1972, W.W. Wirth, 1♂. Routt Co., Yampa River at Steamboat, 19 Jun 1961, A.R. Gaufin, 1♂.

IDAHO, Twin Falls, 3 May 1937, J.A. Gillett, 23♂, 7♀.

MINNESOTA, Bear Creek, Rochester, 25 Apr 1942, P. Harden, 1♂ (UMSP). Anoka Co., Coon Creek, 25 Apr 1936, C.E. Mickel, 1 prepupa (UMSP). Hennepin Co., Nine Mile Creek, 5 May 1933, C.E. Mickel, 9♂, 3♀ (UMSP); same, but 4-8 May 1935, D.G. Den-

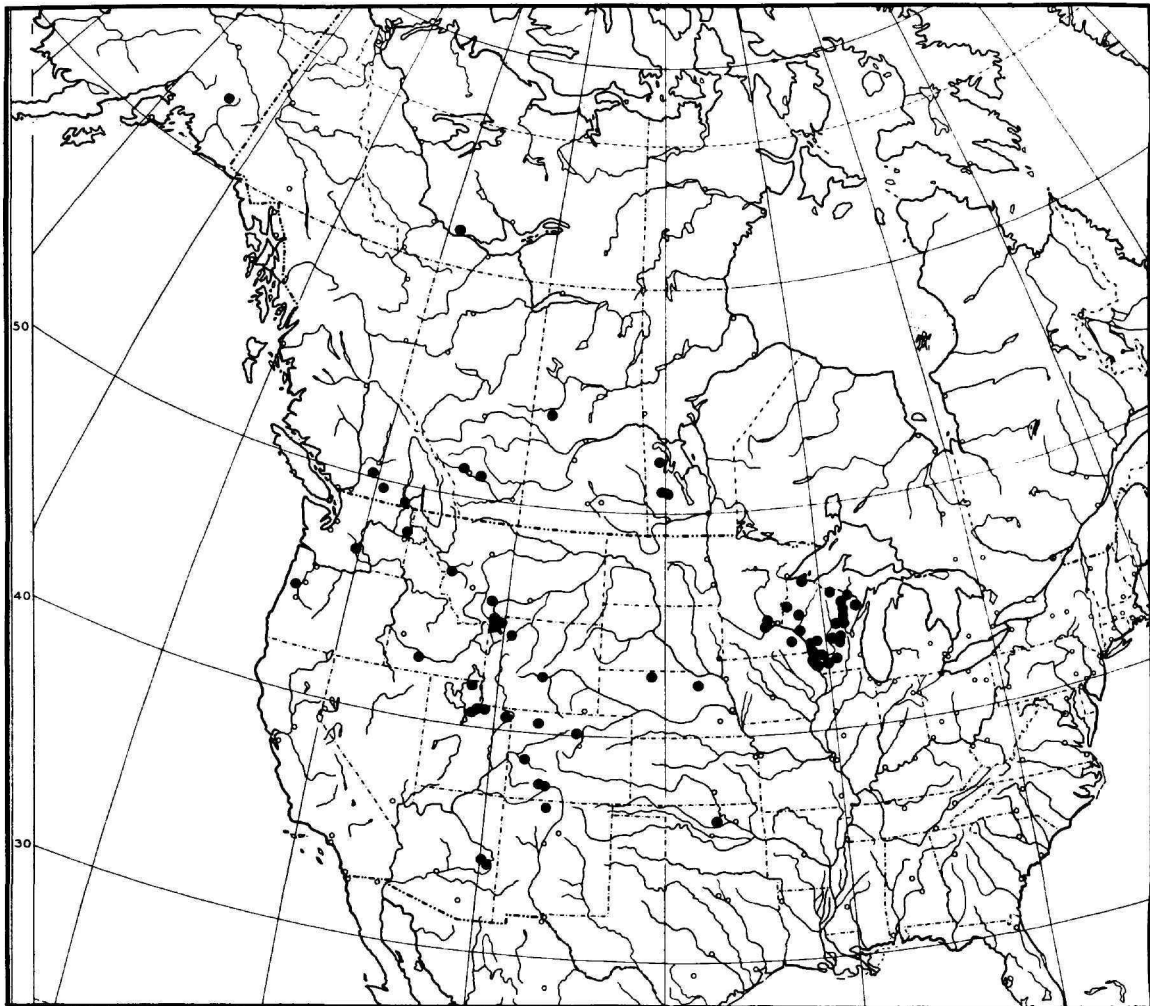


FIGURE 56.—Distribution of *Brachycentrus occidentalis* Banks.

ning, 3♂, 10♀ reared from pupae, 2 prepupae, exuviae (UMSP); same, but 26 Apr 1936, prepupae, pupae (UMSP); same, but 1 May 1937, D.G. Denning, 7♂, 5♀ reared from pupae, pupae (UMSP, USNM).

MONTANA, East Gallatin River near Bozeman, Sep 1971, T. Glorvigan, 20 larvae. Missoula Co., Clearwater River, Hwy. 20 near Clearwater Jct., 17 May 1969, A.R. Gaufin, 4♂, 4♀.

NEBRASKA, Royal, 16 Jan 1964, L.H. Daw-

son, 3 larvae. Cherry Co., Smith Falls, 27 Sep 1967, E.F. Rapp, Jr., 25 larvae.

NEW MEXICO, Río Arriba Co., Río Brazos at Brazos, 8 Jun 1974, Stark and Wolff, 3♂, 6♀.

OKLAHOMA, Paine Co., Stillwater, 11 Jun 1959, J.F. Reinert, 5♂, 1♀.

OREGON, Corvallis, 7 Apr 1907, Laura Hill, 1♂ (MCZ).

UTAH, Cache Co., Blacksmith Fork River, Blacksmith Fork Canyon, 4859 ft., 15 Oct 1961, A.V. Nebeker, 20 larvae. Salt Lake Co.,

Emigration Canyon (creek), 6100 ft., 16 Sep 1966, 8 larvae. Summit Co., Hidden Cove Pond, 14 Oct 1966, R.W. Baumann, 1 larva. Summit Co., Weber River, at Peoa bridge, 10 Nov 1961, 4 larvae; same, but 6191 ft., 14 Oct 1970, G. Yearsley, 25 larvae; same, but near Peoa, under rocks, 16 May 1974, B. Stark, 18♂, 10♀; same, but Peoa, 13 May 1976, Baumann et al., 2♂, 1♀ (CUC); same, but Rockport, 26 Jan 1976, Surdick and Daleboot, 5 larvae, 1♂ metamorphotype (decayed) (CUC). Uinta Co., Green River at Dinosaur National Monument, Aug 1967, S.L. Jensen, 6 larvae.

WASHINGTON, Nappel, 21 Apr 1940, J. Stanshish, 8♂ (UMSP). Kitatitas Co., Yakima River, ~10 mi. S Ellensburg, 28 May 1957, J.M. Campbell, 12♀. Spokane Co., Little Spokane River at Milan, 25 Jul 1962, G.F. Edmunds, 25 larvae.

WISCONSIN, Manitowish River, Boulder Junction, 2 Oct 1937, T.H. Frison, 8 larvae (INHS). Adams Co., Big Roche Creek, 8 Nov 1972, 7 larvae (UWM). Adams Co., Big Roche à Cri, 4 May 1970, 5♂, 1♀ (UWM). Bayfield Co., North Fork Fish Creek, 6 Oct 1979, 15 larvae (UWM). Bayfield Co., Lower Pine Creek, 12 May 1970, 4♂ (UWM). Buffalo Co., Church Valley, Hwy. D, 12 May 1970, 1♂ (UWM). Buffalo Co., Spring Creek, 1 Nov 1972, 30 larvae (UWM). Crawford Co., Baker Creek, Hwy. 61, Griffin Hollow, 29 Apr 1976, 1♂ (UWM). Dane Co., Mt. Vernon Creek, 13 Dec 1977, P.M. Kotila, 15 larvae (UWM). Dunn Co., Rock Creek, 1 Nov 1972, 6 larvae (UWM). Dunn Co., Eau Salle River, 4 May 1970, 5♂, 12♀ (UWM). Florence Co., Lamontangere Creek, 27 May 1970, 1♂ (UWM). Forest Co., Armstrong Creek, 13 Sep 1972, 4 larvae (UWM). Grant Co., Big Spring Brook, 20 Oct 1980, 6 larvae (UWM). Green Co., Braezels Brook, 5 Nov 1980, 30 larvae (UWM). Iowa Co., Trout Creek, 17 Oct 1979, 50 larvae. Iowa Co., 19 May 1937, F. Snyder, 4♂, 2♀ (UMSP). LaCrosse Co., Dutch Creek, 6 Nov 1980, 4 larvae (UWM). Langlade Co., Evergreen River, 17 Oct 1980, 10 larvae

(UWM). Marinette Co., Harvey Creek, 26 May 1970, 1♂, 1 pharate ♂ (UWM). Marquette Co., Neenah Creek, 2 Nov 1973, 5 larvae (UWM). Marquette Co., Chaffe Creek, 4 May 1970, 30♂ (UWM). Marquette Co., Lawrence Creek, 4 May 1970, 4♂, 4♀ (UWM). Monroe Co., Squaw Creek, Fort McCoy, 26 Jul 1976, J.C. Morse, 10 larvae (CUC). Polk Co., Cowen Creek, 22 Oct 1980, 10 larvae (UWM). Portage Co., Spring Creek, 1 Dec 1974, Todd and Taylor, 2 larvae (UTK). Richland Co., Branch Mill Creek, N Basswood, 29 Apr 1970, 25♂, 1♂ 1♀ in copula (UWM). Richland Co., Melanchton Creek, 27 Apr 1970, 9♂, 7♀ (UWM). Richland Co., Ryan Hollow, 29 Apr 1970, 10♂ (UWM). Richland Co., Grissal Creek, 15 May 1970, 1♂ (UWM). Richland Co., Core Hollow, 29 Apr 1970, 14♂ (UWM). Shawano Co., Silver Creek, Red River, 15 May 1979, 6 larvae, 13 pupae (UWM). Vernon Co., Sherry Creek, 15 May 1970, 1♂ (UWM). Vilas Co., Deerskin River, 15 Oct 1979, 15 larvae (UWM). Waushara Co., Soules Creek, 4 May 1970, 5♂ (UWM). Waushara Co., Little Pine Creek, Hwy. Y, 4 May 1970, 17♂ (UWM). Waushara Co., Bird Creek, Hwy. T, 4 May 1970, 4♂, 5♀ (UWM). Waupaca Co., Tomonow River, 1 Nov 1974, R. Glesne, 3 larvae (UTK). Waupaca Co., Roddy Creek, 19 Nov 1980, 15 larvae (UWM).

WYOMING, Shoshone River, Shoshone National Forest, 4 Sep 1977, 14 larvae (UMSP). Yellowstone National Park, Yellowstone River, swarm above canyon, 7 Apr 1925, A.C. Burrill, 2♂, 4♀; same, but Madison River (T135 R5E S36), 25 Apr 1963, J.R. Heaton, 11♂, 8♀; same, but Firehole River, 21 Aug 1962, P.J. Spangler, 10 larvae; same, but Black Sand Basin, 22 Jun 1977, Chapin and Morse, 1 larva (CUC); same, but Lewis River at Lewis Falls, 22 Jun 1977, 17♂, 1♀ (CUC). Natrona Co., Sweetwater River, Independence Rock, 21 Jun 1977 Chapin and Morse, 3 larvae (CUC).

CANADA, ALBERTA, Cochrane, 3770 ft., 10 Jun 1952, C.P. Alexander, 1♂ (UMA). Eyre-more, 5 May 1926, H.E. Gray, 1♂ 1♀ (MCZ).

BRITISH COLUMBIA, Bon Accord, 14 May, 1♂ (lectotype, MCZ); same, but 5 May, Russell, 1♂ (lectoparatype, MCZ). Oliver, 26 May 1923, C.B. Garrett, 2♂ 1♀ (MCZ). Nicola, 4 May 1923, E.R. Buckell, 1♂ (MCZ); same, but 16 May 1922, P.N. Vroom, 1♂ (MCZ). Nicola Lake, 29 May 1922, E.R. Buckell, 2♂ 1♀ (MCZ). Trail, 12 May 1927, A.A. Dennys, 1♂ (MCZ).

MANITOBA, Edwards Creek, Riding Mountain National Park, 11 Jun 1962, reared to 30 Jun 1962, G.B. Wiggins, 1 pupa (ROM). Norgate, stream on Hwy. 19, ~0.8 mi. W Hwy. 5, 6 Sep 1970, ROM field party, 50 larvae (ROM). McKinnon Creek, Hwy. 361 between Hwy. 5 and Riding Mountain National Park, 6 Sep 1970, ROM field party, 5 larvae (ROM). Cowan Creek, C5-2, 19 May 1980, D.G. Cobb, 5♂ (FWI).

NORTHWEST TERRITORIES, shore of MacKenzie River near Fort Providence Ferry, 16 Jul 1965, R.A. Evers, 3♂, 2♀ (INHS).

SASKATCHEWAN, mossy stream, Hwy. 224, ~4.5 mi. N Meadow Lake Provincial Park, Goodsoil, 16 Aug 1970, ROM field party, 2 larvae (ROM).

Brachycentrus (Sphinctogaster) chelatus Ross

FIGURES 57-63

Brachycentrus chelatus Ross, 1947:164.—Fischer, 1970:101.
Brachycentrus numerosus (Say).—Harris, Lago and Scheiring, 1982:81 [misidentification].

This species is provisionally placed in the *B. lateralis* (Say) subgroup because it lacks the macrochaetae on the tenth tergum. However, the apex of the clasper, especially in posteroventral aspect, is very similar in shape to that of species in the *B. numerosus* (Say) subgroup.

The genitalia of the male offer a number of distinctive characters. The tenth tergum is long and decumbent with the tip divided, and the clasper has a large basal area and its apex, in posteroventral aspect, shows a sharp point with a second, distinct lobe on the mesal margin.

The larvae are equally distinctive. The almost

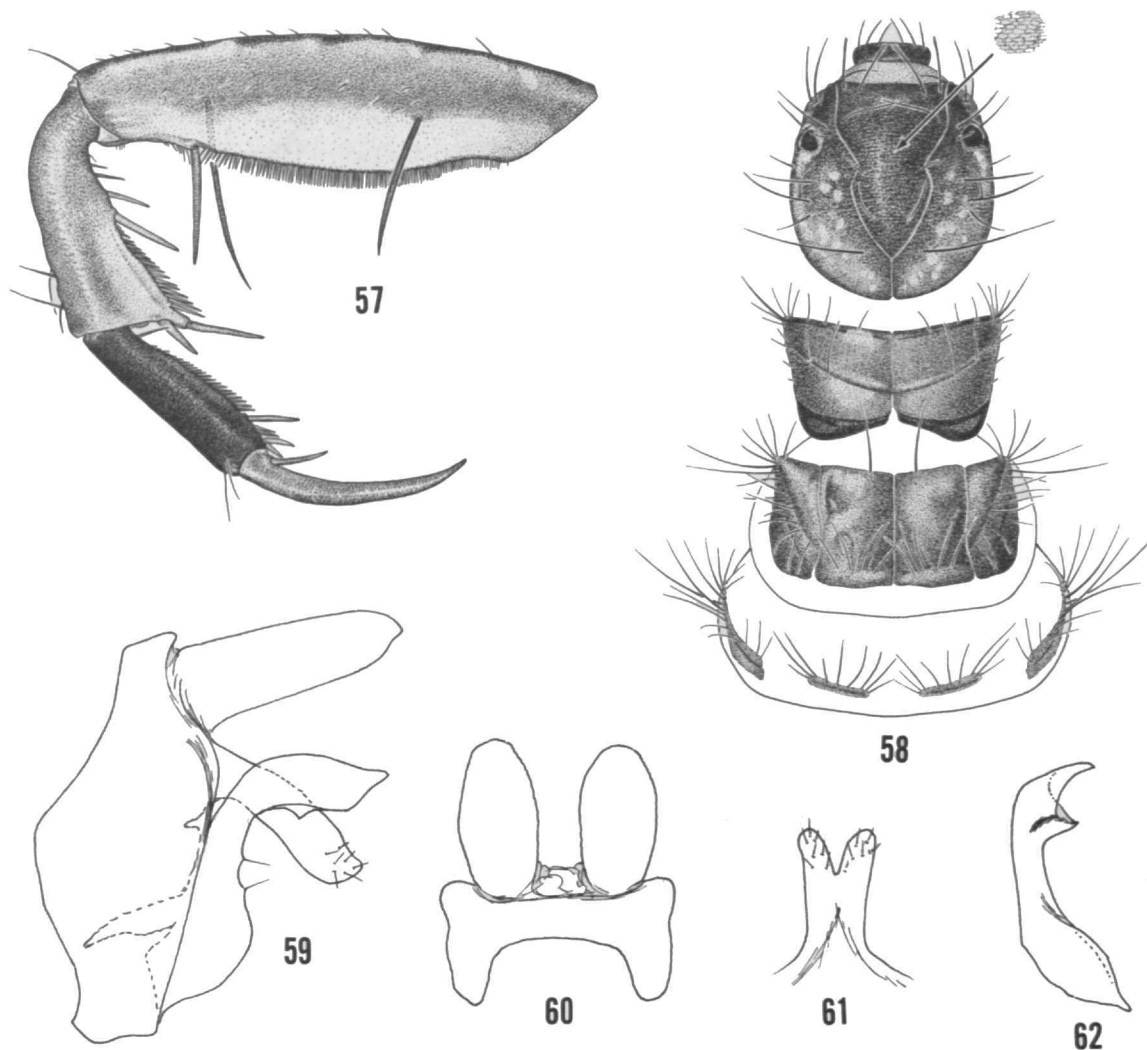
uniformly dark sclerites will separate it from most species. The roughened surface of the frontoclypeus and adjacent genae is unique in the North American species of the genus.

ADULT.—Length of forewing, ♂ 6-7 mm, ♀ 8-9 mm. Color fuscous, body and appendages fuscous, legs paler apicad; forewing fuscous, with larger and smaller cream-colored maculae. Male abdomen with seventh sternum bearing a small, posteromesal point or small, equilateral lobe.

Male Genitalia: Ninth segment lacks sternal lobe. Cercus elongate, tapering apicad in lateral aspect; in dorsal aspect cerci completely divided and well-separated mesally. Tenth tergum elongate, decumbent in lateral aspect; in dorsal aspect much longer than broad, tip divided, lateral lobes nearly twice as long as wide (in examples from western Florida, lobes are wider than long). Clasper with large basal area, apical area in lateral aspect with a small apicodorsal point; in posteroventral aspect with tip produced into a sharp point, from inner margin a pointed lobe subapically.

LARVA.—Length to 11 mm. Sclerites brown to fuscous; head brownish-fuscous, often with genae laterally and posteriorly paler than front, generally with muscle scars distinctly paler (sometimes not so); surface of frontoclypeus and genae mesad of primary setae granulate, except smooth over muscle scars; legs brownish-fuscous, mid- and hindlegs with tarsi distinctly infusate, femora with dorsal margin sometimes with a dark band, with ventral third paler than dorsal two-thirds. Femora of mid- and hindlegs with 3 enlarged setae; apico- and basodorsal setae only slightly larger than other dorsal setae; ventral margin with a uniform fringe. Tibiae of mid- and hindlegs with a series of 3-4 basoventral setae. Two pairs of submesal, ventral setae on first abdominal segment equal in size, but slightly larger than homologous setae on second segment. Lateral fringe present from third through sixth abdominal segment, with a very few hairs on seven. Gills single, arising in dorsal, lateral, and ventral rows.

TYPE MATERIAL.—Holotype, male, INHS: "Perry, Ga., 3-17-45, P.W. Fattig," "HOLO-



FIGURES 57-62.—*Brachycentrus chelatus* Ross: 57, larval hindleg; 58, larval head and thorax with detail of sculpturing of frontoclypeus; 59, male genitalia, lateral; 60, male ninth tergum and cerci, dorsal; 61, male tenth tergum, dorsal; 62, male clasper, postero-ventral.

TYPE *Brachycentrus chelatus* ♂ Ross." In alcohol, abdomen cleared, studied.

MATERIAL EXAMINED.—USA, ALABAMA, Escambia Co., Hall Creek, 4.5 mi. N Flomaton, 25 Mar 1981, Harris and O'Neil, 4♂ (SCHC, USNM). Escambia Co., Little Escambia Creek, Hwy. 31, 2 mi. E Flomaton, 25 Mar 1981, Harris and O'Neil, 2♂, 1♀ (SCHC, USNM). Mobile Co.,

Little Creek, 4 mi. SE Citronelle, 26 Mar 1981, Harris and O'Neil, 1♂ (SCHC). Mobile Co., Puppy Creek, Hwy. 217, 6 mi. SW Citronelle, 26 Mar 1981, Harris and O'Neil, 1♂ (SCHC).

FLORIDA, Okaloosa Co., Titi Creek, Rt. 211, Eglin Air Force Base, 22 Nov 1970, P. Carlson, 4 larvae (CUC). Santa Rosa Co., Coldwater Creek at Rt. S-194, 1 Feb 1969, J.B. Wallace et

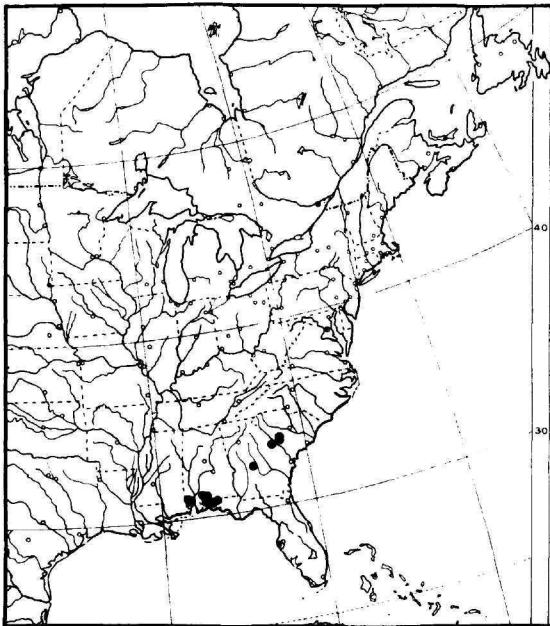


FIGURE 63.—Distribution of *Brachycentrus chelatus* Ross.

al., 5 larvae, 1♂ metamorphotype (UGA, VPI); same, but emerged 6 Feb 1969, 1♀ (UGA); same, but emerged 16 Feb 1969, 1♂ (UGA); same, but emerged 19 Feb 1969, 1♀ (UGA). Santa Rosa Co., Blackwater River State Forest, 10–11 Mar 1972, O.S. Flint, Jr., 1♂, 2♀. Santa Rosa Co., Blackwater River, Riley Landing, 3 mi. NW Holt, 8 Apr 1972, W.L. Peters et al., 10 larvae (CUC); same, but 9 May 1972, 1 larva (CUC); same, but 30 Oct 1971, 1 larva (CUC). Walton Co., Rocky Creek, Eglin Air Force Base, 14 Mar 1979, J. Schéiring, 12♂ (SCHC, USNM); same, but 20 Apr 1979, 2♂ (SCHC); same, but 11 May 1979, 12♂ (SCHC); same, but 14 Jul 1978, 12 larvae (SCHC, USNM).

GEORGIA, Perry, 17 Mar 1945, P.W. Fattig, 1♂ (holotype, INHS). Richmond Co., Ga. Rt. 56, 1.0 mi. S Augusta, 19 Feb 1970, Wallace and Sherberger, 4 larvae (UGA).

SOUTH CAROLINA, Aitken Co., Upper Three Runs Creek, Savannah River Plant, 29 Jan 1977, Herlong and Prichard, 1 larva (CUC); same, but 24 Feb 1978, 1♂ metamorphotype (CUC); same, but 26 Feb 1977, 1 larva, 1♂, 1♀ metamorpho-

types (CUC); same, but 11 Mar 1977, 200♂♀ (CUC); same, but 29 Mar 1977, 2♂, 4♀ (CUC); same, but 8 Jul 1977, 100 larvae (CUC); same, but 22 Aug 1977, 100 larvae (CUC); same, but 6 Nov 1976, 1 larva; same, but 14 Dec 1976, 1 larva; same, but 19 approximately biweekly collections between 10 May 1979 and 16 Feb 1980, Kelley and McEwan, hundreds of larvae (CUC); same, but 30 Aug 1980, R.W. Holzenthal, 12 larvae (CUC); same, but 26 Sep 1981, L.E. Schimmel, 5 larvae (CUC); same, but Lower Three Runs Creek, 27 Nov 1979, Kelley and McEwan, 14 larvae (CUC). Aiken Co., Hollow Creek, near Jackson, 3 Jun 1981, S.W. Hamilton, 10 larvae (CUC); same, but 4 Sep 1976, J.W. Chapin, 10 larvae (CUC). Aiken Co., S.C. Rt. 125, NW Jackson, 1 Apr 1970, Wallace et al., 31♂ 6♀ (UGA).

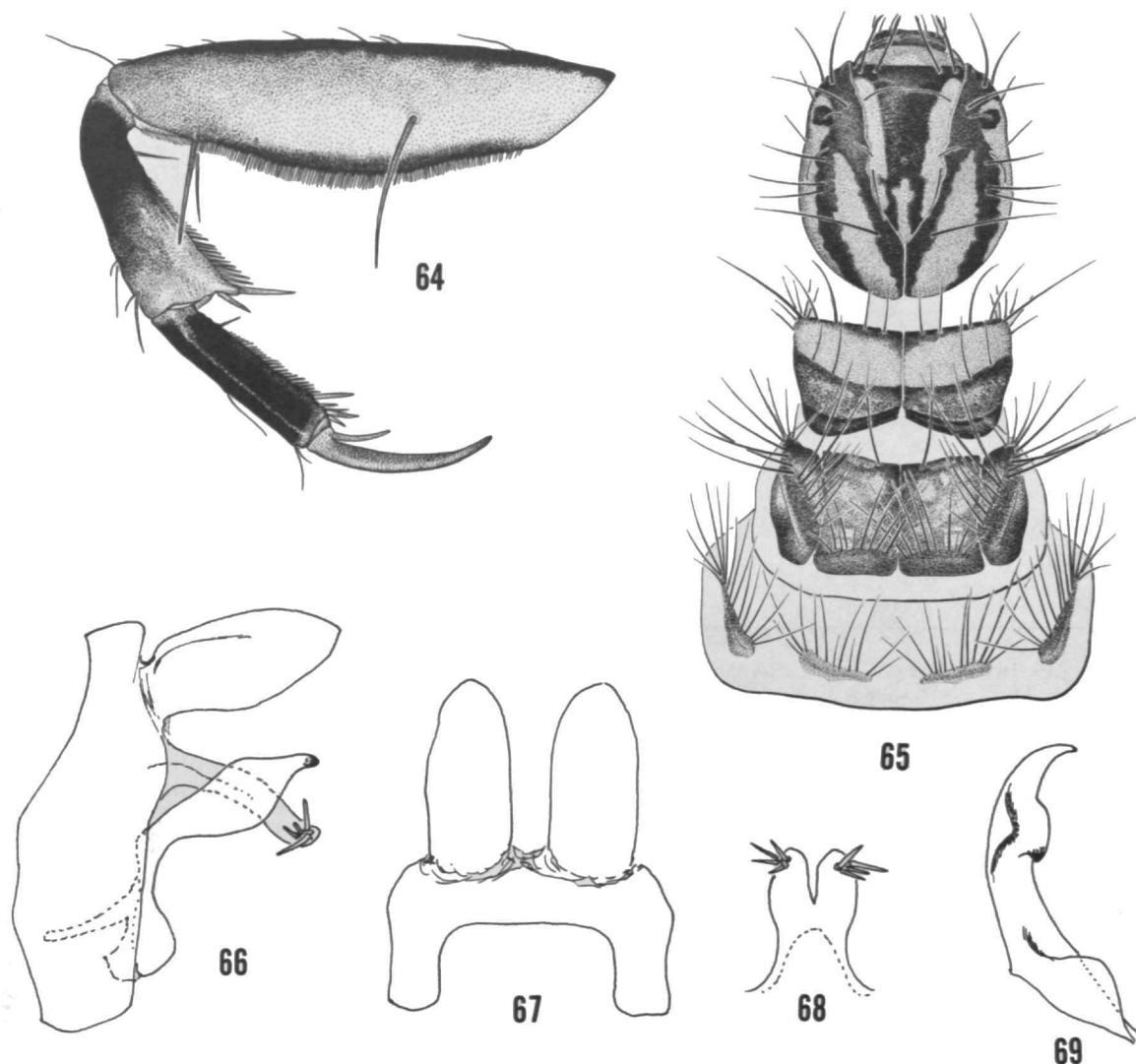
Brachycentrus (Sphinctogaster) appalachia,
new species

FIGURES 64–70

This species is placed in the *numerosus* subgroup, where it is most similar to *B. spiniae* in terms of the number of macrochaetae on the tenth tergum, but more like *B. numerosus* in the shape of the clasper. In *B. appalachia* there is no dorsal and ventral flap at the tip of the clasper as in *B. spiniae*, only a single continuous mesal margin from the apical point through a long, but shallow, subapical lobe.

The larvae are very strikingly colored and at first sight appear to be *B. lateralis* or *B. incanus*, but differ in possessing totally differently colored legs. The tibiae and tarsi of the mid- and hindlegs are striking annulate, rather than pale with a narrow, dorsal, dark band. From examples of *B. numerosus* and related species it differs in possessing only one basomesal seta on the tibia of the mid- and hindlegs.

ADULT.—Length of forewing, ♂ 7–8 mm, ♀ 8–10 mm. Color, male: body and appendages fuscous, legs paler apicad, forewing fuscous with pale marks; female, pale, body stramineous, head and thorax dorsomesally infuscate, forewing pale grayish. Seventh sternum of male abdomen with



FIGURES 64-69.—*Brachycentrus appalachia*, new species: 64, larval hindleg; 65, larval head and thorax; 66, male genitalia, lateral; 67, male ninth tergum and cerci, dorsal; 68, male tenth tergum, dorsal; 69, male clasper, posteroventral.

a large posteromesal lobe, broader than long.

Male Genitalia: Ninth segment without a sternal lobe. Cercus elongate, ovoid; cerci totally divided and separated mesally in dorsal aspect. Tenth tergum elongate, narrow in lateral aspect; in dorsal aspect deeply divided apicomically, each lobe rounded apically with 3-4 macrochaetae. Clasper with a large basal area, apex pro-

duced into a short point in lateral aspect; in posteroventral aspect with a subapical, lateral, trianguloid flap, apex produced into a point, mesal margin with a narrow, long lobe subapically.

LARVA.—Length to 12 mm. Sclerites golden-yellow, contrastingly marked with fuscous; frontoclypeus with narrow, pale bands laterally from

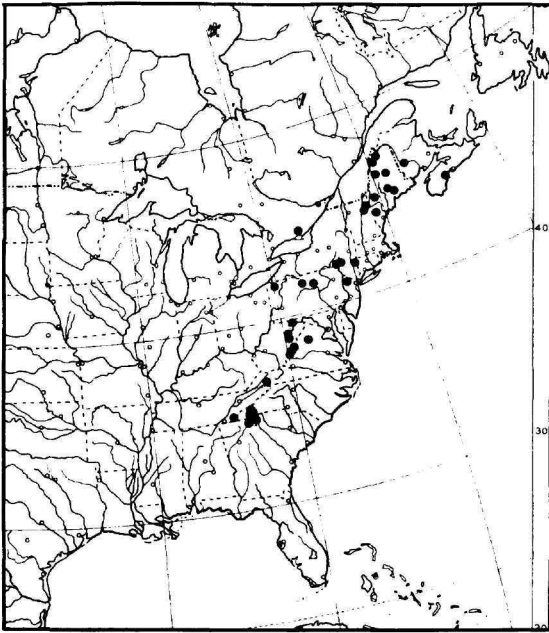


FIGURE 70.—Distribution of *Brachycentrus appalachia*, new species.

anterior margin near apex, gena with a narrow, dark band along frontoclypeal suture and in a band from eye posteriad, gula and adjacent narrow band on gena ventrally fuscous; legs mostly golden yellow with tarsi of mid- and hindlegs fuscous, tibiae fuscous for basal half, femora with a fuscous dorsal margin. Femora of mid- and hindlegs with 3 enlarged setae, apico- and basodorsal setae only slightly larger than other dorsal setae; ventral margins with uniform setal fringes; tibiae with a single basomesal seta (many populations from the Carolinas have a second small seta here). Two pairs of submesal setae on venter of first abdominal segment equal in size, distinctly larger than homologous setae on segment two. Lateral fringe present from third through sixth segments. Gills single, arising in dorsal, lateral, and ventral rows.

TYPE MATERIAL.—*Holotype* (male): WEST VIRGINIA, Randolph Co., Cheat Bridge at Rt. 250, 17 May 1963, Field and Flint. USNM Type 101320.

Paratypes: GEORGIA, Tallulah River, 9 mi. N Clarkesville, 3 Apr 1949, Ricker and Scott, 1♂ (INHS). MAINE, Washington Co., Narraguagus River, 26 May 1978, T. Mingo, 33♂ (UMO, USNM, ROM, INHS); same, but 27 May 1978, 3♂ (USNM). NEW HAMPSHIRE, Jefferson, 20 Jun 1964, black light, 1♂ (UNH). NORTH CAROLINA, Swain Co., Oconoluftee River, Cherokee, 6 May 1978, Chapin, Herlong and Hudson, 3♂, 4♀ (CUC). Soco River, near Cherokee, 21 Apr 1949, W.E. Ricker, 1♂ (INHS). PENNSYLVANIA, Lycoming Co., Trout Run, Rt. 15, 9 May 1982, P.H. Adler, 1♂. SOUTH CAROLINA, Oconee Co., Chattooga River at Rt. 28, 4 Apr 1976, J.W. Chapin 4♂ (CUC); same, but 9 Apr 1978, 41♂, 18♀ (CUC, USNM); same, but 10 Apr 1976, 1♂ (CUC); same, but 14 Apr 1978, 2♂, 10♀ (CUC); same, but 16 Apr 1978, 4♂, 9♀ (CUC).

OTHER MATERIAL.—USA, MAINE, Aroostook Co., St. John River, Dickey, 22 Sep 1977, St. John River Survey Party, larvae (UMO). Aroostook Co., St. John River, Allagash, 22 Sep 1977, St. John River Survey Party, larvae (UMO). Aroostook Co., St. John River, Seven Islands, 23 Sep 1977, St. John River Survey Party, larvae (UMO). Aroostook Co., Ninemile Brook at Ninemile bridge, 22 Sep 1977, St. John River Survey Party, larvae (UMO). Aroostook Co., Big Black River at Shields Branch, 22 Sept 1977, St. John River Survey Party, larvae (UMO). Aroostook Co., Chimenticook Stream below Little East Lake, 26 Sep 1977, St. John River Survey Party, larvae (UMO). Aroostook Co., Campbell Branch, Little Black River, 23 Sep 1977, St. John River Survey Party, larvae (UMO). Franklin Co., Crossman Stream, Rt. 4, Madrid, 4 Oct 1978, T.M. Mingo, larvae (UMO). Oxford Co., Durgin Brook, Rt. 160, Brownfield, 19 Sep 1978, T.M. Mingo, larvae (UMO). Penobscot Co., Sunkhaze Stream, 10 mi. E Milford, 11 Sep 1978, T.M. Mingo, larvae (UMO); same, but 20 Mar 1980, larvae (UMO). Penobscot Co., Baker Brook, 5 mi. E Milford, 11 Sep 1978, T.M. Mingo, larvae (UMO). Penobscot Co., Penobscot River, Brown Islands, Winn, 18 Jul 1980, T.M. Mingo, larvae (UMO). Piscataquis Co., Bear Brook, Rt. 11 at

turnoff to W Seboeis Lake, 14 Sep 1978, T.M. Mingo, larvae (UMO). Piscataquis Co., Telos Stream, Telos Road, 19 Oct 1978, T.M. Mingo, larvae (UMO). Piscataquis Co., Abol Stream, Park Perimeter Road, Baxter State Park, 29 Oct 1978, T.M. Mingo, larvae (UMO). Piscataquis Co., Nesowadnehunk River, Kidney Pond Bridge, Baxter State Park, 29 Aug 1979, T.M. Mingo, larvae (UMO); same, but 7 Sep 1979, larvae (UMO); same, but 13 Sep 1979, larvae (UMO). Piscataquis Co., Nesowadnehunk River, 1 mi. above Kidney Pond Bridge, Baxter State Park, 15 Aug 1979, T.M. Mingo, larvae (UMO). Piscataquis Co., Nesowadnehunk River, ¼ mi. below Roaring Brook, Baxter State Park, 29 Aug 1979, T.M. Mingo, larvae (UMO). Piscataquis Co., Nesowadnehunk River, Ledge Falls, Baxter State Park, 29 Aug 1979, T.M. Mingo, larvae (UMO). Somerset Co., North Branch Penobscot River, Golden Road, Comstock Township, 18 Oct 1978, T.M. Mingo, 2 larvae (UMO). Washington Co., Narraguagus River, 19 Apr 1974, T. Mingo, 4 larvae; same, but Island Site (1 mi. S Rt. 9 bridge), 29 Apr 1978, 100 larvae (UMO); same, but 5 May 1978, 100 larvae, 10 prepupae (UMO); same, but 20 May 1978, 2 larvae, 60 prepupae (UMO); same, but 26 May 1978, 2 larvae, 10 ♂ metamorphotypes, 45 empty cases (UMO, USNM).

MARYLAND, Garrett Co., Savage River at Big Run Campground, 17 Apr 1968, Yamamoto and Odum, 1 prepupa (ROM).

NEW HAMPSHIRE, Ammonoosuc River, Zealand Campground, 11 Jun 1957, O.S. Flint, Jr., 2 pupae; same, but 3 Aug 1958, 5 larvae, 1 pupal case; same, but 25 Aug 1957, 50 larvae. Franconia, 20 Aug 1947, B.D. Burks, 3 larvae (INHS). Mill Brook, Cherry Mountain, 18 Aug 1934, W.H. Anderson, 2 larvae (INHS).

NEW JERSEY, Pequest River, Rt. 46, Townsbury, 10 Jun 1956, J.F. Hanson, 1 larva.

NEW YORK, Willewemoc River, 1.5 mi. W DeBruce, Neff and Collette, 1♀ metamorphotype. Willewemoc River, Roscoe, 7 May 1977, 2:30 P.M., L. Solomon, 2♀. Little Beaverkill, Roscoe, 13 Feb 1977, L. Solomon, 8 larvae; same,

but reared to 8 Mar 1977, ♀ emerged, 2 cases with sclerites. Beaverkill, Roscoe, 18 Sep 1976, L. Solomon, 9 larvae; same, but 29 Apr 1977, 1♀. Beaverkill, Rockland, 6 Dec 1959, Flint and Nowosielski, 1 larva. Beaverkill, East Branch, 6 Dec 1959, Flint and Nowosielski, 30 larvae. Beaverkill, Horton, 5 May 1979, emerging 3:00–5:00 P.M., L. Solomon, 16♀. Dutchess Co., Wappingers Creek, Stanfordville, 17 Apr 1976, L. Solomon, 3♀ metamorphotypes, 4 pupae, 10 cases.

NORTH CAROLINA, Macon Co., Cullasaja River, Hwy. 28, 5 Nov 1977, Etnier et al., 2 larvae (UTK). Swain Co., Oconoluftee River, Rt. 19, 1 mi. W Cherokee, 13 Feb 1977, J.W. Chapin, 3 larvae (CUC); same, but 17 Mar 1977, 2 larvae (CUC); same, but 19 Mar 1977, 6 prepupae (CUC); same, but 22 Apr 1977, 1♂ metamorphotype (CUC); same, but 29 Apr 1978, 2♂, 2♀ metamorphotypes (CUC); same, but 16 Oct 1976, 6 larvae (CUC); same, but 13 Nov 1976, 4 larvae (CUC); same, but 2 mi. W Cherokee, 13 Feb 1977, 3 larvae (CUC).

PENNSYLVANIA, Potter Co., Kettle Creek, Cross Fork, 26 Aug 1963, J.H. Graffius, 1 larva. Venango Co., Sugar Creek, 23 Nov 1982, J. Busch, 53 larvae; same, but 2 Jan 1983, 15 larvae. Penna, summer 1976, E. Kupsky, 9 larvae (CUC).

SOUTH CAROLINA, Whitewater River, Jocassee, 9 Mar 1966, R. Prins, 3 larvae (CUC). Oconee Co., Chattooga River at Rt. 28, 9 Apr 1978, J.W. Chapin, 1♂ metamorphotype, 3 pupae (CUC); same, but 10 Apr 1976, 1♂ metamorphotype (CUC); same, but 9 Sep 1976, 5 larvae (CUC); same, but 10 Nov 1976, 3 larvae (CUC).

TENNESSEE, Polk Co., Ocoee River, Copper Hill, 11 Mar 1973, W. Pennington, 6 larvae (UTK). Polk Co., Fightingtown Creek, 3 Nov 1974, J. Foster, 1 larvae (UTK).

VIRGINIA, Monterey, 28 Sep 1936, T.H. Frison, 3 larvae (INHS). Alleghany Co., Jackson River, Rt. 220, 2 Jul 1976, R. Graney, 1 larva (VPI). Alleghany Co., Potts Creek, Rt. 18, 5 mi. SW Jordan Mines, 4 Oct 1967, Yamamoto and Odum, 40 larvae (ROM); same, but 11 Aug

1968, Yamamoto and Kohalmi, 15 larvae (ROM). Bath Co., Jackson River, near Rt. 603 bridge, Aug 1973, B. Strickler, 2 larvae; same, but Rt. 603, 2 mi. S Rt. 687, 11 Sep 1979, C.M. and O.S. Flint, Jr., 25 larvae. Bath Co., Back Creek, Rt. 43, 8 Oct 1972, R. Strickler, 1 larva (VPI). Bath Co., Blowing Spring Camp, 8 mi. W Warm Springs, 10 Sep 1979, C.M. & O.S. Flint, Jr., and B. Kondratieff, 11 larvae (USNM, VPI); same, but 5 Oct 1967, Yamamoto and Odum, 50 larvae (ROM); same, but 11 Aug 1968, Yamamoto and Kohalmi, 50 larvae (ROM). Highland Co., Cowpasture River, 3 mi. N Williamsville, 27 Jul 1974, M.M. Davis, 6 larvae. Highland Co., Back Creek, 8 mi. N Bacova, 2 Jul 1976, P.K. Powell, 2 larvae (VPI). Highland Co., Jackson River, Rt. 84, 5 mi. SW Monterey, 5 Oct 1967, Yamamoto and Odum, 50 larvae (ROM). Madison Co., Rapidan River, Graves Mill, 800 ft., 18 Apr 1975, C.M. and O.S. Flint, Jr., 4 pupae. Smyth Co., South Fork Holston River, Jct. Rt. 660 and 600, 19 Aug 1979, J.R. Voshell, 10 larvae (VPI).

WEST VIRGINIA, Shavers Fork, Stuart Recreation Area near Elkins, 26 May 1962, T.J. and R.E. Spilman, 2 empty cases with sclerites.

CANADA, New Brunswick, Meductic, 25 Aug 1939, T.H. Frison and Frison Jr., 1 larva (INHS).

NOVA SCOTIA, Chester Basin, 23 Aug 1939, T.H. Frison and Frison Jr., 1 larva (INHS).

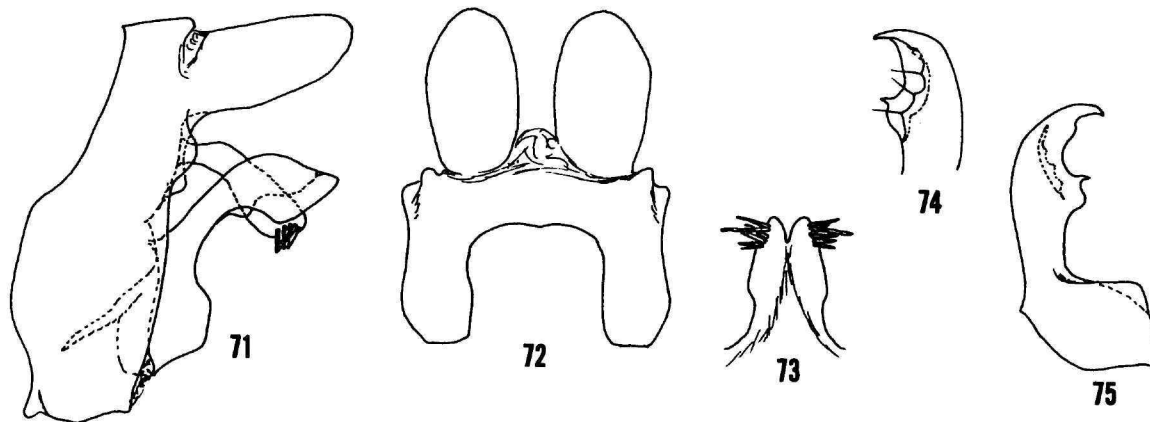
ONTARIO, Hastings Co., Thurlow Twp., Moira River, Latta, 6 Jun 1975, Wiggins et al., 50 larvae (ROM); same, but 20 Jun 1972, ROM field party, 20 larvae (ROM); same, but 27 Jun 1971, G.B. Wiggins, 25 larvae (ROM); same, but 3 Jul 1979, Schefter and Richardson, 3 larvae (ROM); same, but 15 Oct 1968, Wiggins and Barr, 50 larvae (ROM).

Brachycentrus (Sphinctogaster) spinae Ross

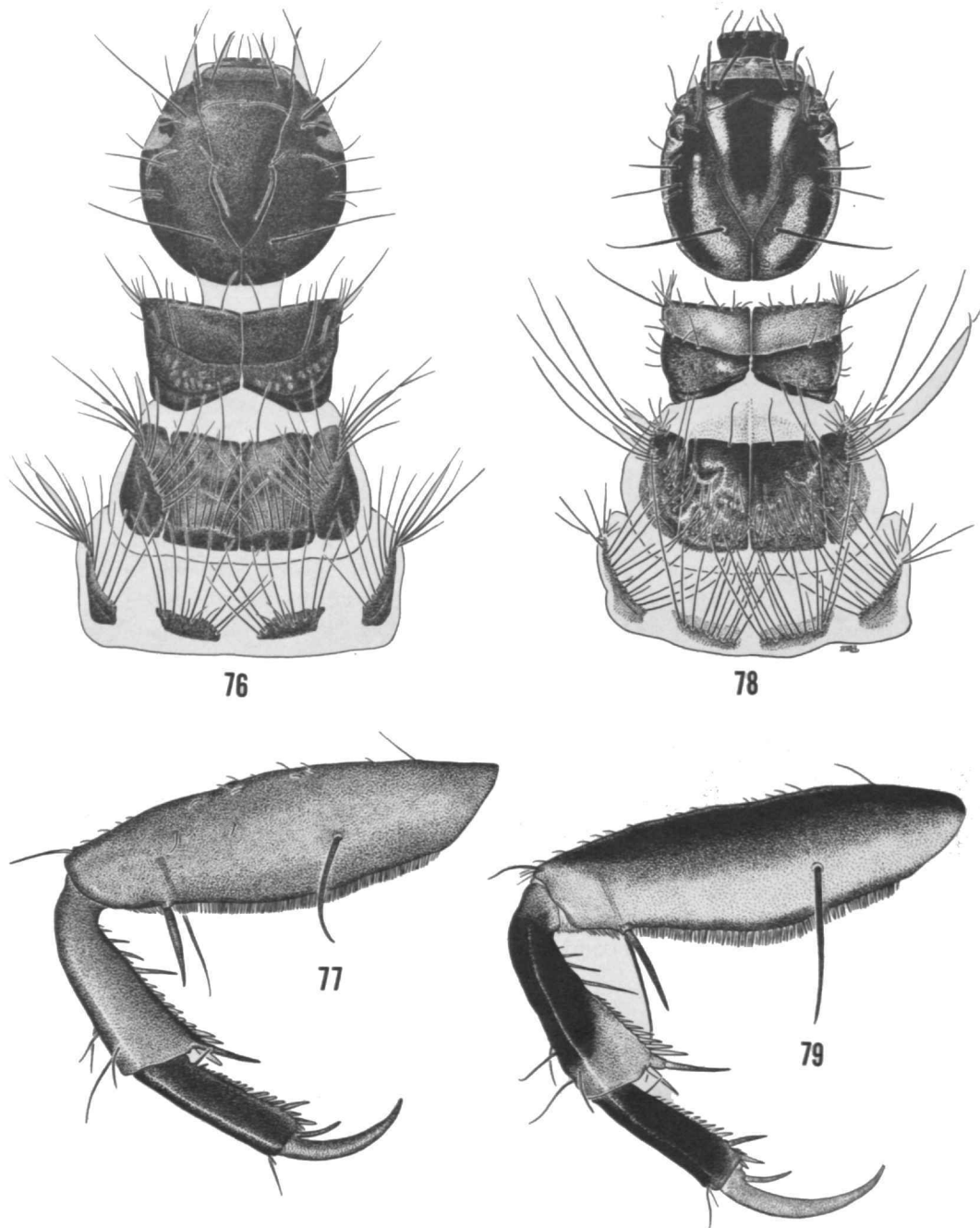
FIGURES 2, 71-80

Brachycentrus spinae Ross, 1948:153.—Fischer, 1970:111.

B. spinae Ross and *B. appalachia* new species appear to be sister species of the *B. numerosus* (Say) complex, sharing the derived character state of multiple macrochaetae on the tenth tergum and development of the mesal margin of the clasper into a small lobe subapically. They differ in details of the shapes of the tenth tergum and cerci, and especially in the apex of the claspers. In *B. spinae* Ross there is a thin, dorsal, shelflike flap in addition to the ventral one, which is more strongly developed, resulting in an almost semicircular excision in the mesal margin



FIGURES 71-75.—*Brachycentrus spinae* Ross: 71, male genitalia, lateral; 72, male ninth tergum and cerci, dorsal; 73, male tenth tergum, dorsal; 74, tip of clasper, dorsal; 75, male clasper, posteroventral.



FIGURES 76-79.—*Brachycentrus spinae* Ross: 76, larval head and thorax, dark-headed form; 77, larval hindleg, dark-headed form; 78, larval head and thorax, typical form; 79, larval hindleg, typical form.

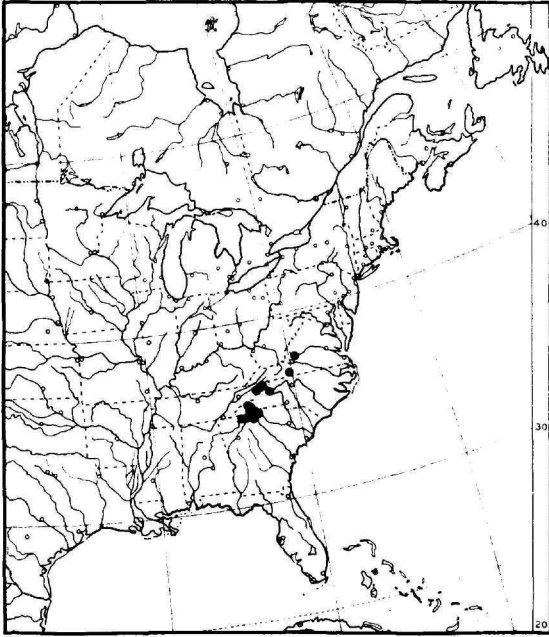


FIGURE 80.—Distribution of *Brachycentrus spinae* Ross.

of the clasper in posteroventral aspect.

The variability within this species, as I recognize it here, is extremely perplexing. There are certain populations whose mature larvae differ strikingly from the typical larvae of *B. spinae*. These larvae (Figures 76–77) have a head uniformly dark brown and quite round in outline. Adults associated by metamorphotypes with these larvae offer only minor differences in the shape of the apex of the tenth tergum and lobe on the mesal margin of the clasper. However, the few collections of adults show all possible assortments of these small differences in genital structure. A number of larval collections are also rather intermediate in that the heads are clearly elongate and almost uniformly brown, but with slight paling at the sites of the pale marks of typical *B. spinae*. Because the extreme of both adult and larval differences appear to be connected by intermediate forms or mixtures of characteristics, I am considering this one surprisingly variable species. Perhaps many more careful rearings and long series from many localities

will prove otherwise. Therefore, under material examined I am separating the records of those clearly referring to the round-headed form and the intermediate form from the typical form.

The round-headed, dark, larval form is easily distinguished from the larvae of all other species by these characteristics. The larvae of the typical form are very similar to those of *B. numerosus* from which they may be separated by the differently marked legs and lack of distinct apical cluster of pale muscle scars on the frontoclypeus. From *B. solomoni*, new species, whose larvae are not always separable, *B. spinae* differs in general by having the pale head marks more elongate, on occasion even approaching the appearance of *B. appalachia*, new species.

ADULT.—Length of forewing, ♂ 9.5–11 mm. Color in alcohol, fuscous, with an indication of a paler subapical area on the forewing. Male abdomen with seventh sternum bearing a broad, nail-like posteromesal lobe.

Male Genitalia: Ninth segment without a sternal lobe. Cercus elongate, tapering; cerci in dorsal aspect completely divided and separated on midline, almost oval in outline. Tenth tergum elongate, narrow, slightly broader apicad in lateral aspect; in dorsal aspect divided apicomesally, apices of lateral lobes rounded, with 8–12 macrochaetae each. Clasper with a large basal area, apex broad, obliquely truncate in lateral aspect; in posteroventral aspect apex produced into a sharp point, mesal margin concave, with a small point surmounting a small, narrow, ventral, shelflike flap, with a narrow, dorsal shelflike flap.

LARVA.—Length to 11 mm. Sclerites mostly dark brown or fuscous marked with paler, yellowish bands; frontoclypeus paler laterad, bright yellowish anteriorly to midlength constriction, indistinctly paler posteriorly; gena darkest near frontoclypeal suture and in a band posteriorly of eye, indistinctly paler posteriorly; gena darkest near frontoclypeal suture and in a band posteriorly of eye, indistinctly paler between bands, laterally, and ventrally; heads of certain populations uniformly dark brown, nearly circular in outline, in other populations heads more elongate, light

brown often much paler in areas of pale marking mentioned above. Legs dark, mid- and hindlegs with fuscous tarsi, tibiae reddish-brown for apical third, fuscous for basal $\frac{2}{3}$, femora reddish-brown on ventral half, fuscous on dorsal half. Femora of mid- and hindlegs with 3 enlarged setae; apico- and basodorsal setae only slightly enlarged over other dorsal setae; ventral fringe uniform. Tibiae of mid- and hindlegs with basoventral row of 3–4 setae. Two pairs of submesal setae on first abdominal venter equal in size, larger than homologous setae of second segment. Lateral fringe present from third through sixth segments. Gills single in dorsal, lateral, and ventral rows.

TYPE MATERIAL.—Holotype, male, INHS: "Camp Creek Greene Co, Tenn. Apr. 24, 1947 Light trap Mike Wright," "*Holotype* *Brachycentrus spinae* ♂ Ross." In alcohol, abdomen cleared, studied.

MATERIAL EXAMINED.—*Typical Form*: USA, NORTH CAROLINA, Old Fort, bridge NW of town, 1 Apr 1971, J.C. Morse, 1 prepupa (CUC). Tuckasegee River, Dillsboro, 4 Apr 1949, W.E. Ricker, 1♂ (INHS). Great Smoky Mountains National Park, Deep Creek Campground, 14–21 May 1970, O.S. Flint, Jr., 1♂. Burke Co., Linville Gorge, 13 May 1970, D. Ambrose, 1♂ (UTK).

SOUTH CAROLINA, Pickens Co., Rocky Bottom Creek, at S-39-100, 9 Apr 1976, J.W. Chapin, 2 pupae, 5♂, 3♀ metamorphotypes (CUC).

TENNESSEE, Greene Co., Camp Creek, 24 Apr 1947, Mike Wright, ♂ holotype (INHS); same, but 22 Apr 1947, 12♂ paratypes (INHS); same, but 27 Apr 1947, 36♂ paratypes (INHS); same, but 0.5 mi. south Camp Creek Community Store, 9 Apr 1976, Knauth et al., 3♂ metamorphotypes, 3 pupae, 1 prepupa (UTK); same, but 0.4 mi. SE Camp Creek, 14 Nov 1982, J. and C. Louton, 200 larvae; same, but upper bridge crossing, 16 Nov 1982, Melgaard and Wojtowicz, 25 larvae. Carter Co., Watauga River, Elizabethton, 21 Oct 1981, Melgaard and Wojtowicz, 5 larvae; same, but Hunter Bridge, 15 Oct 1981, 5 larvae.

VIRGINIA, Amherst Co., Otter River, 10 Sep 1975, R.E. Smithson, Jr., 1 larva (VPI). Patrick Co., Rock Castle Creek, 15 Mar 1974, L. Town-

send, 1 larva, 1 pupa (VPI).

Dark Headed Form: USA, GEORGIA, Towns Co., Soapstone Creek, Hwy. 66, 2.4 mi. SW Hwy. 17, 7 Mar 1981, S.W. Hamilton, 20 larvae (CUC).

NORTH CAROLINA, Cherokee Indian Reservation, Oconaluftee River at Cherokee, 6 May 1978, Chapin, Herlong and Hudson, 23♂, 15♀, 4♂, 1♀ metamorphotypes, 14 pupae; (CUC, USNM); same but mass reared 7 May 1978, 1♂, 1♀ (CUC); same, but 29 Apr 1978, 12 pupae. Bradley Fork of Oconaluftee River at Smoke-mont Campground, GSMNP, 2 Oct 1967, Yamamoto and Odum, 50 larvae (ROM). Swain Co., Oconoluftee River, Rt. 19, 2 mi. W Cherokee, 17 Mar 1977, J.W. Chapin, 1 larva (CUC); same, but 1 mi. W Cherokee, 29 Apr 1978, 1♀ metamorphotype (CUC). Macon Co., Coweeta Hydrolab, 5 May 1972, R. Baer, 1♂ metamorphotype, 1 pupa (VPI); same, but 21 Apr 1973, 3 pupal cases with sclerites (ROM); same, but Shope Creek, 16 Feb 1976, R. McKay, 6 larvae (ROM); same, but 24 Apr 1976, 1♂ metamorphotype (UGA); same, but 27 Nov 1974, J.B. Wallace, 6 larvae (UGA); same, but Shope Creek, 3 mi. W Otto, 24 Apr 1953, 9♂, 4♀ (INHS). Davidson River, Brevard, 29 Sep 1961, J.A. Payne, 2 larvae (CUC, USNM); same, but 8 Oct 1961, N.H. Anderson, 25 larvae (CUC). Brevard, 8 Oct 1961, R.E. O'Brien, 3 larvae (CUC). Transylvania Co., Davison River, 26 Dec 1974, W. Pennington, 3 larvae (UTK). Jackson Co., Chattooga River, 28 Aug 1938, T. Howell, 3 larvae (INHS). Cashiers, Green's Creek, 11 Sep 1958, Flint and Wiggins, 15 larvae (ROM); same, but 14 Sep 1958, 8 larvae (ROM).

SOUTH CAROLINA, Oconee Co., Chattooga River, Rt. 28, 5 Aug 1976, J.W. Chapin, 2 larvae (CUC); same, but 10 Nov 1976, J.W. Chapin, 1 larva (CUC). Oconee Co., Chattooga River, Burrell's Ford, 2 Sep 1978, M.J. Rowlands, 2 larvae (CUC); same, but 27 Sep 1978, 2 larvae (CUC); same, but Ellicott's Rock, 27 Sep 1978, 4 larvae (CUC). Pickens, 8 Oct 1961, M.P. Nolan, 2 larvae (CUC).

Intermediate Form: USA, GEORGIA, Union

Co., Cooper Creek at Tom Jones Branch, 25 Sep 1972, C.E. Dunn, 25 larvae (ROM).

NORTH CAROLINA, Macon Co., Burning Town Creek, 26 Jul 1939, T. Howell, 5 larvae (INHS). Macon Co., Kimsey Creek, Standing Indian Campground, 28 Jul 1979, J. Morse, 2 larvae (CUC). Swain Co., Deep Creek, 16 Aug 1939, T. Howell, 12 larvae (INHS); same, but camping area, GSMNP, 13 Sep 1958, Flint and Wiggins, 25 larvae (ROM). Transylvania Co., Davidson River, off Rt. 276, 5 Aug 1982, B. Kondratieff, 50 larvae (VPI).

Brachycentrus (Sphinctogaster) numerosus (Say)

FIGURES 3, 81–88

Phryganea numerosa Say, 1823:160.

Brachycentrus numerosus (Say).—Hagen, 1868:272.—Ross, 1944:264.—Fischer, 1970:109.

B. numerosus (Say), *B. etowahensis* Wallace, and *B. solomoni* new species, form a very closely related group of species, separable with difficulty in the adult stage. In the male genitalia, *B. numerosus* may be recognized by the divergent apices of the tenth tergites, the only slightly enlarged apex of the clasper and lack of a subapical lobe on the inner margin of the clasper when seen in ventral aspect.

The larvae of *B. numerosus* are similar to *B. etowahensis* Wallace in the coloration of the legs, but quite different from *B. solomoni*, new species, in this character. However, *B. etowahensis* is easily distinguished as it possesses 5–7 major setae, rather than 3, on the mid- and hindfemora. The coloration of the heads of all three also differ slightly, with *B. numerosus* being the species with the most extensive pale markings. In fact the species is quite variable in appearance with many specimens virtually lacking all dark banding on the posterior half of the genae.

ADULT.—Length of forewing, ♂ 8–10 mm, ♀ 11–12.5 mm. Color fuscous, tibiae and tarsi paler; forewing fuscous marked with paler spots and bands. Seventh sternum of male ab-

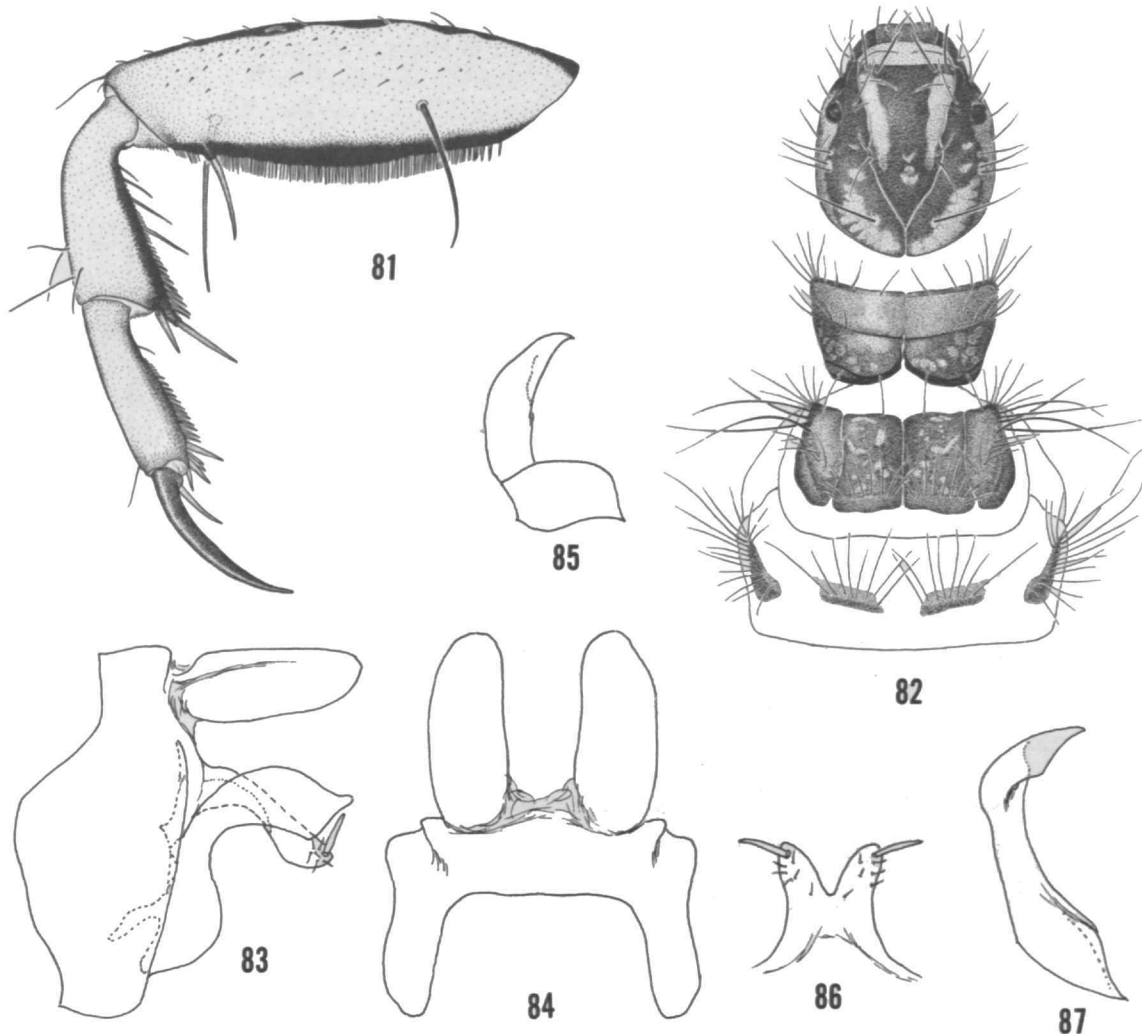
domen with a posteroventral, nail-like lobe, often small and trianguloid.

Male Genitalia: Ninth segment lacking a sternal lobe. Cercus elongate, slightly tapered; cerci in dorsal aspect completely divided and separated mesally, elongate ovoid. Tenth tergum elongate, enlarged apicad in lateral aspect; in dorsal aspect deeply divided apicomessally, lobes divergent, each as long as wide with 1 macrochaeta (rarely with a second small one on one or both sides). Clasper with a large basal area, apex only slightly enlarged, with tip pointed in lateral aspect; in ventral aspect with tip developed into a mesally-directed sharp point, inner margin without any subapical lobe.

LARVA.—Length to 12 mm. Sclerites dark brown to fuscous, marked with yellow longitudinal bands; frontoclypeus yellow laterally, especially anterior to midlength constriction, with a cluster of yellow muscle scars posteromesally; gena dark next to frontoclypeus, in a band posteriad from eye (dark bands often obsolete posteriad, in which case occipital region of head is broadly yellow) and again ventrolaterally and ventrally, yellow between bands; legs yellow, with ventral margins of mid- and hindfemora, tibiae and tarsi and dorsal margin of femora, fuscous. Femora of mid- and hindlegs with 3 enlarged setae; apico- and basodorsal setae enlarged over other dorsal setae; ventral fringe uniform. Tibiae of mid- and hindlegs with a basomesal row of 4–5 setae. Two pairs of submesal setae on venter of first abdominal segment of equal size, slightly larger than homologous setae of second segment. Lateral fringe present from third through sixth segments, with small tufts of hair posteriad on seven. Gills single, in dorsal, lateral and ventral rows.

TYPE MATERIAL.—Neotype, male, INHS: published as "Momence, Illinois: May 4, 1937, Ross and Mohr." Type not seen; topotypes with same data studied.

MATERIAL EXAMINED.—USA, ALABAMA, Bibb Co., Schultz Creek near Centerville, 12



FIGURES 81-87.—*Brachycentrus numerosus* (Say): 81, larval hindleg; 82, larval head and thorax; 83, male genitalia, lateral; 84, male ninth tergum and cerci, dorsal; 85, male clasper, ventral; 86, male tenth tergum, dorsal; 87, male clasper, posteroventral.

Mar 1983, S.C. Harris, 1 pupa with larval sclerites (SCHC).

CONNECTICUT, Mill River, Hamden, 4 Oct 1961, S. Hitchcock, 8 larvae. Mill River, Sleeping Giant State Park, Mt. Carmel, 1 Oct 1943, K.M. and A.H. Sommerman, 1 larva (INHS); same, but 2 Jul 1976, M.J. Chapin, 30 larvae (CUC). New Haven Co., Hammonasset River, Killingworth, 16 Apr 1978, W.C. Downs, 3

pupae (ROM). New Haven Co., Sleeping Giant State Park, 7 Oct 1967, Yamamoto and Odum, 12 larvae (ROM).

DELAWARE, Kent Co., Pratts Branch, NW Frederica, 25 Feb 1973, N.L. Mavrowitz, 11 larvae (UDN). Kent Co., Sewell Branch, Blackiston, 5 Oct 1971, R.W. Lake, 30 Larvae (UDN). Sussex Co., Famy Branch, near Millsboro, off Rt. 113, 23 Apr 1979, R.W. Lake,

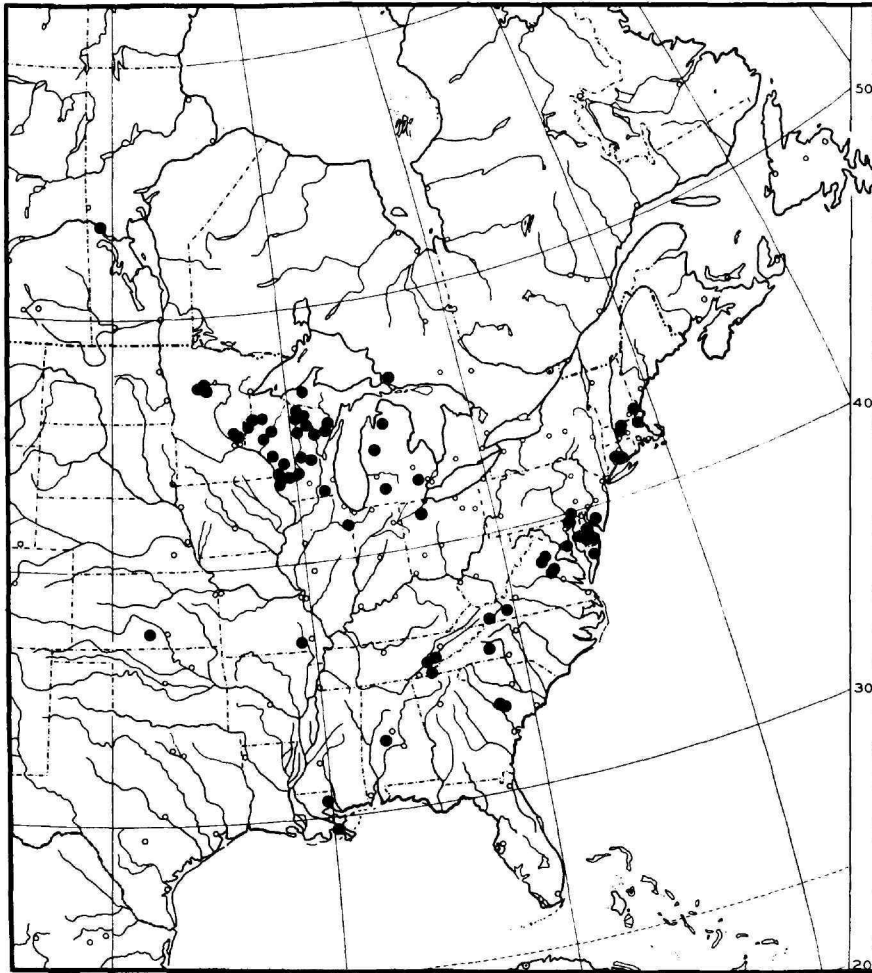


FIGURE 88.—Distribution of *Brachycentrus numerosus* (Say).

2♂ (UDN); same, but 2 Apr 1975, 1♂, 2♀ (UDN); same, but 5 Apr 1972, 1 larva, 20 pupae (UDN); same, but 5 Apr 1979, 1♂, 16♀ (large swarm, mostly ♀♀ with eggs) (UDN). Sussex Co., Woodenhawk, tributary of Marsh Hope Creek, 29 Aug 1972, Lake and Harkins, 8 larvae (UDN). Sussex Co., Long Branch, Bridgeville, 26 Aug 1971, Lake and Harkins, 50 larvae (UDN). Sussex Co., James Branch, Smith Hill, 3 Sep 1972, R.W. Lake, 1 larva (UDN).

ILLINOIS, Momence, 4 May 1937, Ross and Mohr, 35♂, 61♀ (including 2 mating pairs)

(INHS); same, but 14 Jul 1936, B.D. Burks, 15 larvae (INHS); same, but 21 Aug 1936, Ross and Burks, 3 larvae (INHS); same, but Kankakee River, 7 May 1940, B.D. Burks, 4♂, 3♀ metamorphotypes, 2 pupae (INHS); same, but 15 Aug 1939, Ross and Burks, 6 larvae (INHS); same, but 27 Oct 1938, Mohr and Burks, 25 larvae (INHS); same, but 3 Nov 1938, Mohr and Burks, 50 larvae (INHS); same, but 21 Dec 1938, Mohr and Burks, 6 larvae (INHS).

INDIANA, Pulaski Co., Tippecanoe River State Park, 8 May 1944, 1♂ (UGA).

KANSAS, Kingman Co., E bridge over Chickaskia River on Hwy. 42, 1.5 mi. W Spivey, 13 Jul 1976, S.W. Hamilton, 1 larva (CUC).

LOUISIANA, Magnolia, 18 Feb 1933, J.H. Roberts, 7♂, 1♀ (LSU). St. Tammany Parish, Tchefoncte River, La. Hwy. 40, 22 Jul 1978, Holzenthal and Levy, 12 larvae (CUC).

MAINE, Hancock Co., Narraguagus River, Bracy's Pond area, 12 May 1973, T. Mingo, 2♂, 2♀. Hancock Co., South Hump, 8 Jun 1974, T. Mingo, 1♂, 3♀. Hancock Co., Starvation Branch, Union River, Rt. 9, 5 May 1978, T.M. Mingo, larvae (UMO). Hancock Co., Narraguagus River, Humpback Brook, 1 Mar 1974, T.M. Mingo, larvae (UMO). Oxford Co., Ellis River, Rt. 5, South Andover, 20 Sep 1978, T.M. Mingo, larvae (UMO). Penobscot Co., Pushaw Stream, Rt. 43, Hudson, 10 Jul 1979, T. Mingo, larvae (UMO); same, but 23 Sept 1979, larvae (UMO, USNM). Washington Co., Narraguagus River, 1 mile S Rt. 9 bridge, 26 May 1978, T. Mingo, 17 ♂ (UMO, USNM).

MARYLAND, Patuxent River near Annapolis, 15 Apr 1938, B.D. Burks, 2♂ (INHS). Caroline Co., Choptank River, Greensboro, 8 Apr 1980, W.L. Butler, 3 larvae (MWQMD). Harford Co., Deer Creek, Rt. 1, 29 Jul 1975, W.L. Butler, 6 larvae (MWQMD). Worcester Co., Nassawango Creek, Rt. 12, 23 May 1981, W.L. Butler, 2 larvae (MWQMD).

MASSACHUSETTS, Amherst, 3 Sep 1953, O.S. Flint, Jr., 1 larva; same, but stream behind Univ. Mass., 9 Sep 1953, R.A. Allaire, 2 larvae; same, but Fort River, at Pelham Road, 1 May 1957, D. Dame, 1 pupa. Brookside Dam, 1 May 1938, J.F. Hanson, 8♂, 3♀ (UMA). Stream (?Bachelors Brook), near South Hadley, 8 Apr 1941, 3 larvae, 6 prepupae (UMA). Wellesley, 29 Apr 1899, A.P. Morse, 4♂ 1♀ (MCZ). Franklin Co., Millers River, W Erving, 7 Sep 1980, D. Maddison, 2 larvae (ROM).

MICHIGAN, Middle Branch Ontonagon River, 25-26 May 1963, Genetti, 2♂, 1♀. Sanborn Creek, Nirvana, 28 May 1939, Frison and Ross, 4♂ (INHS). Antrim Co., Manistee River, Rt. 618, 25 Oct 1966, N. Andresen, 1

larva (ROM). Kalamazoo Co., Augusta Creek in Kellogg Forest, 12 Aug 1969, G.B. Wiggins, 19 larvae (ROM). Washtenaw Co., Portage River, Cedar Lake Road, 4 Feb 1976, C. Keil, 3 larvae (VPI).

MINNESOTA, St. Francis River above Rice Lake, 5 mi. NW Zimmerman, 2 May 1964, emerged 4 May, D. Etnier, 4♂, 1♀ with exuvia and cases (UMSP, UTK). Anoka Co., Coon Creek, 22-27 Oct 1933, W. Elkins, 7 larvae (UMSP); same, but 1 May 1935, D. Denning, 5 larvae (UMSP); same, but 25 Apr 1936, C.E. Mickel, 6 prepupae (UMSP). Clearwater Co., Mississippi River, Co. Hwy. 2, 5 mi. N Lake Itasca P.O., 17 Aug 1972, G.B. Wiggins, 2 larvae (ROM). Hubbard Co., Mississippi River, 17 Aug 1977, G. Daussin, 11 larvae (UMSP). Hubbard Co., Birch Creek, 16 Aug 1935, D. Denning, 5 larvae (UMSP). Hubbard Co., Birch Creek, Rd. 4, N Lake George, 15 Aug 1974, G.B. Wiggins, 1 larva (ROM). Hubbard Co., Straight River, Rt. 71, S Park Rapids, 17 Aug 1970, G. B. Wiggins, 12 larvae (ROM); same, but 21 Aug 1972, 15 larvae (ROM).

MISSOURI, Williamsville, 26 Aug 1951, Becker et al., 50 larvae (INHS).

NEW HAMPSHIRE, Oyster River, Lee, 10 May 1946, W. Jahoda, 2♂ (INHS).

NEW JERSEY, Cumberland Co., stream, N Mill Road, 0.6 mi. N Garden Road, Vineland, 20 Apr 1980, R.W. Bouchard, 70♂, 40♀ (UTK).

NORTH CAROLINA, Morganton, 1877, Morrison, 11♂ 1♀ (MCZ).

PENNSYLVANIA, Lancaster Co., Octararo Creek, ½ mi. below Mt. Vernon Bridge, 7 Sep 1943, H.K. Groff, 4 larvae; same, but E Branch Octararo Creek, 17 Sep 1943, 7 larvae (INHS). Penna, summer 1976, E. Kupsky, 1 larva (CUC).

SOUTH CAROLINA, Aiken Co., Upper Three Runs Creek, Savannah River Plant, 11 Mar 1977, Hurlong and Prichard, 10♂ (CUC); same but 8 Aug 1977, 9 larvae (CUC); same, but 7 Aug 1979, Kelley and McEwan, 1 larva (CUC); same, but 1 Sep 1979, 1 larva (CUC); same, but 27 Oct 1979, 1 larva (CUC); same, but 8

Dec 1979, 1 larva (CUC); same, but 7 Jan 1980, 6 larvae (CUC); same, but 24 Jan 1980, 2 larvae (CUC); same, but 29 Jan 1977, 1 larva (CUC); same, but 12 Feb 1977, 1♂ (CUC); same, but 7 Oct 1975, Giheath and Sanders, 17 larvae (CUC); same, but Tinker Creek, 6 Nov 1976, 4 larvae (CUC); same, but 11 Mar 1977, 1 pupa (CUC). Aiken Co., Hollow Creek, U.S. 278, 4 Sep 1976, Herlong and Morse, 25 larvae (CUC). Barnwell Co., Lower Three Runs Creek, Savannah River Plant, 27 Nov 1979, Kelley and McEwan, 1 larva (CUC). Savannah River Plant, 4 May 1973, Fisher, 1♂ abdomen (UTK).

TENNESSEE, Loudon Co., Coytee Spring, Little Tennessee River, 23 Apr 1975, Etnier et al., 19♂, 11♀ (UTK). Meigs Co., Big Sewee Creek, Tn. 58, 15 Sep 1982, D.A. Etnier, 6 larvae (UTK). Polk Co., Ocoee River, Copper Hill, 11 Mar 1973, W. Pennington, 1 larva (UTK). Polk Co., Hiwassee River below Patty Bridge, 5 Apr 1982, D.A. Etnier, 3♂ (UTK).

VIRGINIA, Rappahannock River, Remington, 21 Mar 1940, Frison et al., 1 prepupa (INHS). Culpepper Co., Rapidan River, 0.5 mi. S Rt. 743, 15 Jul 1980, Kondratieff and Voshell, 1 larva (VPI). Grayson Co., New River, 6 Jun 1973, J. Wright, 3 larvae (VPI). Grayson Co., New River near Fox, 24 Sep 1981, O.S. Flint, Jr., 50 larvae. Hanover Co., North Anna River, Rt. 602, 6 Mar 1971, W.V. Morgan, 6 prepupae (VPI); same, but Rt. 208, 18 Apr 1978, G.M. Simmons, Jr., 2♂ (VPI). Louisa Co., South Anna River, Rt. 522, 21 Jun 1977, J.R. Voshell, 3 larvae (VPI); same, but 19 Jul 1977, 1 larva (VPI); same, but 19 Aug 1977, 9 larvae (VPI); same, but 22 Oct 1977, 2 larvae (VPI); same, but Rt. 657, 20 Jul 1977, 9 larvae (VPI). Montgomery Co., Little River, Rt. 787, 4 Apr 1980, B.C. Kondratieff, 1♂, 4♀ (VPI).

WISCONSIN, Namakegon River, Spooner, 29 Apr 1939, Frison and Burks, 20 larvae (INHS). Adams Co., Dry Creek, 4 May 1970, 1♂ (UWM). Adams Co., Little Roche Creek, 31 Oct 1979, 12 larvae (UWM). Burnett Co., Wood River, 13 May 1970, 30 ♂♀ (UWM).

Chippewa Co., Oneil Creek, 22 Apr 1980, 2 larvae (UWM). Crawford Co., Baker Creek, Hwy. 61, 29 Apr 1970, 2♂ (UWM). Dunn Co., Hay River, 24 Oct 1979, 6 larvae (UWM). Forest Co., Popple River, 6 Nov 1979, 5 larvae (UWM). Langlade Co., Prairie River, 18 Oct 1979, 3 larvae (UWM). Marathon Co., Little Rib River, 13 Oct 1980, 10 larvae (UWM). Marinette Co., South Branch Pemebonwon River, 15 Oct 1980, 3 larvae (UWM). Marquette Co., Klawster Creek, Hwy. B, 5 May 1970, 13♂, 4♀ (UWM). Monroe Co., Silver Creek, 6 Nov 1979, 5 larvae (UWM). Oconto Co., North Branch Oconto River, 2 Nov 1979, 1 larva (UWM). Oneida Co., Little Somo River, 9 Nov 1972, 3 larvae (UWM). Polk Co., Teade River, 22 Oct 1980, 41 larvae (UWM). Richland Co., Wisconsin River, Hwy. 60, 29 Apr 1970, 2♂ (UWM). Sauk Co., Honey Creek, 29 Mar 1971, L.J. Bayer, 2♂, 1♀ (UWM). Trempealeau Co., South Fork Beaver Creek, 30 Oct 1979, 15 larvae (UWM). Vernon Co., West Fork Kickapoo River, 29 Oct 1980, 1 larva (UWM). Vilas Co., Wisconsin River, 9 Nov 1972, 20 larvae (UWM). Walworth Co., Bluff Creek, 18 Aug 1972, 1 larva (UWM); same, but 27 Apr 1970, 9♂, 42♀ (UWM). Washburn Co., Namekagon River, 26 Oct 1980, 12 larvae (UWM). Waupaca Co., South Branch Little Wolfe River, 31 Oct 1980, 7 larvae (UWM).

CANADA, MANITOBA, Saskatchewan River, The Pas, 7 Jun 1953, W. Krivda, 10♂, 13♀ (ROM).

ONTARIO, creek near Sault Ste. Marie, 4 Jun 1956, W.E. Ricker, 1♂ (INHS).

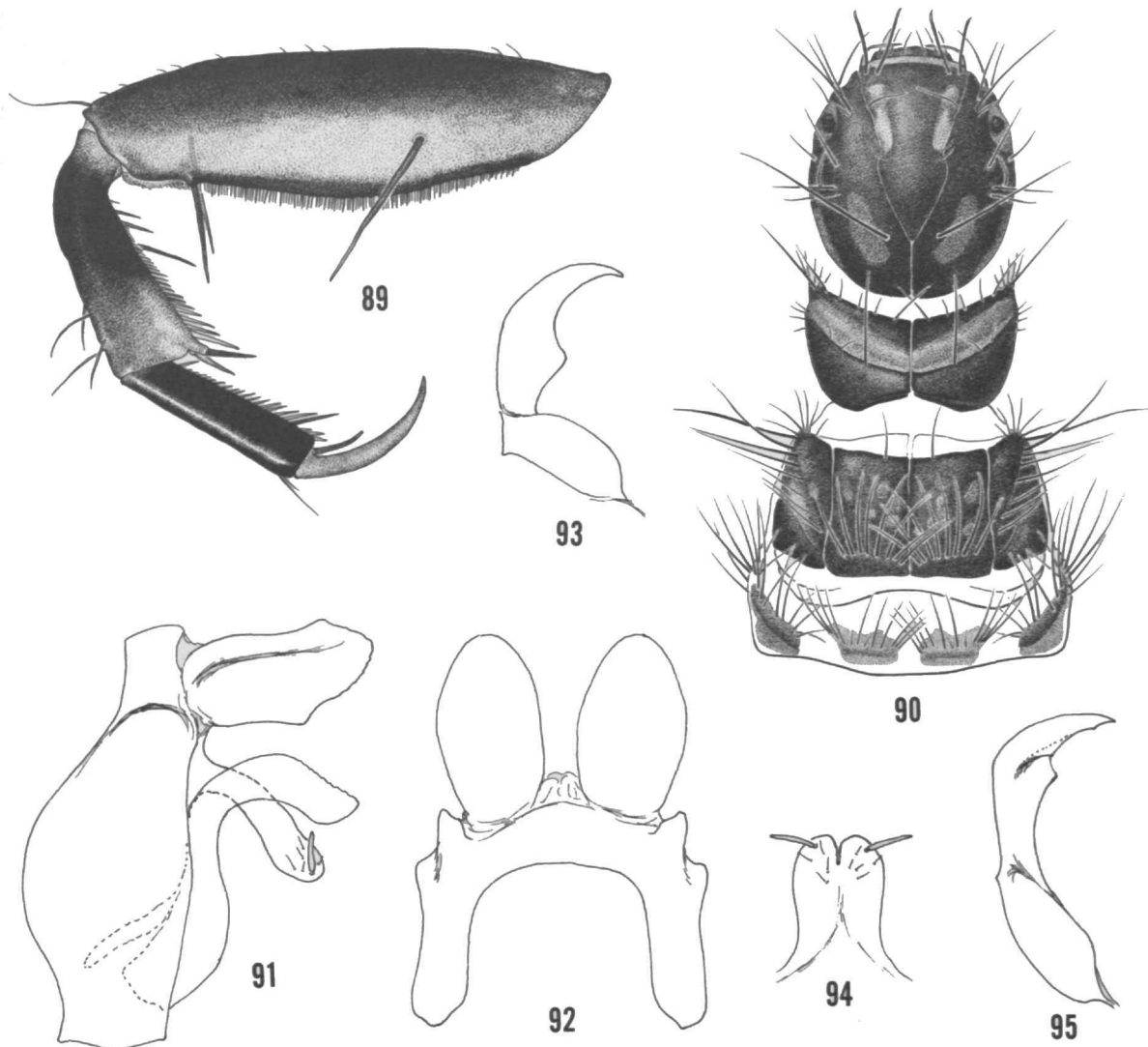
Brachycentrus (Sphinctogaster) solomoni,
new species

FIGURES 89–96

Brachycentrus nigrisoma [sic] (Banks).—Lloyd, 1915:81–86.—Murphy, 1919:154–159.—Lloyd, 1921:82–87.—Sibley, 1926:105 [misidentifications].

Brachycentrus nigrosoma (Banks): Betten, 1934:386 [misidentification].

This species is very closely related to *B. nume-*



FIGURES 89-95.—*Brachycentrus solomoni*, new species: 89, larval hindleg; 90, larval head and thorax; 91, male genitalia, lateral; 92, male ninth tergum and cerci, dorsal; 93, male clasper, ventral; 94, male tenth tergum, dorsal; 95, male clasper, posteroventral.

rosus (Say), which it seems to replace, in general, in the more mountainous sections of the Appalachian Mountains. The males may be distinguished from the closely related *B. numerosus* (Say) and *B. etowahensis* Wallace by the possession of a distinct, although small, lobe subapically from the inner margin of the clasper when seen in ventral aspect, and in addition the apex of the

clasper is not enlarged and the apex of the tenth tergum is only shallowly divided on the midline and the halves are appressed against each other.

The larvae are similar in all three species, but those of *B. solomoni*, new species, differ from the other two in the coloration of the legs, being much darker with the tibiae mostly infuscate but reddish-brown on the apicomeral fourth. The

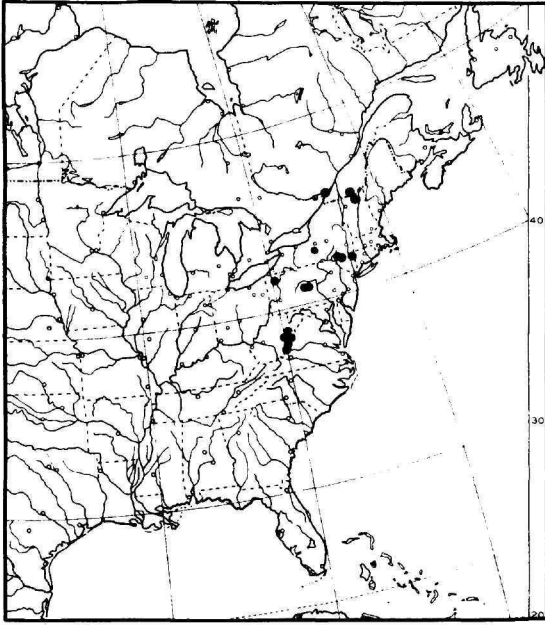


FIGURE 96.—Distribution of *Brachycentrus solomoni*, new species.

head is also darkest of all three with the anteromesal spots restricted in size and the posterior pair often strongly infuscate and much obscured. They actually appear to be very similar in appearance to many larvae of *B. spinae* Ross, from which they can generally be distinguished by the more restricted pale markings on the head. The larvae and their habits were first described by Lloyd (1915, 1921) and Murphy (1919) from New York under the name of *B. nigrisoma* [sic]. A series (INHS) of male and female metamorphotypes collected by Lloyd from McLean, New York are proof of the current identity of these larval descriptions.

ADULT.—Length of forewing, ♂ 9–10 mm, ♀ 11–13 mm. Color fuscous, tibiae and tarsi paler; forewing fuscous with paler spots in an indistinct, subapical band. Male abdomen with seventh sternum bearing a broad, posteromesal, nail-like lobe.

Male Genitalia: Ninth segment without a sternal lobe. Cercus elongate, almost truncate in lateral aspect; in dorsal aspect cerci divided and

separated mesally, nearly oval in outline. Tenth tergum elongate, barely enlarged apicad in lateral aspect; in dorsal aspect with tip slightly divided mesally, halves not divergent, wider than long, with 1 macrochaeta each (commonly with a second small macrochaeta on one side). Clasper with a large basal area, tip evenly curved, not enlarged apicad, apex with a small point; in ventral aspect apex developed into a mesally directed point, mesal margin with a small (generally), subapical lobe.

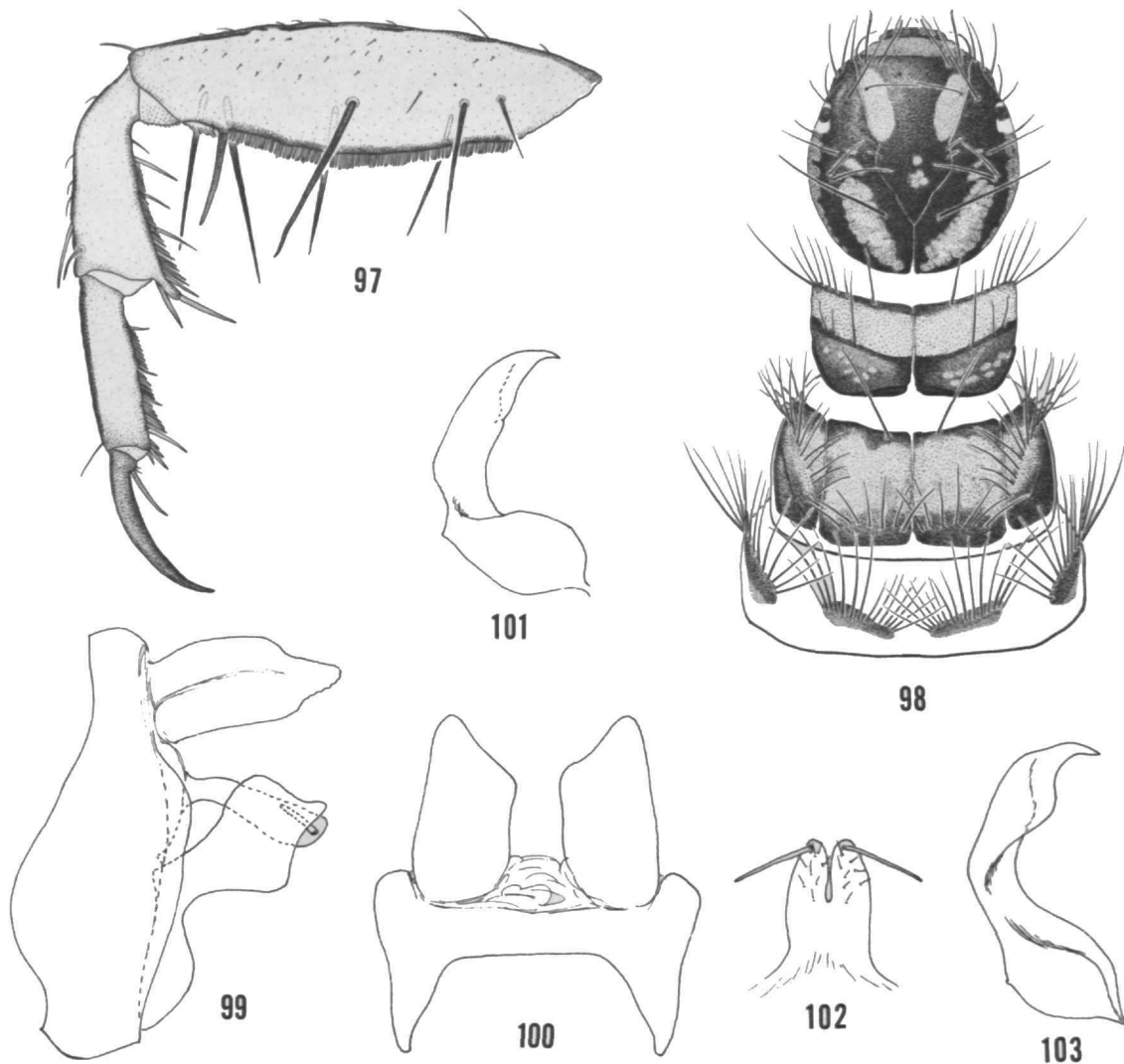
LARVA.—Length to 13 mm. Sclerites dark brown to fuscous, marked with reddish-brown; frontoclypeus anteriorly to midlength constriction with a lateral, elongate, paler mark; gena mostly dark, with genal and postocular dark bands confluent posteriad, enclosing an indistinctly paler mark posteriad, slightly paler laterad, dark ventrally; mid- and hindlegs infuscate, tibia reddish-brown on apicoventral fourth and in a broad band down middle of femur. Femora of mid- and hindlegs with 3 enlarged setae; apicodorsal seta slightly enlarged over other dorsal setae; ventral fringe uniform. Tibiae of mid- and hindlegs with a basomesal row of 3–4 setae. Two pairs of submesal setae on venter of first abdominal segment of equal size, larger than homologous setae of second segment. Lateral fringe present from third through sixth segments. Gills single, in dorsal, lateral, and ventral rows.

TYPE MATERIAL.—Holotype, male, USNM: USA, NEW YORK, Beaverkill, Roscoe, 7 May 1976, L. Solomon. USNM Type 101321. Paratypes: Same data, 1♂, 6♀; same, but 2 May 1976, 1♂; same, but 30 Apr 1976, 4:30 p.m. large ovipositing swarms, 1♂, 1♀. Dutchess Co., Wappingers Creek, Stanfordville, 12:30 p.m., 17 Apr 1976, L. Solomon, 1♂, 1♀. Pennsylvania, Penn's Creek, Weikert, D.C. Proper, 1♂, 3♀; same, but 7 mi. W Weickert, 23 Apr 1977, 2♂. Venango Co., Sugar Creek, 28 Apr 1981, J. Busch, 2♂, 4♀. VIRGINIA, Alleghany Co., Potts Creek, 3 mi. SW Jordan Mines, 18 Apr 1968, Yamamoto and Odum, ♂♂, ♀♀ (ROM). Bath Co., Jackson River, Hidden Valley Bridge, 19 Apr 1980, S. Hiner, 1♂, 1♀ (VPI, USNM). Bath Co., Blowing Springs Campground, 17 Apr 1968, Yamamoto and

Odum, 3♂, 8♀ (ROM). Craig Co., Potts Creek, Steel Bridge Campground, Rt. 18, 22 Apr 1979, C. Parker, 3♂, 4♀ (VPI). WEST VIRGINIA, Pendleton Co., Smokehole Campground, near Franklin, 9 Apr 1977, M. and D. Davis, 3♂, 2♀. Near Dry Creek, Red Creek, 30 Apr 1944, Frison and Ross, 5♂ (INHS). CANADA, QUEBEC, Cascades Point, 3 Jun 1930, L.J. Milne, 1♂ 1♀ (MCZ).

OTHER MATERIAL.—USA, NEW YORK, Mc-

Lean, 15 May 1925, J.T. Lloyd, ♂♂, ♀♀ metamorphotypes (INHS). Beaverkill, near Rockland, 4 Apr 1959, Flint and Neff, 30 larvae; same, but 6 Dec 1959, Flint and Nowosielski, 15 larvae. Little Beaverkill, Roscoe, 13 Feb 1977, L. Solomon, 3 larvae. Beaverkill, Roscoe, 29 Apr 1977, 2 prepupae, 1 pupa. Dutchess Co., Wappingers Creek, Stanfordville, 17 Apr 1976, L. Solomon, 1♂ metamorphotype.



FIGURES 97-103.—*Brachycentrus etowahensis* Wallace: 97, larval hindleg; 98, larval head and thorax; 99, male genitalia, lateral; 100, male ninth tergum and cerci, dorsal; 101, male clasper, ventral; 102, male tenth tergum, dorsal; 103, male clasper, posteroventral.

PENNSYLVANIA, summer 1976, E. Kupsky, 4 larvae (CUC).

VERMONT, Lyndonville, 26 Dec 1936, D. Denning, 1 larva (UMSP).

CANADA, QUEBEC, Ruitter Brook, Dunkin, 27 Sep 1956, G.B. Wiggins, 1 larva (ROM).

Brachycentrus (Sphinctogaster) etowahensis
Wallace

FIGURES 1, 97-104

Brachycentrus etowahensis Wallace, 1971:313.

B. etowahensis Wallace, the third species of the *B. numerosus*/*B. solomoni* subgroup, occupies a rather restricted range around the southern end of the Appalachians. The male genitalia are similar to those of *B. numerosus* in lacking the subapical lobe on the mesal face of the clasper, but are very much broader apically than in either of the other species. The apex of the tenth tergum is deeply, but narrowly divided in dorsal aspect, with the two lobes not divergent.

The larvae are unique, at least within the North American species of the subgenus, in possessing more than three (usually 5-7) major setae on the femora of the mid- and hindlegs, a characteristic shared with *B. echo* (Ross). The legs are colored like those of *B. numerosus* (Say); that is, yellow with narrow, black, dorsal and ventral margins. The head is nearly black, very round, with four well-defined, very yellow, dorsal marks with a small cluster of more-or-less fused, yellow, muscle scars near the apex of the frontoclypeus.

ADULT.—Length of forewing, ♂ 7-9 mm. Color in alcohol fuscous, tibiae and tarsi paler. Male abdomen with seventh sternum bearing a large (almost twice as wide as long), posteromesal, nail-like lobe.

Male Genitalia: Ninth segment without a sternal lobe. Cercus elongate, irregular in outline; in dorsal aspect cerci divided and separated mesally, inner margin irregular. Tenth tergum elongate, barely enlarged apicad in lateral aspect; in dorsal aspect narrowly divided mesally with halves not divergent, each with a large macrochaeta. Clasper with a large basal area, apical area short,

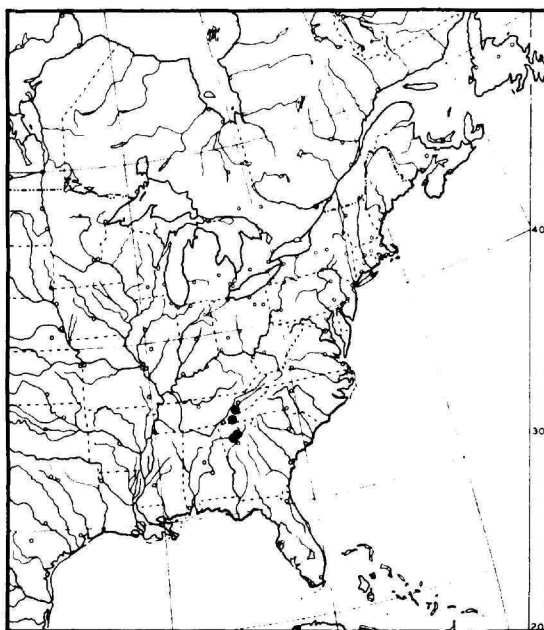


FIGURE 104.—Distribution of *Brachycentrus etowahensis* Wallace.

broad, almost quadrate in outline with a small pointed apex; in ventral aspect with apex developed into a mesally directed point, without a subapical, mesal lobe.

LARVA.—Length to 10 mm. Sclerites fuscous, marked with yellow; frontoclypeus anterior to midlength constriction with an ovoid yellow mark laterally, with a yellow mark posteromesally; gena fuscous anterior and next to frontoclypeal suture, in a band posterior to eyes, and ventromesally, remainder yellow; legs yellow with narrow, dorsal and ventral, fuscous bands on most segments of mid- and hindlegs. Femora of mid- and hindlegs with 5-7 enlarged setae; apico- and basodorsal setae slightly enlarged over other dorsal setae; ventral fringe uniform. Tibiae of mid- and hindlegs with a basoventral row of 4-5 setae. Two pairs of submesal setae on venter of first abdominal segment of equal size, slightly larger than homologous setae of second segment. Lateral fringe present from third through seventh segments, but poorly developed on seventh. Gills single, in dorsal, lateral and ventral rows.

TYPE MATERIAL.—Holotype, male, UGA, published as "Etowah River, 5.5 miles southeast of Ball Ground, Cherokee Co., Georgia (reared); pupa coll. 12 April, 1971, adult emerged 9 May 1971, J.B. Wallace and W.R. Woodall." Type not seen; topotypic paratypes collected 25 Apr 1971 studied.

MATERIAL EXAMINED.—USA, GEORGIA, Town Creek, Canton, 8 Oct 1950, J. Wilson, 6 larvae (INHS). Cherokee Co., Etowah River, 5.5

mi. SE Ball Ground, 25 Apr 1971, Wallace and Woodall, 3♂ paratypes. Cherokee Co., Etowah River at shoal ~1 mi. below Ga 372, 23 Sep 1980, Etnier et al., many larvae (UTK).

TENNESSEE, Loudon Co., Little Tennessee River, Coytee Spring, 23 Apr 1975, Etnier et al., 22 larvae, 2 prepupae, 3 pupae (UTK, CUC). Polk Co., Hiwassee River below Patty Bridge, 5 Apr 1982, D.A. Etnier, 30 prepupae and pupae (UTK).

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