

## A review of *Goerita* (Trichoptera: Goeridae), with description of a new species

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**Abstract:** *Goerita* Ross is restricted to the Appalachian Mountains and Allegheny Plateau of eastern North America. A new species is described, bringing the total in the genus to three. Keys to larvae and adults are presented, and the distributions of the species are recorded.

### Introduction

Ross (1938) erected *Goerita* for his new species *G. semata*, described from the Great Smoky Mountains National Park. A second species, *G. betteni* Ross, was described from a single specimen collected in West Virginia (Ross 1962). A third species, *G. genota* (Ross 1941), was transferred to *Goeracea* by Denning (1968). Flint (1960) described a larva he presumed to be that of *Goerita semata* from a locality less than one mile from the *G. semata* type locality in the Great Smoky Mountains National Park. Wiggins (1973) redescribed Flint's larva and described the larva of *G. betteni*. Recent work in small headwater streams among the peaks of the Great Smoky and Blue Ridge Mountains has shown that the presumed larva of *G. semata* described by Flint represents a new species. Below, I describe the new species and the true larva of *G. semata* and the female of *G. betteni*, and present keys to larvae and adults of all species.

Material examined during this study is deposited as indicated below. ADH: Alex D. Huryn, Orono, ME. BLRI: Blue Ridge Parkway, Asheville, NC. BMS: Buffalo Museum of Science, Buffalo, NY. CUAC: Clemson University Arthropod Collection, Clemson, SC. EKSU: Eastern Kentucky State University, Richmond, KY. GRSM: Great Smoky Mountains National Park, Gatlinburg, TN. UGA: University of Georgia, Athens, Georgia. USNM: United States National Museum, Washington, D.C. UTK: University of Tennessee, Knoxville, TN. VPI: Virginia Polytechnic Institute and State University, Blacksburg, VA.

### *Goerita* Ross, 1938: 171

Type species by original designation: *Goerita semata* Ross.

**Larva.** Length of mature larva to 6.1 mm. All sclerotized parts reddish brown to yellowish; sclerites of head and thorax pebbled. Thorax: Prosteral horn prominent. Pronotum very large, with prominent median arch dorsally and raised ridge on each side of midline posteriorly; lateral edges each produced into well-developed flange, with anterior corner sharply produced; surface of sclerites covered with uniformly spaced tiny setae set in small punctures. Mesonotum with mesal pair of sclerites having angulate transverse ridge extending across posterior one-third or one-fourth of each sclerite; mesepisternum acutely produced anteroventrally. Metanotum with sa1, sa2, and sa3 sclerotized, separate, and setose. Membranes of meso- and metanota covered with small, closely spaced microsclerites, darkest on mesonotum becoming faint on metanotum. Abdomen lacking gills and lateral fringe. Abdominal segments III - VIII each with 1 - 3 forked lamellae laterally, just dorsad of midline on each side (W. K. Gall, *in litt.*). Chloride epithelia present ventrally on segments IV - VI. Spacing humps of first abdominal segment broad and low, with 20 - 58 setae on each side between median and lateral humps, and 74 - 140 setae on ventral surface. Dorsal sclerite of segment IX with 14 - 49 setae. Anal prolegs each with claw strongly curved, without accessory hook or teeth; basal tuft with two stout, decurved setae arising from small sclerite.

**Case.** Made of sand grains, strongly tapered and slightly curved, sometimes with slightly larger grains incorporated laterally. Pupal case firmly

attached to substrate, closed anteriorly with slightly larger grains in more loosely constructed atrium extending from front of larval case, and closed posteriorly with silk plate having sieve of small holes for water flow.

**Adult.** General color brown. Length of forewing: males 4.8 - 5.7 mm ( $n = 30$ ); females 5.7 - 6.4 mm ( $n = 6$ ). Head: Maxillary palps of female each five-segmented; maxillary palps of male each three-segmented, held vertically in front of face: first segment expanded apically; second segment arising subapically from first, quadrate or elongate and with cluster of scales on dorsal surface; third segment a thin membranous filament arising from base of second (Fig. 1). Ocelli lacking; face having elongate setal wart adjacent to each eye, with or without smaller pair mesal to first, and with or without pair on vertex between antennae; vertex on each side having narrow wart adjacent to eye and extending ventrad to gena, elongate oval ocular wart adjacent to eye extending posteriorly toward occiput, and usually having small posterior pair on occiput near coronal suture. Thorax: Wings similar in size and shape, having generalized venation typical of Goeridae; without scales or other modifications. Tibial spurs 2, 4, 4. Male genitalia: Interpretation of the male genitalia of *Goerita* is not straightforward. I follow the terminology used by Schmid (1983) in his discussion of *Goeracea*, the presumed sister group of *Goerita* (W. K. Gall, *in litt.*). Preanal appendages represented as low ridges completely fused with base of external branches of segment X. Segment X composed of elongate external branches fused along length with median portion of segment X (membranous, bifid plate of Schmid); internal branches apparently lacking. Inferior appendages each two-segmented. Phallic apparatus consisting of phallosome and endotheca, with aedeagus absent; endotheca having 1 - 6 spines internally. Female genitalia: Sterna VIII and IX divided by large lightly sclerotized vulval lobe, but sternum VIII connected anteriorly by narrow sclerotized strap.

***Goerita flinti* Parker, new species**

(Figs. 1, 2, 3, 4)

*Goerita semata*, Flint 1960, p. 39, Fig. 20.

*Goerita semata*, Wiggins 1973, p. 17, Fig. 20.

**Diagnosis:** The larva of *G. flinti* (Fig. 2) is easily distinguished from those of *G. betteni* and *G. semata* by the distinctive middorsal ridge of the

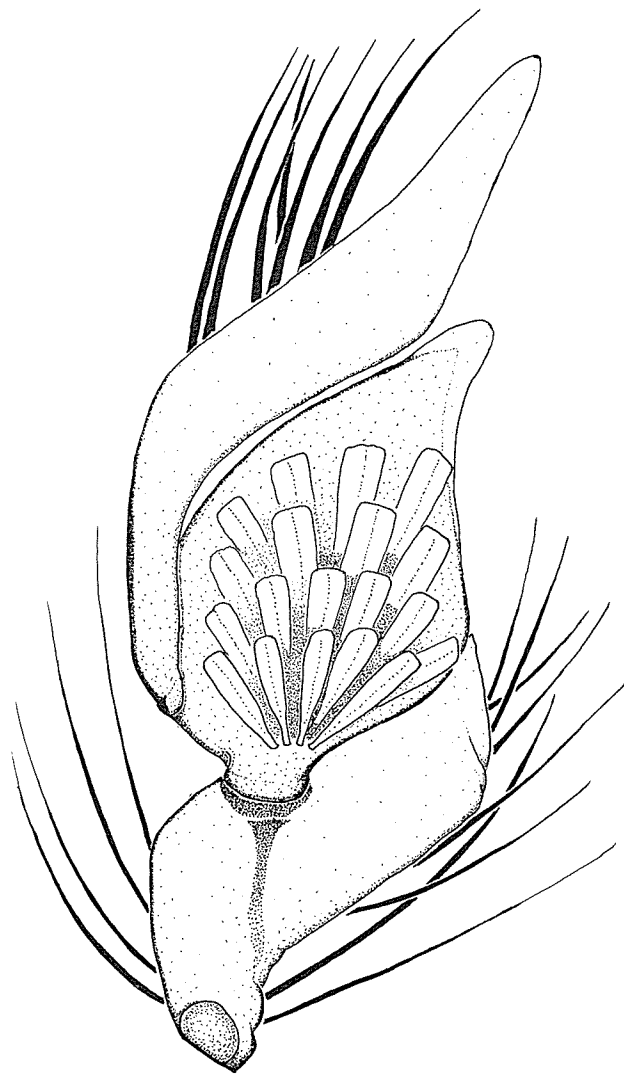


Figure 1. *Goerita flinti* Parker, new species. Male left maxillary palp, dorsal.

pronotum, which has large bulbous swellings posterolaterally and only a very faint impression along the middorsal suture. In *G. betteni*, the posterior portion of the middorsal ridge is narrow and straight sided; in *G. semata* the ridge has bulbous swellings posterolaterally, but it also has a deep thumb-like impression on the midline in the posterior third. The male likewise is easily distinguished by the genitalia (Fig. 3), with the stout blade-like setae on the narrow apex of each of the elongate external branches of segment X being diagnostic. Differentiating the females of *G. flinti* from those of *G. betteni* and *G. semata* is more problematic.

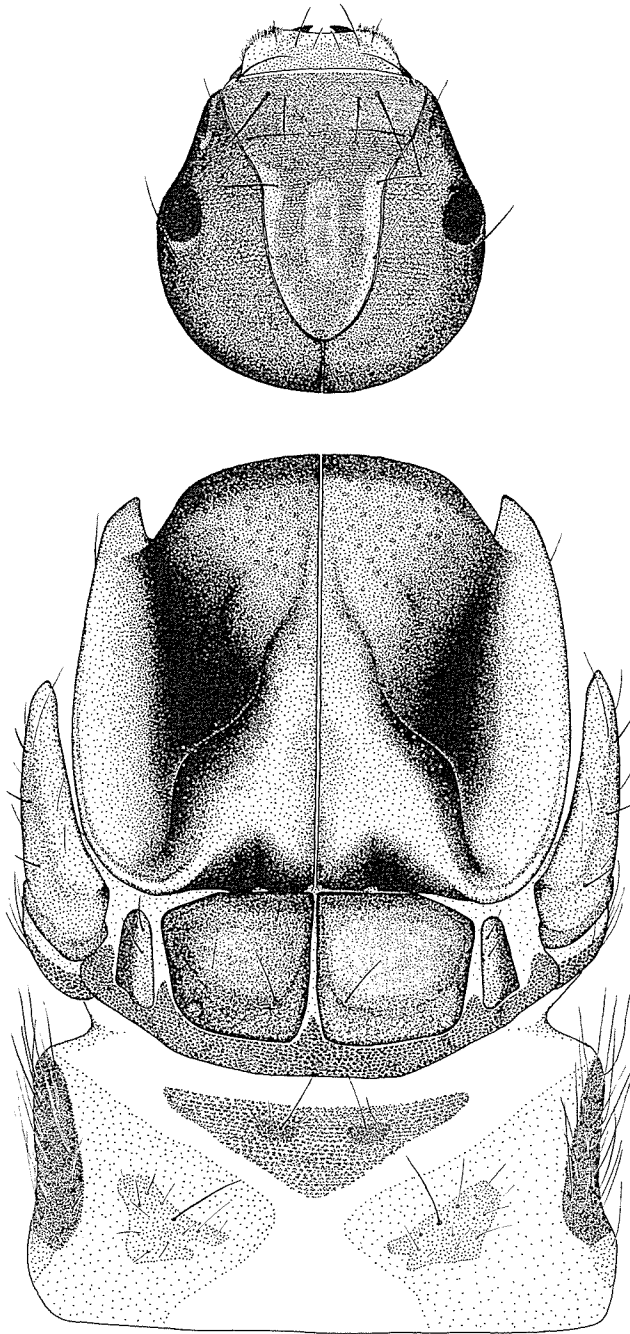


Figure 2. *Goerita flinti* Parker, new species. Larval head and thorax, dorsal aspect.

*Goerita flinti* can be distinguished from *G. semata* by the straight apex of the vulval lobe in lateral aspect (Fig. 4a), which in *G. semata* is angled dorsad in lateral aspect (Fig. 7a); they are discriminated from *G. betteni* females by the wider vulval lobe, which is not constricted before the apex.

**Larva.** Fig. 2. The larva of *G. flinti* has been described previously by Flint (1960) and Wiggins (1973) as the presumed larva of *G. semata*. Typical for genus as described above. Mature larva 4.8 - 5.4 mm. Head: With weak dorsolateral ridge above each eye and medially on frontoclypeal apotome. Thorax: Pronotum with mesal ridge strongly arched, extending from near anterior margin to posterior margin and having strongly inflated lateral ridges arising from approximately midpoint and extending to posterior margin of sclerite, with lateral and mesal ridges smoothly and continuously joined dorsally with only very slight, narrow impression along middorsal line; lateral ridges appearing bulbous in lateral aspect.

**Case.** Cylindrical, strongly tapered and slightly concave ventrally; made of uniformly-sized sand grains, closely spaced; posterior opening partially closed with silk leaving quadrate opening above center.

**Adult.** Forewing length 5.0 - 5.6 mm in males ( $n = 10$ ), 6.0 - 6.3 mm in females ( $n = 4$ ). Color generally brown, wings having faint irrorations basally along anterior veins. Head: Male maxillary palps each (Fig. 1) with second segment quadrate and having numerous scales on dorsal surface; third segment entirely semi-membranous with very narrow sclerotized strip extending from base midway along lateral edge before expanding slightly and fading completely; segment very thin, but expanded mesally at midlength, tapering to acute apex; ventral surface of each segment with many long fine setae. Female maxillary palps each 5-segmented. Male genitalia (Fig. 3): Segment IX (Fig. 3a) very narrow dorsally, broader ventrally, and expanded apically on lateral margins. External branches extending posteriorly as far as apices of basal segments of inferior appendages, broadly united with median portion of segment X for much of their length, each external branch very broad basally, narrowing just before apex to one-third or less of basal width, slightly clavate apically in both lateral and dorsal aspects, with apex rounded to bluntly pointed; apex having cluster of 4 - 6 setae, with one or more setae blade-like and longer and stouter than rest; median portion of X consisting of two plates narrowly separated by membrane on midline, slightly shorter than preanal appendages, blade-like, acute apically and with scattered setae basally. Inferior appendages each having basal segment sinuous in lateral aspect, emarginate apically with ventral lobe acute, dorsal lobe broadly rounded; in ventral aspect, basal segment J-shaped;

apical segment slightly shorter than basal, narrow at base, abruptly widened ventrally beyond midlength in lateral aspect, uniformly narrow throughout length in dorsal aspect, and having large number of small, peg-like setae on ventromesal surface. Phallic apparatus (Fig. 3c) inflated near midlength, with eversible membranous lobe of endotheca having 1- 4 spines internally. Female genitalia (Fig. 4): Sterna VIII and IX broadly separated ventrally by large lightly sclerotized vulval lobe (Fig. 4b), which has apex straight in lateral aspect (Fig. 4a); lateral portions of sternum VIII connected anteriorly by narrow sclerotized strap; lateral sclerites of sternum IX triangular in ventral aspect, subquadrate in lateral; tergum IX weakly sclerotized and separated from tergum X by membrane. Vaginal apparatus large, extending anteriorly near midlength of VII, strongly tapered from posterior base to acute anterior apex.

**Type material.** Holotype male, NORTH CAROLINA: Swain County, Great Smoky Mountains National Park, sweeping riparian vegetation along Tawya Creek, Inventory & Monitoring Site TAI&M, 1.5 miles from intersection of Bradley Fork Trail and Dry Sluice Gap Trail, 1012 m, 22 June 1993, G. K. Salansky & S. Summerall (USNM). Paratypes: NORTH CAROLINA: Swain County, Great Smoky Mountains National Park, same data as holotype, 2 males, 1 female (BMS). Headwaters of Noland Creek Research Watershed, 1720 m, emergence trap, 28 June 1995, G. K. Salansky, 1 male (UTK). Same, but sweeping, 2 July 1991, C. R. Parker, 3 males (UTK). Same, 3 July 1991, C. R. Parker & C. E. Noseworthy, 1 male (UTK). Same, in drift sample, 7 July 1992, C. E. Noseworthy, 1 male (CUAC). Same, sweeping, 10 July 1991, C. R. Parker, 1 male, 1 female (CUAC). Same, 14 July 1992, C. R. Parker, 1 male (CUAC). Sta 69, Indian Gap Trail, 5100', 25 June 1957, J. F. Hanson, 1 male (USNM). TENNESSEE: Sevier County, Sta 26, Indian Gap Trail, 5100', 8 July 1957, J. F. Hanson, 3 males, 2 females (USNM).

**Other material examined.** NORTH CAROLINA: Swain County, Great Smoky Mountains National Park, headwaters of Noland Creek Research Watershed, 1720 m, 10 July 1991, C. R. Parker, 8 larvae (CUAC). Same, 23 July 1991, C. R. Parker, 4 larvae (GRSM). TENNESSEE: Sevier County, Great Smoky Mountains National Park, Indian Gap, spring along trail, headwaters of Road Prong Creek, 16 May 1975, G. A. Schuster, V. Tolbert, 5 larvae (EKSU). Same, 19 May 1959, O. S. Flint, Jr., 1 female pupa, 6 larvae (USNM). Same, 15-20 May 1970, O. S.

Flint, Jr., 62 larvae (USNM). Same, 7 June 1961, O. S. Flint, Jr., 20 larvae (USNM). Same, 13 September 1958, O. S. Flint, Jr. and G. B. Wiggins, 143 larvae (USNM). Sta 26 Tenn 64-67Hb, Indian Gap Trail, 5100', 8 July 1957, J. F. Hanson, 8 larvae (USNM). Sta 26, Indian Gap Trail, 5100', 3 August 1957, J. F. Hanson, 42 larvae (USNM). Road Prong Creek, 3700', 7 July 1975, V. Tolbert, G. A. Schuster, 28 larvae (EKSU).

**Distribution.** Known only from North Carolina and Tennessee.

**Etymology.** It is with great pleasure that I name this species for Dr. Oliver S. Flint, Jr., who described the larva of *G. flinti* originally, and who has encouraged me throughout my career.

### *Goerita semata* Ross

(Figs. 5, 6, 7)

*Goerita semata* Ross, 1938, p. 172, Fig. 113.

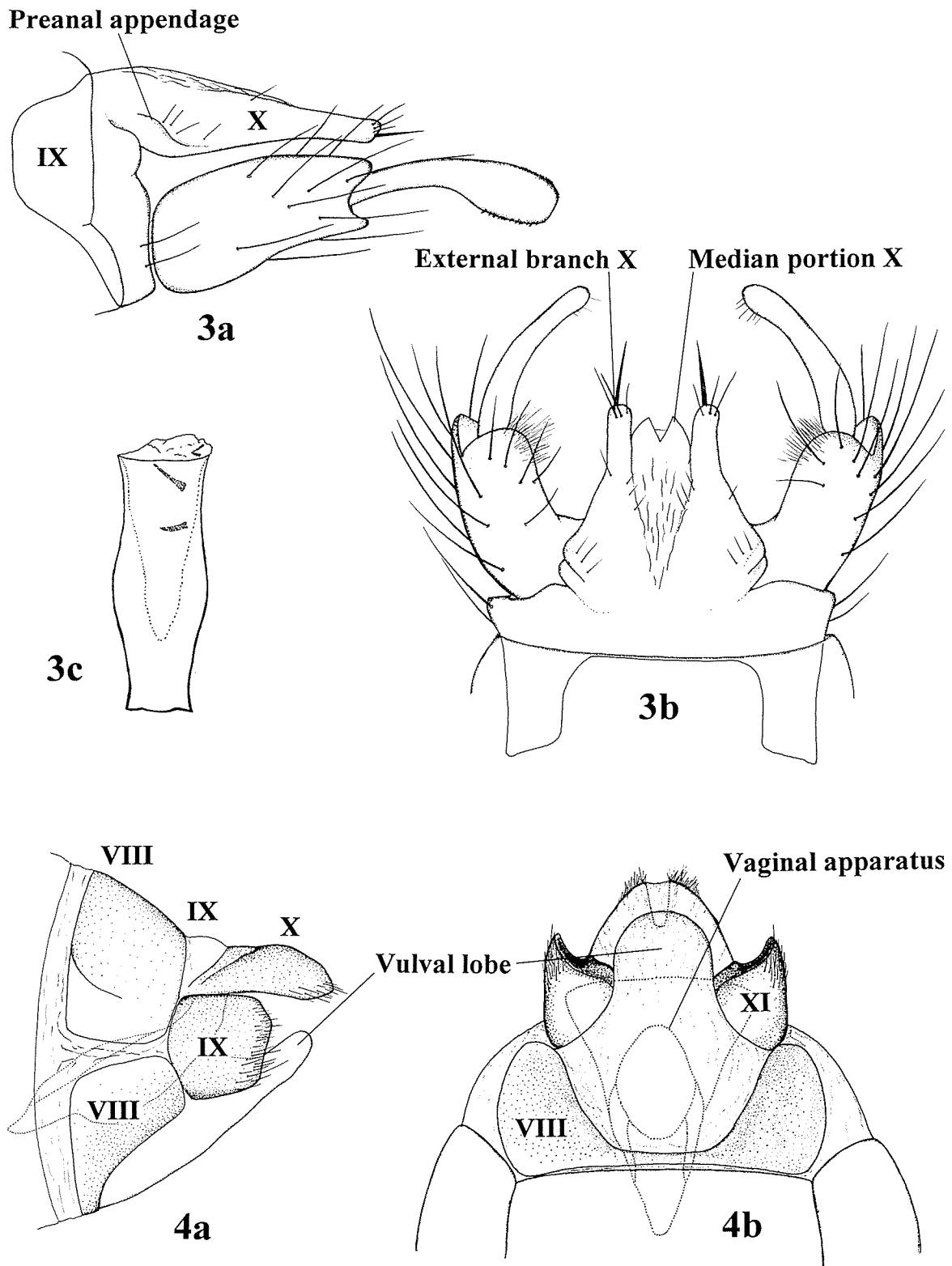
*Goerita semata*, Ross 1944, p.257, Figs. 874, 875, 878.

*Goerita semata*, Wiggins, 1973, p. 17, Fig. 34.

**Diagnosis.** The larva of *G. semata* is the only one of the three species which has a deep impression on the middorsal ridge (Fig. 5). The male maxillary palps are like those of *G. flinti*, and differ from those of *G. betteni* in that the second segment of each is quadrate. The preanal appendages of the male (Fig. 6) each lacks the long stout setae at the apex found in *G. flinti* and are much narrower than the broad clavate lobes of *G. betteni*. Male tergum X median portion evident only as small rounded projections on the mesal surfaces of the external branches. The apex of the median vulval lobe is angled sharply dorsad in lateral aspect, in contrast to those of *G. flinti* and *G. betteni*.

**Larva.** Fig. 5. Previous descriptions attributed to *G. semata* actually refer to *G. flinti*, as discussed under that species. Metamorphotypes and reared specimens form the basis of the association. Length of mature larva to 6.0 mm. Thorax: Overall, very similar to that of *G. flinti*, differing chiefly in presence of deep and distinctive depression along posterior portion of midline of middorsal ridge of pronotum; posterolateral bulbous swellings less inflated than in *G. flinti*. Abdomen: Segment I with 37 - 47 setae on each side between lateral and dorsal spacing humps; 74 - 92 setae ventrally. Dorsal sclerite of tergum IX with 25 - 30 setae.

**Case.** Length to 8.0 mm. Construction identical to that of *G. flinti*, using similar sized grains throughout. Pupal case anteriorly with hood of



Figures 3 - 4. *Goerita flinti* Parker, new species. Figure 3. Male genitalia: 3a - Lateral; 3b - Ventral; 3c - Phallic apparatus, ventral. Figure 4. Female genitalia: 4a - Lateral; 4b - Ventral.

somewhat coarser grains and silk plate having numerous small holes for water to pass through. Cases often attached to rocks with posterior end elevated above substrate.

**Adult.** The male (Fig. 6) has been well described by Ross (1938). The female (Fig. 7) was described by Ross (1938) and illustrated by Wiggins (1973). Both sexes can be distinguished from those of the other species by the characters given in the diagnosis and the key.

**Material examined.** NORTH CAROLINA: Buncombe County, Blue Ridge Parkway, roadside seep 0.25 mi from Craggy Gardens Picnic Area, MP367.6, 1554 m, 16 May 1994, C. M. & O. S. Flint, Jr., 7 larvae. Same, pupae collected 10 June, adults emerged 14, 18, & 19 June 1993, G. K. Salansky, S. Summerall, C. R. Parker, 2 male, 2 female adults (BLRI); Same, 18 July 1991, C. R. Parker, 2 larvae, 2 male metamorphotypes, 1 female metamorphotype, 2 female adults (BLRI); Same, 29 August 1991, C. R. Parker, 10 larvae (BLRI). Haywood County, Blue Ridge Parkway, road cut spring seep, North Bluff Waterrock Knob, MP451.6, 6 June 1993, G. K. Salansky, S. Summerall, C. R. Parker, 5 larvae, 2 pupae, 1 male adult (GRSM). Woodfin Cascades parking area, MP446.7, 1382 m, sweeping seep area to right of stream above bridge, 11 July 1991, C. R. Parker, 4 male, 1 female adults (BLRI). Woodfin Cascades parking area, MP446.7, 1382 m, Lower Woodfin Falls, 35°27' W, 83°06' W, 17 May 1994, C. W. & O. S. Flint, Jr., larva. Macon County, moss covered bedrock, lower Wine Spring, 7 May 1995, J. J. Hutchens, Jr., 2 larvae (UGA). Coweeta Hydro Lab, WS27, RF@378 m, 6x6' Surber, 21 November 1985, A. D. Huryn, 1 larva (ADH). Same, Lt. Trap @ Stewart Trail, 22 June 1983, A. D. Huryn, 1 male adult (USNM). Same, Malaise trap, 24 June - 6 July, 1983, A. D. Huryn, 4 male adults (USNM). Same, 7 July - 27 July 1983, 1 male adult (ADH). TENNESSEE: Carter County, Left Prong Hampton Cr., seep area, 50 ft above last rd crossing, 14 April 1997, C. Williams, TWRA #854, 788, 1 male metamorphotype, 1 female pupa, 8 larvae (UTK). Sevier County, Great Smoky Mountains National Park, Silers Creek, cascade at top of Section 9, 1128 m, 29 June 1986, C. R. Parker, 1 female.

**Distribution:** Apart from the North Carolina and Tennessee specimens reported here, Etnier et al. (in press) and Vineyard (1990) also reported it from Tennessee, and Parker and Voshell (1981) recorded *G. semata* from Virginia.

### *Goerita betteni* Ross

(Figs. 8, 9, 10)

Sericostomatid sp., Betten 1934, p. 413, plate 67, figs. 6 - 11.

*Goerita betteni* Ross 1962, p. 132, fig. 3.

*Goerita betteni*, Wiggins 1973, p. 20, fig. 17, 18, 19, 24.

*Goerita betteni*, Wiggins 1977, p. 232, fig. 10.21.

*Goerita betteni*, Wiggins 1996, p. 232, fig. 16.3.

**Diagnosis.** The larva of *G. betteni* (Fig. 8) previously has been illustrated by Wiggins (1973, 1977, 1996) and distinguished from *G. flinti* (as *G. semata*); the middorsal pronotal ridge is evenly confluent with the rest of the pronotum, that is, it lacks the lateral swellings found in *G. flinti* and *G. semata*, and it is only slightly and narrowly impressed dorsally, in contrast with *G. semata*. The male (Fig. 9) is easily distinguished by the broad, clavate external branches of segment X. The female (Fig. 10), described below for the first time, is very similar to *G. flinti*, but may be distinguished by the vulval lobe which is slightly constricted before the apex.

**Adult.** Female genitalia (Fig. 10): Sterna VIII and IX broadly separated ventrally by large lightly sclerotized vulval lobe; lobe with apex straight in lateral aspect and slightly constricted before apex in ventral aspect; lateral portions of sternum VIII connected anteriorly by narrow sclerotized strap; lateral sclerites of sternum IX subquadrate in ventral and lateral aspects; tergum IX weakly sclerotized and separated from tergum X by membrane; tergum X with pair of lateral longitudinal ridges. Vaginal apparatus not as large as in *G. flinti*.

**Material examined.** KENTUCKY: Menifee County, Broke Leg Falls, Broke Leg Creek, at US460, approx 1 km NE of Morgan Co line, 29 December 1992, G. Schuster, 2 larvae (EKSU). Whitley County, Cumberland Falls State Park, Trail #2, 5th trib. crossing from picnic area, 18 May 1985, G. A. Schuster, 17 larvae, 13 pupae, 1 male, 2 female metamorphotypes, 27 male adults (EKSU). PENNSYLVANIA: Venango County, Oil Creek State Park, small seep, 21 April 1979, C. M. & O. S. Flint, Jr., 59 larvae (USNM). TENNESSEE: Anderson County, small northern trib. to Ligias Fork ca 600 m above Carroll Br., 27 April 1996, D. A. Etnier, J. T. Barter, R. B. Evans, S. J. Fraley, 1 larva (UTK). Campbell County, headwaters seep trib. to West Prong Davids Creek, 19 February 1994, M. P. Hansbrough, 1 larva (UTK). Seep ca. 4.2 rd mi W of TN

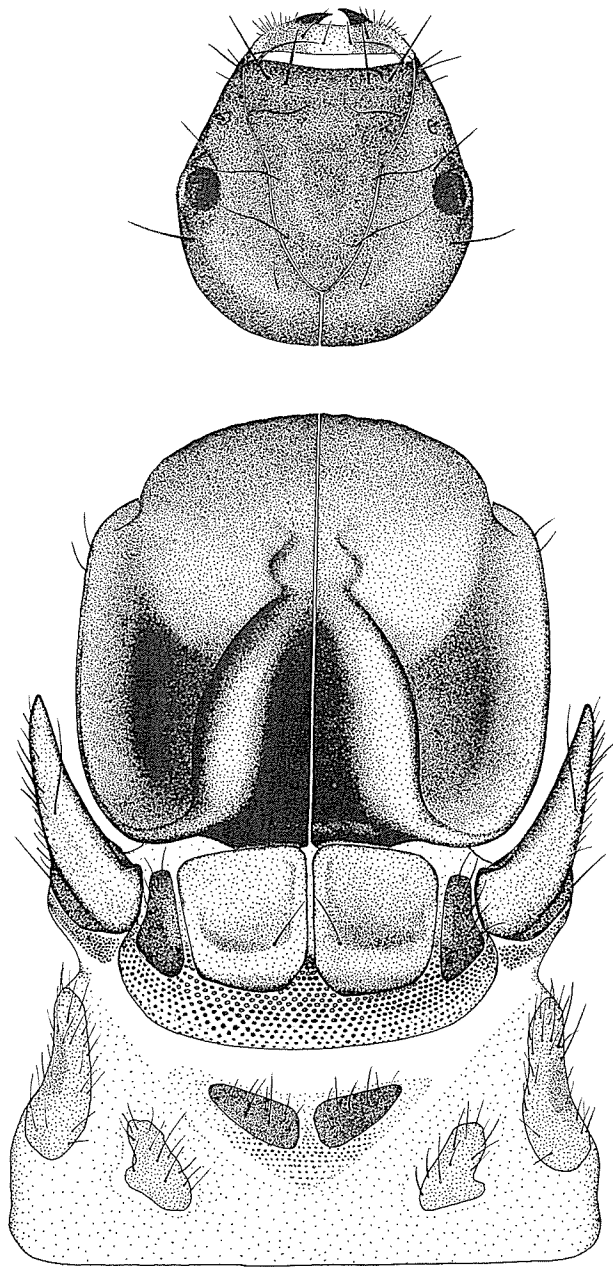


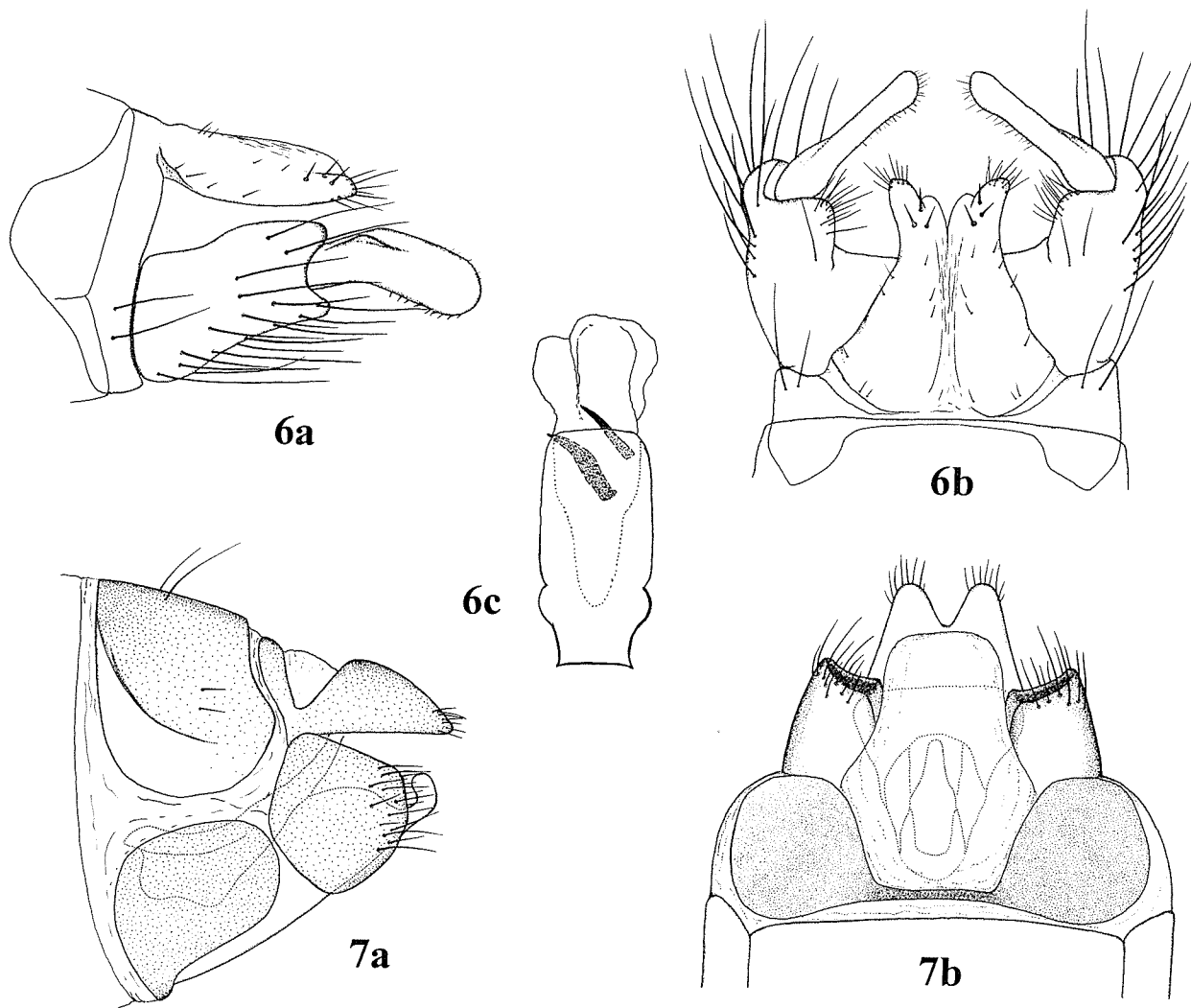
Figure 5. *Goerita semata* Ross. Larval head and thorax, dorsal aspect.

297 on Whistle Cr. Rd., at hairpin turn with side rd to south, 5 May 1996, R. B. Evans, J. T. Baxter, S. J. Fraley, D. A. Etnier, 2 pupae (UTK). Putnam County, spring going into Calf Killer River, 1.5 mi from jct of US70 & TN80S, 11 March 1975, An-

draws, Hughes, Schuster, 13 larvae (EKSU). First spring outflow on east side of TN 84, ca 1 mile South of TN US 70N, 6 June 1972, C. Saylor, D. Etnier, 2 males (UTK). Scott County, New River, lower shoal, ca ½ mi above Silcox Ford (mouth of Lick Cr.), Reed property, seep on N side, D. A. Etnier, 1 larva. White County, Lost Creek on falls on Co. Rd. 4448, 6 air mi SE of Sparta, 14 April 1976, F. Andrews, N. Burkhead, J. Louton, G. Schuster, 7 larvae (EKSU), 1 larva (UTK). Same, 14 April 1977, G. and C. Schuster, larvae (UTK). Same, 14 May 1977, CAS, G. A. Schuster, 40 larvae, 2 pupae (EKSU). WEST VIRGINIA: Greenbriar County, first order trib to Costs Run, 0.3 mi e of jct of Summit Lake Rd above Lake, 14 December 1985, R. Butler, R. Kirchner, G. Schuster, 13 larvae (EKSU). Nicholas County, rock wall adjacent to Hunters Run approx. 3 mi E Richwood, approx. 1/3 mi from WV Hwy 39/150, 14 December 1985, R. Butler, R. Kirchner, G. A. Schuster, 10 larvae (EKSU). Pocahontas County, seeping wall on left side of road about 1 km NE jct SR39/55 and SR150, 30 January 1993, G. A. Schuster, 6 larvae (EKSU). Hills Creek, nr Cranberry Glades, Monongahela National Forest, 17 May 1979, R. F. Kirchner, 11 larvae (VPI). Three Falls of Hill Creek, rocky seep along side of path, 30 July 1978, D. C. Tarter, 1 male adult (reared) (USNM).

**Distribution:** In the original description of the holotype of *G. betteni* from West Virginia, Ross (1962) referred to a specimen from New York, described by Betten (1934) as an unnamed genus and species, as probably a member of this species. Wayne K. Gall (Buffalo Museum of Science, *in litt.*) has confirmed the presence of *G. betteni* in New York from the vicinity of Betten's collection. Neither Gall nor I have examined Betten's specimen, but we both consider it to be a specimen of *G. betteni*. Gall (1994) listed additional records of this species from New York, as well as, from Maryland and Ohio. Phillippi and Schuster (1987) reported *G. betteni* from Kentucky, North Carolina, Ohio, and Pennsylvania. Masteller and Flint (1979; 1984) listed it from Pennsylvania. It was reported from Tennessee by Edwards (1966), Wiggins (1973, 1977), Etnier and Schuster (1979), Etnier *et al.* (in press), and Denning (1982). It was reported from Virginia by Parker and Voshell (1981); and from West Virginia by Wiggins (1973), Denning (1982), Tarter and Hill (1980), and Tarter (1990), since Ross' (1962) original description.

Ross distinguished *G. betteni* from *G. semata* in part by the presence of four internal rods



Figures 6 - 7. *Goerita semata* Ross. Figure 6. Male genitalia: 6a - Lateral; 6b - Ventral; 6c -Phallic apparatus, ventral. Figure 7. Female genitalia: 7a - Lateral; 7b - Ventral.

(spines) in the phallic apparatus rather than two. However, in a series of 23 male *G. betteni* specimens from Cumberland Falls State Park in Whitley County, Kentucky, examined by G. A. Schuster and me, phallic spines ranged from 2 to 6. Although 4 is the predominant number (52%), the occurrence of individuals with other counts, and the occurrence of specimens of *G. flinti* with 1 to 4 spines, argues against the use of this character to distinguish species of *Goerita*.

**Phylogeny**

*Goeracea* Denning has been proposed elsewhere as the sister taxon of *Goerita* (Gall 1994; Gall

| Number of spines in the phallic apparatus of 23 <i>Goerita betteni</i> specimens from Whitley Co. Kentucky |                  |   |    |   |   |
|--|------------------|---|----|---|---|
|  | Number of Spines |   |    |   |   |
|  | 2                | 3 | 4  | 5 | 6 |
| Number of Individuals  | 1                | 1 | 12 | 7 | 2 |



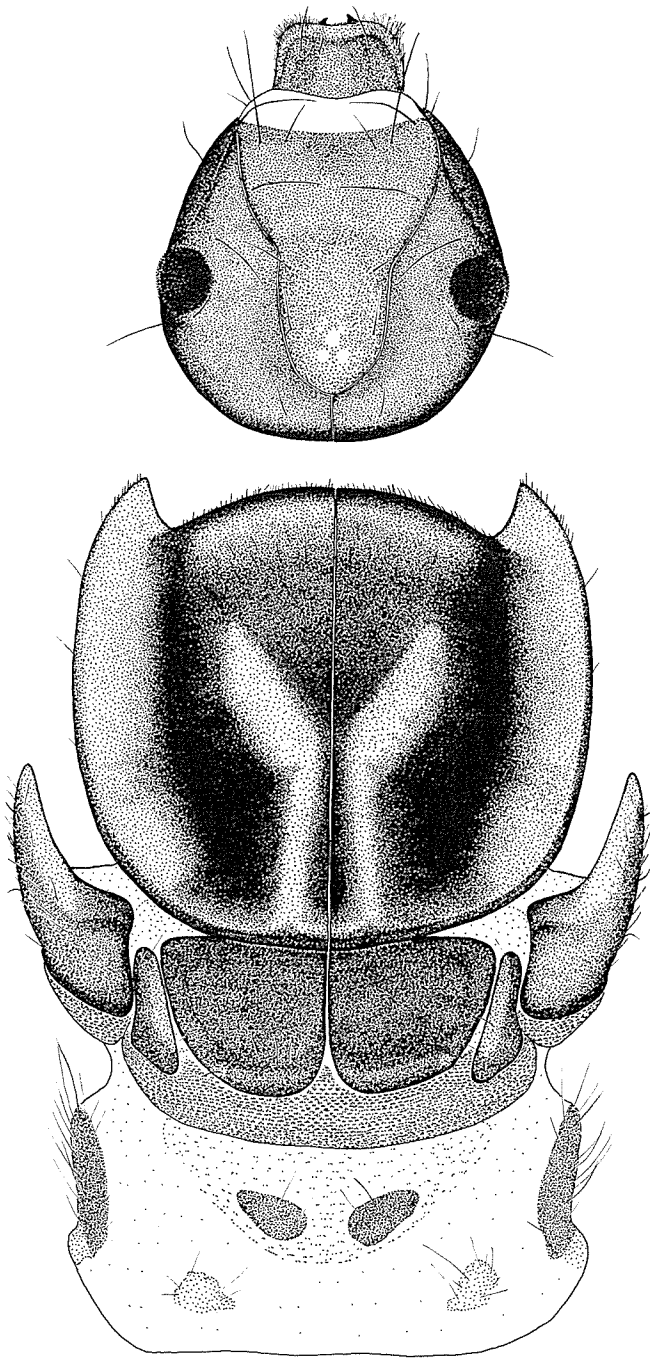


Figure 8. *Goerita betteni* Ross. Larval head and thorax, dorsal aspect.

and Wiggins in prep.). Two characters that support the monophyly of *Goerita* are 1) the prominent median ridge of the larval pronotum and 2) the modified maxillary palps of the males. In *Goera*, and in the majority of Trichoptera larvae, the

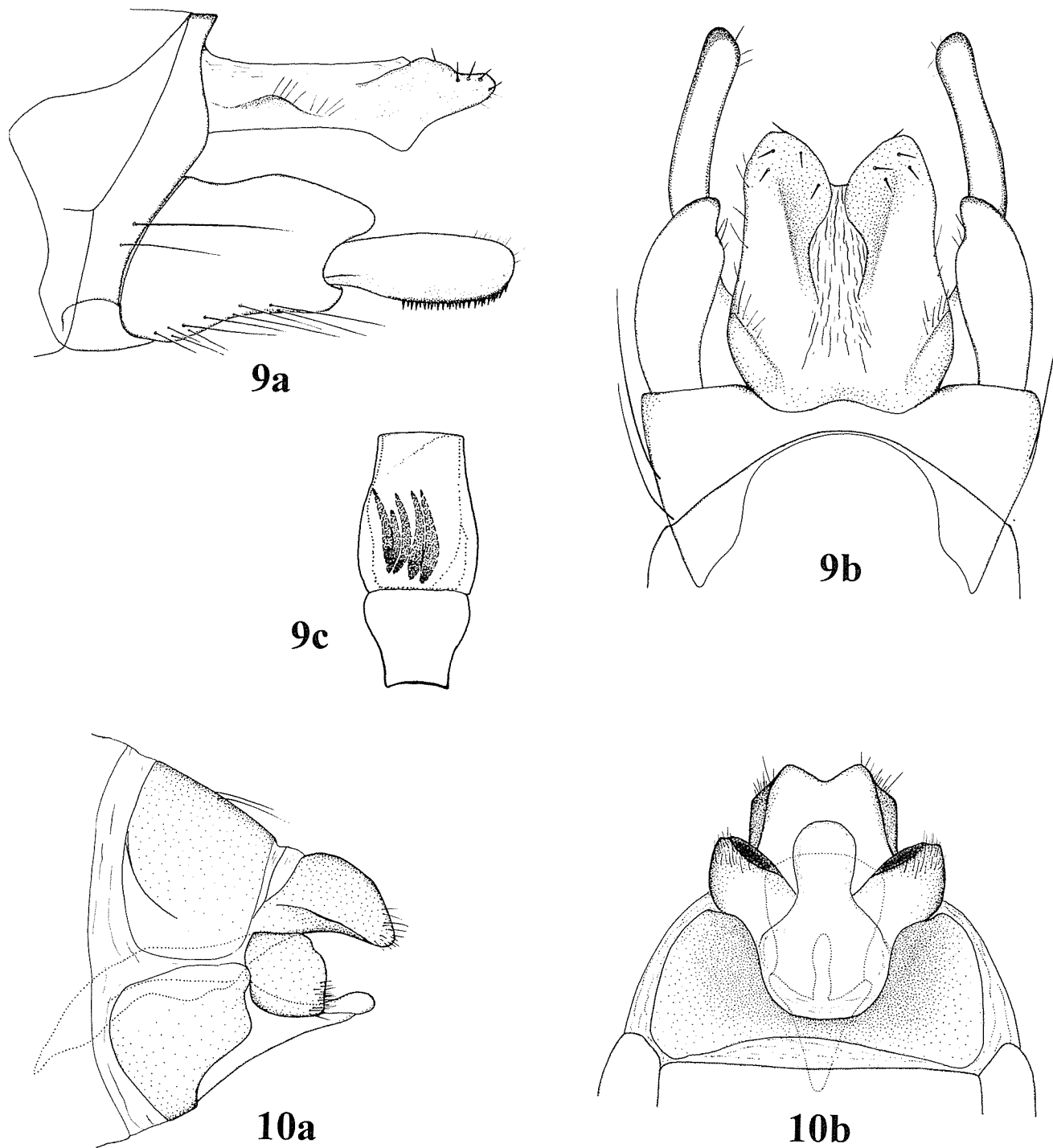
pronotum lacks a median ridge (Wiggins 1973, Figs. 10a, 11a; figures throughout Wiggins 1996). The presence of the median ridge in *Goerita* larvae is therefore interpreted as the derived condition. The posterolateral swelling of the median ridge in *G. flinti* and *G. semata* is interpreted here as a further specialization that unites them as sister species. The modifications of the male maxillary palps of *Goerita* (convergent with similar modifications in some species of *Goera*) are less extreme in *G. betteni* (Wiggins 1973, Fig. 24a) than in *G. flinti* and *G. semata* (cf. Fig. 1). The quadrate second segment, and the membranous, almost filamentous third segment in the latter two species represent additional specializations that reinforce the interpretation that *G. flinti* and *G. semata* are sister species, and together are the sister taxon of *G. betteni*.

#### Biology of *Goerita* species

Only one detailed study of the biology of a *Goerita* species has been published to date (*G. semata*, Huryn and Wallace 1985). The author is preparing an account of the biology of *G. flinti*. Only a brief summary of what is known is presented here.

*Goerita flinti*: This species inhabits high elevation springs, seeps, and spring-fed headwater streams draining the highest peaks of the southern Appalachian Mountains of North Carolina and Tennessee. The type locality in Taywa Creek is at 1012 m, and the Noland Divide Research Watershed is at 1720 m elevation. At these elevations the average stream gradient is high, often exceeding 20%. As a result, discharge fluctuates widely with storm events, ranging from <0.2 to >45 liters/sec at the Noland Divide site. Temperatures also vary widely from season to season, despite the influence of ground water from numerous springs. At the Noland Divide site, water temperatures range from 0.5°C to 14°C. The pH of the water at Noland Divide ranges from 4.3 to 6.3 (Flum *et al.* 1997). The forest canopy consists of red spruce, Fraser fir, yellow birch, and American beech, and is at least 70% closed. The understory vegetation is dominated by rhododendron and wood nettle.

Larvae are found on the undersides of rocks, usually attached at right angles to the surface. A large number of aquatic insect species occur in these habitats, the most common caddisflies being *Rhyacophila nigrita* Banks, *Paleagapetus celsus* Ross, *Dolophilodes distinctus* (Walker), *Wormal-*



Figures 9 - 10. *Goerita betteni* Ross. Figure 9. Male genitalia: 9a - Lateral; 9b - Ventral; 9c - Phallic apparatus, ventral. Figure 10. Female genitalia: 10a - Lateral; 10b - Ventral.

*dia moesta* (Banks), *Parapsyche cardis* Ross, *Pycnopsyche sonso* (Milne), *Lepidostoma ontario* Ross, and *Neophylax mitchelli* Carpenter. Adults

are most commonly encountered in June and July, but may appear in late May.

*Goerita semata*: Huryn and Wallace (1985) studied populations of *G. semata* from western

North Carolina, although they misidentified their larvae as the species illustrated by Flint (1960). Larvae occur on liverwort- and moss-covered rock faces totally dry or washed by films of water (madicolous habitat). I have collected *G. semata* in similar habitats along the Blue Ridge Parkway. Huryn and Wallace (1985) determined that *G. semata* has a two-year life cycle in the small headwater streams at the Coweeta Hydrologic Laboratory. Greatest larval densities occurred in February, and greatest growth occurred in March and April. Larvae feed on detritus and diatoms.

*Goerita betteni*: Wiggins (1973, 1977, 1996) and Gall (1994) described the habitat of *G. betteni* as vertical rock faces in thin films of water along cool forested ravines. Gall suggests the life cycle may well require two-years, because of the presence of two size-classes of larvae in his collections. No other details are available on the biology of *G. betteni*.

#### Key to Species of *Goerita* Modified from Wiggins (1973)

##### Larvae

1. Median ridge of pronotum evenly convex laterally (Fig. 8) ..... *G. betteni*
- Median ridge of pronotum with prominent posterolateral swellings (Figs. 2, 5) ..... 2
- 2(1). Median ridge of pronotum with deep thumb-like impression posteriorly (Fig. 5) *G. semata*
- Median ridge of pronotum without impression (Fig. 2) ..... *G. flinti*

##### Adults

1. Male ..... 2
- Female ..... 4
- 2(1). External branches of segment X broadly clavate apically, about as wide as their respective bases, their mesal margins sinuous and converging toward apex, extending well beyond basal segment of inferior appendages (Fig. 9) *G. betteni*
- External branches of segment X weakly clavate or rod-shaped, with apices narrower than their respective bases, their mesal margins straight or divergent toward apex, extending to just beyond basal segment of inferior appendages .. 3
- 3(2). External branches of segment X rod-shaped in dorsal aspect, separated mesally by a distance greater than their respective apical widths, and each having one or more very strong blade-like setae distinctively larger than all others (Fig. 3) ..... *G. flinti*

- External branches of segment X with apices weakly clavate in dorsal aspect, separated mesally by a distance not greater than their respective apical widths, with a cluster of fine to small setae apically, lacking distinctively longer, stouter setae (Fig. 6) ..... *G. semata*
4. Vulval lobe angled sharply dorsad at apex in lateral aspect (Fig. 7a) ..... *G. semata*
- Vulval lobe not angled dorsad at apex (Fig. 4a, 10a) ..... 5
- 5(4). Vulval lobe no greater than one half the width of overlying terga Ix and X in ventral aspect (Fig. 10b) ..... *G. betteni*
- Vulval lobe much greater than one-half width of overlying terga Ix and X in ventral aspect (Fig. 4b) ..... *G. flinti*

#### Acknowledgments

Figures 2-10 were skillfully prepared by D. Novikov. I thank the following for the loan of specimens essential to this study: D. A. Etnier, O. S. Flint, Jr., J. J. Hutchens, Jr., G. A. Schuster, J. R. Voshell, Jr., W. K. Gall, and J. C. Morse greatly improved the manuscript by reviewing an early draft. This study was supported with funding from the Inventory and Monitoring programs of the National Park Service and the National Biological Service (now the Biological Resources Division of the U. S. Geological Survey).

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