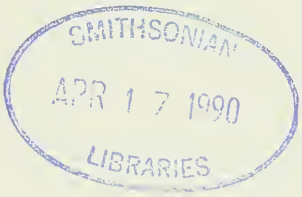

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A Revision of the Holarctic Species of Orthocladius (Euorthocladius)

(Diptera: Chironomidae)

By **Annelle R. Soponis**

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Abstract:

Thé classification of the Holarctic species of the subgenus *Orthocladius (Euorthocladius)* is revised. Keys to species for adult males, pupae, and larvae are given. Keys to subgenera of *Orthocladius* are included for adult males, pupae, and larvae. Fifteen names of *Orthocladius (Euorthocladius)* are recognized as valid. Redescriptions or notes on previously-known species and descriptions of three new species are presented. The new species are: *ashei, coffmani,* and *roussellae*. Type Material was examined for the following species: *abiskoensis, anteilis, calvus, difficilis,*

kanii, luteipes, saxosus, suspensus, telochaetus, and *thienemanni.* Lectotypes are designated for *abiskoensis* Thienemann and Krüger, *rivulorum* Kieffer, and for the type of the subgenus, *thienemanni* Kieffer. The type of *rivicola* Kieffer could not be located.

Introduction

Adults of *Orthocladius (Euorthocladius)* are small to medium-sized, yellow, green, brown, or black chironomids. In the temperate zone they emerge primarily in spring, fall and winter, although some are taken at high altitudes and latitudes in summer.

Live larvae have brown head capsules and green, brown, or yellow bodies, and live in gelatinous tubes in cold springs or fast-flowing waters of inlets, creeks, streams, and rivers. These gelatinous tubes are initially clear, and can be covered with sand or algae, appearing brown or green depending on the habitat. In the *rivicola*-group, larvae live in ellipsoid tubes fastened along their margins to stones and rocks. In some species, e. g. *saxosus* and *thienemanni,* larvae are gregarious. In the *rivulorum*-group, larvae live in suspended tubes, attached by one end to stones and rocks. Larvae of certain species have been collected from moss *(ashei, abiskoensis, rivolorum),* reeds *(thienemanni), Ranunculus (ashei),* and algal mats *(roussellae).* Larvae collected from mud have probably occured there accidentally.

Species of *Orthocladius (Euorthocladius)* can be sympatric ands synchronous, and it is not unusual to collect exuviae of different species, e. g. *rivicola* with either *ashei, luteipes,* or *thienemanni,* in the same sample.

Based primarily on pupal characters, the species can be placed in one of two groups: the *rivicola*-group *(ashei, calvus, difficilis, kanii, luteipes, rivicola, thienemanni);* and the *rivulorum*-group *(anteilis, coffmani, rivulorum, roussellae, suspensus).* The species *abiskoensis* and *saxosus* share characteristics of both groups.

Characters separating species can be very subtle, and several species remain undescribed. Intraspecific variation is apparently large, and needs to be studied further. Three species found in Japan are almost identical morphologically to certain species from Europe and/or North America, but because of important morphological differences in the pupa or adult male, the incipient species in the subgenus, and the lack of series of reared specimens, these species are not synonymized here: *suspensus* and *rivulorum, kanii* and *luteipes,* and *saxosus* and *telochaetus.*

Although names of *Orthocladius (Euorthocladius)* have appeared often in the literature, actual museum specimens are few, given the number of species. Whether this reflects low abundances or inadequate collecting of natural populations remains unanswered.

The subgenus *Orthocladius (Euorthocladius)* is recorded only from the Holarctic Region. Because the genus *Orthocladius* is distributed worldwide (Soponis 1977), it would not be surprising to find species of *Orthocladius (Euorthocladius)* in other regions of the world in cold or fast-flowing waters.

Species of *O. (Euorthocladius)* are most easily identified in the pupal stage. Specific identification of adult males is particularly difficult because of intraspecific variation and morphological similarity of congeners. Specific identifications of larvae can be made with more confidence than of adult males, but for accurate specific identification larvae should be associated with the pupal stage.

Prior to the present study, six species of *Orthocladius (Euorthocladius)* were recorded from the Palearctic region (Sasa & Yamamoto 1977, Fittkau & Reiss 1978) and two species from the Nearctic region (Sublette & Sublette 1965). Presently ten species are reported from the Nearctic region and nine species from the Palearctic region, with six species occuring in both regions. There has been uncertainty about whether or not to place *frigidus* and *abiskoensis* in the subgenus *O. (Euorthocladius). Orthocladius frigidus* belongs to *Orthocladius (Orthocladius).* (Soponis, 1987), and *Orthocladius abiskoensis* has been placed in *O. (Euorthocladius)* by Säwedal (1978), which is accepted here.

The primary objective of this study was to revise the classification of the Holarctic species of *Orthocladius (Euorthocladius),* thereby gaining a better understanding of the genus *Orthocladius.* Adult males of *Orthocladius* are difficult to place to subgenus, but pupae and larvae can be assigned with relative ease. Adult males and larvae of *Orthocladius* are difficult and sometimes impossible to place to species, but pupae can be determined to species with relative ease.

The following keys should be considered tentative; the most accurate specific identifications of *Orthocladius (Euorthocladius)* will be those based on specimens associated with the pupal stage. Caution must be used in identifying Palearctic material since the species-rich *Orthocladius (Orthocladius)* of the Palearctic still needs revision.

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It is my pleasure to thank all those who contributed to this project over the years, and I apologize for any omissions: W. P. Coffman for testing the pupal key; P. S. Cranston for helping with literature and types; J. H. Epler for discussing systematic problems; E. J. Fittkau for providing the opportunity to publish; R. W. Flowers for translating Tokunaga 1964; P. Grootaert for facilitating loans of the Goetghebuer types; L. C. V. Pinder for providing an early version of the *Orthocladius calvus* manuscript; F. Reiss for facilitating access to the ZSM collection and the Thienemann types and notebooks; and, J. E. Sublette for supplying photographs of *Orthocladius anteilis.*

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BMNH	British Museum (Natural History), London, P. S. Cranston
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Materials and Methods

This study was based on an examination of approximately 700 specimens, representing 15 species of *Orthocladius (Euorthocladius).* Type material was remounted in Canada balsam after treating the specimen in sequential baths of 10% potassium hydroxide (KOH), distilled water, glacial acetic acid, 2-propanol, and 2-propanol-cedarwood oil (Oliver & Roussel 1983). Specimens stored for long periods in alcohol dehydrate and fade. Maceration ("clearing") of the internal tissues is often impossible to accomplish without simultaneously making the exoskeleton invisible. Using cold 2% KOH for a longer time rather than hot 10% KOH briefly macerates tissue while maintaining specimens in better condition. Euparal appears to cause more collapse of structures than balsam. Although balsam may be considered the choice for mounting museum specimens, Hoyer's may be a better alternative for teneral and problem specimens. Handling specimens through successive dehydrations and chemical treatments is avoided with the use of Hoyer's.

For the most part, terminology follows Saether (1980). Figures, counts, and measurements are my own, and follow Soponis (1977). In adult males of *Orthocladius,* two kinds of eyes can be distinguished: those with typically, slightly extended medial margins, here called male-like (Fig. 12), and those with widely separated medial margins, here called female-like (Fig. 13). The entire length of the leg was measured, rather than the median axis (cf. Schlee 1968). Since *Orthocladius* adults do not have prominent tibial extensions as do adults of, e.g. *Corynoneura,* there is no advantage in measuring along the median axis. In adult males, AW is the antepronotal width measured medially.

Here, cast-off pupal skin(s) is/are referred to as exuviae (Ex) as recommended by Langton (1984). A cast off larval skin is referred to as a larval skin (LS).

Only the fourth larval instar was studied, unless otherwise indicated. For the larvae the mental ratio (MR) (Soponis 1987) is used: width of the median tooth/width of first lateral tooth of the mentum.

Other standard ratios used are:

AR – (male – antennal ratio (Edwards 1929): length of last flagellomere/total length of flagellomeres 1–12
AR – (larva – antennal ratio (Fittkau 1962, modified by Schlee 1966): length of basal segment/total length of terminal segments
LR – leg ratio (Edwards 1929): length of first tarsal segment/length of tibia
HR – hypopygium ratio (Saether 1968): length of gonocoxite/length of gonostylus

The Subgenus Orthocladius (Euorthocladius)

Euorthocladius Thienemann, 1935; 1944.
Spaniotoma (Orthocladius) group *Euorthocladius*. Johannsen, 1937.
Orthocladius (Orthocladius) [partim]. Andersen, 1937. Goetghebuer, 1942.
Hydrobaenus (Bryophaenocladius) [partim]. Kloet & Hincks, 1945.
Orthocladius van der Wulp [partim]. Chernovskii, 1949. Sublette & Sublette, 1965. Pankratova, 1970. Sasa & Yamamoto, 1977. Oliver, 1981.
Orthocladius (Euorthocladius). Brundin, 1956. Fittkau et al., 1967. Hamilton et al., 1969. Kloet & Hincks, 1975. Soponis, 1977. Fittkau & Reiss, 1978. Pinder, 1978. Cranston, 1982. Ashe, 1983. Cranston et al., 1983. Oliver & Roussel, 1983. Coffman & Ferrington, 1984.
Hydrobaenus group *Euorthocladius*. Roback, 1957a.
Hydrobaenus Fries [partim]. Wirth & Stone, 1968. Cole, 1969.
?*Lapporthocladius* Thienemann. Brundin, 1956.
Lapporthocladius Thienemann. Säwedal, 1978.

Type of Subgenus: *Orthocladius thienemanni* Kieffer, designated by Thienemann, 1935: 201.

Diagnosis

Adult males and immature stages of *Orthocladius (Euorthocladius)* resemble those of the other subgenera of *Orthocladius*. Most adult males of *Orthocladius (Euorthocladius)* can be distinguished by the multiserial scutellars and the rounded anal point. If the scutellars are uniserial, then the female-like eyes will distinguish most males of *Orthocladius (Euorthocladius)*.

Pupae of *O. (Euorthocladius)* can be distinguished by the lack of anal macrosetae.

Larvae of *O. (Euorthocladius)*, except for *rivulorum*, can be distinguished by the brown head capsule, 5-segmented antenna, robust Lauterborn organs, sparse chaetulae laterales, shortened teeth of the mandible, and 13 to 15 teeth on the mentum.

Description

Adult Male

Small, medium or large chironomids. Yellow, green, brown, or black. Head. Eyes widely separated; temporals uniserial except in *roussellae*, doubled or clumped near the coronal suture. Postorbitals present except in *suspensus* and some *rivulorum*. AR usually 1.00–2.15 (0.80 recorded for alpine *rivicola*). Palps normal to long, with segment 3≥4, except in *anteilis*, *suspensus*, and *thienemanni*, segment 3<4. Thorax. Antepronotal lobes weak to robust, wide or narrow medially. Lateral antepronotals present; acrostichals present or absent within and between species; prealars present; dorsocentrals uniserial except in some *roussellae*, biserial; scutellars usually biserial or multiserial, except in some *rivicola* and some *abiskoensis*, uniserial. Mesonotal pit usually absent; if present, weakly developed. Wings. Length 1.30–3.45 mm. Finely to moderately punctate with anal lobe right-angled, or slightly to strongly produced. VR 1.00–1.22. Brachiolum with 1–2 setae, R with 2–12, squama with 8–40. R4+5 bare except in single specimens of *abiskoensis*, *calvus*, *roussellae*, and *telochaetus*. Costa ending above or distal to M3+4. R2+3 ending about $^1/_3$ the distance between R1 and R4+5. Legs. Hind tibial comb composed of 6–13 setae. Tarsal spines absent on p1; 2 spines usually present on ta1 and ta2 of p2 and p3. Tarsal beard present on p3. LR1 0.57–0.77 (0.80 recorded for *saxosus*); LR2 0.43–0.56; LR3 0.47–0.60. Sensilla chaetica present or absent between and within species. Sensilla chaetica present on basal half of ta1 in p2 and sometimes in p3.

Hypopygium (Fig. 1). Virga present or absent between species and within species. Anal point medium to long, weak to robust, armed laterally with setae, and usually with a rounded tip, pointed tip only in some *abiskoensis* and *coffmani*. Superior volsella collarlike except in *abiskoensis*, triangular. Inferior volsella well developed with dorsal part squared, rounded, nose-like, either covering most of ventral part, or with ventral part extended weakly or prominently below. Gonostylus haired, robust, with grooved spine between two strong setae. Crista dorsalis long, absent only in *abiskoensis*. HR close to 2.00 or higher, except in some specimens of *rivicola* and *thienemanni*.

Variation. The tip of the anal point will apear more rounded if it is flattened down under the coverslip. Microtrichia appear on the anal point in specimens from the high arctic (e. g. *telochaetus*, *thienemanni*).

The crista dorsalis can appear strongly to weakly developed, depending on the orientation of the gonostylus. The effect of orientation on the gonostylus has been illustrated by, e.g. Oliver (1976, figs. 10–12) for *Oliveria tricornis* (Oliver).

The spine on the gonostylus is grooved and appears bifid. This may not be noticed unless the gonostylus is extended, exposing the spine. Usually the spine appears to be blunt at high magnification because of light shining between the bifurcation. This condition is not as pronounced as in some other chironomids, e.g., *Zalutschia briani* Soponis (1979).

The apodemes of the hypopygia are thickened in some species but this character is too variable within *Euorthocladius* to be of diagnostic value, as Schlee (1968) found for the *Corynoneura* group. Schlein and Gratz (1972) used daily growth in the skeletal apodemes of mosquitoes and in genitalic apodemes of muscoid flies in their studies, suggesting that the genitalic apodemes of chironomids may also be subject to variations produced by daily growth.

The virga is not a good diagnostic character in the subgenus *Euorthocladius*. Most members of the *rivicola*-group appear to have a virga present, but in some species of this group it may be present or absent. Whether the virga was never present or subsequently lost (e.g. after mating) is unknown.

The length of the palps is positively correlated with the interocular distance in *rivicola*, but not in *roussellae*, the only two species examined for this relationship.

The degree of the development of the antepronotal lobes corresponds to the orientation of the specimen, and is not a useful species character.

Oliver (1970) was the first to point out that acrostichals could be present or absent within *O. (Euorthocladius)*.

Pupa (Exuviae)

Light to dark brown; darker shading on cephalothorax; apophyses on tergites. Length 2.5–6.5 mm, variation in all species. Largest individuals belong to *roussellae, luteipes, thienemanni,* and *coffmani*; smallest individuals belong to *rivicola, rivulorum*, and *saxosus*.

Cephalothorax. Frontal setae absent. Frontal warts weak or absent, except in *saxosus*, robust; cephalic tubercles usually absent, but may be weakly developed in some species; 3 precorneals, usually clumped; 1–2 median antepronotals, 0–1 lateral antepronotals, 3 dorsocentrals in *rivicola*-group, 4 dorsocentrals in *rivulorum*-group and *abiskoensis* and *saxosus*. Development of cephalothoracic setae variable, from weak to well developed, except in *ashei*, thick and robust. Thoracic horn absent in *abiskoensis*; short (30–110 μm), ellipsoid, and stalked in *rivicola*-group and *saxosus*; long (170–440 μm), tubular, and bubbled or smooth in *rivulorum*-group. Cephalothorax can be dorsally smooth, wrinkled, granular, or rugose, and is variable and inconsistent within species except in *roussellae* and rugose.

Abdomen. Tergites with spine arrangements of 2 kinds: rows of straight spines on III–IV to VIII (*rivicola*-group); or hooklets on II or II–V (*rivulorum*-group). Some species (*abiskoensis, rivulorum, roussellae*) with shagreen of the *Orthocladius (Orthocladius)* type. In all species except *roussellae*, segment I bare of spines. Sternites with spinules on II–VII in different patterns. Dorsal o-setae in *coffmani, luteipes, rivulorum, roussellae*, and *saxosus*; absent in *abiskoensis, ashei, calvus, rivicola*, and *thienemanni*. Anal macrosetae absent. Anal lobe reduced laterally in *rivicola*-group and *saxosus*; strongly developed as large, circular lobes in *coffmani, suspensus*, and *rivulorum*-group; extended distally as long lobes in *abiskoensis* and *roussellae*. Spines on lobes of *roussellae*. Seta on distal half of lobe in *ashei, abiskoensis, coffmani, kanii, rivicola,* and *roussellae*; at midpoint in *abiskoensis, kanii, rivicola, roussellae*, and *thienemanni*; absent in *calvus, luteipes, rivulorum*, and *saxosus*. Lobe bare ventrally, covered with spinules dorsally, usually in a small anterior patch. Genital sheaths of males extended beyond tips of anal lobe in all species; extended beyond tips in females of *luteipes, rivicola, saxosus*, and *thienemanni*. Pedes spurii B absent in *abiskoensis*, and *rivicola*-group; present in *saxosus* and *rivulorum*-group. Pedes spurii A present in *calvus, luteipes, roussellae*, and *saxosus*.

Variation. The hooklets and spines in the spine rows on tergites II–VIII may be directed anteriorly or posteriorly. The direction of these moveable spines has no value as a taxonomic character. Hooklets and spines are probably moved as the pupa leaves its site upon eclosion. Hooklets, or recurved spines, are similar to those in *Orthocladius (Orthocladius)*. In the *rivicola*-group, *calvus* has a patch of spines on tergite II; these are not recurved, but straight and thorn-like (Fig. 37a).

The thoracic horn is stalked in the *rivicola*-group. The horn of *saxosus* is similar to that of *luteipes*, with a weakly developed stalk and a more easily collapsed horn. The thoracic horns of *rivicola, thienemanni*, and *ashei* are similar, with a more prominent stalk and a less easily collapsed horn.

Five dorsocentrals occur in some specimens of *rivulorum*, and no dorsocentrals can be found in some specimens of *saxosus*. The arrangement of dorsocentrals is inconsistent within species (see *rivulorum, roussellae, saxosus*). Dorsocentrals can be branched or forked (*ashei, rivicola*).

Larva (Fourth Instar)

Live larvae with body yellow, brown, or green, or variations of these, as in *saxosus* (yellowish-brown, reddish-brown, or greenish-brown). Head capsule light brown, except in *saxosus, kanii*, and

rousselae, dark brown; occipital margin and mouthparts darker. Eyespots both fused and bipartite, except in *rivicola*, *saxosus*, and *thienemanni*, fused. Mentum convex, with 13 teeth, except in *roussellae*, 15 teeth, and in *rivulorum*, 17–21 teeth. Mandible with 3 inner teeth, 4th tooth either separate or fused; length of apical tooth not longer than combined lengths of next 3 inner teeth except for *rivulorum;* seta interna absent only in *roussellae* when present with 6 branches, apices pointed; outer margin of mandible notched opposite seta subdentalis, rest of margin smooth or crenulate. Epipharynx with 3-toothed pecten; 4 chaetulae laterales, except in *rivulorum*, 9 (Thienemann's "moustache"); 2 chaetulae basales; spinules variable; ungula U-shaped; premandible usually simple, although often notched, except in *calvus*, *roussellae* and one specimen of *saxosus*, bifid; premandible irregularly shaped, blunt, wide, and with a noticeable, rounded inner lobe, except in *rivulorum*, pointed and without a lobe; SI bifid; SII robust, long, simple; SIII slender, long, simple; SIV peg-like, with base; SV peg-like, without base. Antenna 5-segmented; AR 1.38–3.08; Lauterborn organs robust, except in *rivulorum* and *roussellae*, weak to moderately developed; blade usually extended to 4th or 5th segment, except in some *saxosus*, extended beyond the tip. Procercus with 6 terminal and 2 lateral setae. Anal tubules long, rounded, and subequal in *abiskoensis*, *rivulorum*, *roussellae*, and *thienemanni*; dorsal pair shorter and thicker than ventral pair in *luteipes*, *rivicola*, and *saxosus*.

Variation. The color of the head capsule deteriorates after long storage in alcohol; brown head capsules may appear light yellow. Younger instars may have lighter head capsules, especially after molting. The shade or intensity of the head capsule is also geographically variable. Larval skins of *ashei* and *rivicola* reared from Norway have much darker head capsules than larval skins of *ashei* reared from Ireland and larval skins of *rivicola* reared from Canada.

The length of the apical tooth of the mandible depends on the orientation of the specimen. The apical tooth can appear greatly or slightly reduced in the same species, and there appears to be no trend within or between species.

Whether the 4th tooth of the mandible appears to be true (separate) or false (fused) is a character that is both consistent and variable, depending on the species. In *ashei*, *rivicola*, and *thienemanni*, the 4th tooth is fused to the mandible (false). In *abiskoensis* and *rivulorum*, the 4th tooth is separated from the mandible by a groove or space (true). Both conditions occur in *saxosus*. In the type mateial and in reared material from Montana, the tooth is fused; in reared material from Alberta, the tooth is separate. In specimens of *roussellae* collected in the same sample from Wyoming, some specimens have the 4th tooth fused, others separate. Chernovskii (1949) originally used this character in his key to orthoclad larvae, and Pankratova (1970) and Soponis (1977) used this character in *Orthocladius*.

The large and oddly-shaped premandible was rarely orientated in a favorable position to draw. It was difficult to determine whether or not the premandible was notched.

Setae on the larval body appear in different patterns (Fig. 57) and these may be taxonomically useful. Many of the larvae examined, however, had either no setae or only a few short, simple setae. Setae can be lost when larvae are not handled carefully during collection and preservation. Mounting media also affect the retention of setae differently, e.g. setae are retained better in Hoyer's than in either Euparalor balsam. Setae are commonly lost from the procercus. In *rivulorum*, 3 to 6 setae per procercus were observed.

The keys

To use the following keys effectively, good slides are essential. The Palearctic *Orthocladius (Orthocladius)* need to be revised, and there may be difficulties keying these species to subgenus. See Soponis (1977) for labelled structures.

Key to Adult males of *Orthocladius*

1. Hypopygium without well developed dorsal part of inferior volsella (Fig. 2) . . . . . *Orthocladius (Eudactylocladius)*

   Hypopygium with well developed dorsal part of inferior volsella (Figs. 1, 3, 4) 2

2. Eyes extended dorsomedially, male-like (Fig. 12) . . . . . *Orthocladius (Orthocladius)* (part) (Soponis 1977)

Eyes widely separated, female-like (Fig. 13) 3

3. Anal lobe of wing strongly produced; fore tarsal beard present; scutellar setae uniserial or biserial; hypopygium as in Fig. 3 . . . *Orthocladius (Pogonocladius) consobrinus* (Holmgren)

With another combination of characters 4

4. Scutellar setae uniserial 5

Scutellar setae biserial or multiserial 7

5. Gonostylus with robust crista dorsalis (Figs. 32, 33) . . . . . *Orthocladius (Euorthocladius) rivicola* Kieffer (part)

Gonostylus with weak or no crista dorsalis (Figs. 7, 8) 6

6. Virga present or superior volsella collar-like . . . . . *Orthocladius (Orthocladius)* (part) (Soponis 1977)

Virga absent and superior volsella triangular (Figs. 7, 8) . . . . . *Orthocladius (Euorthocladius) abiskoensis* Thienemann & Krüger (part)

7. Antennae reduced and gonostylus with large projection on dorsal edge proximally (Fig. 5) . . . . . *Orthocladius (Orthocladius) ferringtoni* Soponis

Antennae not reduced and gonostylus without large projection on dorsal edge 8

8. Superior volsella collarlike (Fig. 1) 9

Superior volsella not collarlike . . . . . *Orthocladius (Orthocladius)* (part)

9. Dorsocentral setae biserial to multiserial *Orthocladius (Orthocladius) smolandicus* Brundin

Dorsocentral setae uniserial 10

10. Gonostylus with weak or no crista dorsalis (Figs. 7, 8) . . . . . *Orthocladius (Orthocladius) abiskoensis* Thienemann & Krüger (part)

Gonostylus with robust crista dorsalis 11

11. Gonostylus complex; hypopygium (Fig. 4) . . . . . *Orthocladius (Orthocladius) trigonolabis* Edwards

Gonostylus simple; hypopygium otherwise 12

12. Inferior volsella appearing doubled, dorsal part subequal to ventral part as in some *Orthocladius (Orthocladius)* (Figs. 9, 10) 13

Inferior volsella not appearing doubled, dorsal part not subequal to ventral part 14

13. Palpal segment 3>4; anal point weak (Fig. 9) . . . . . *coffmani* n. sp.

Palpal segment 3<4; anal point robust (Fig. 10) . . . . . *anteilis* (Roback)

14. Lateral antepronotals >8; hypopygium as in Figs. 11, 14, 15 . . . . . *roussellae* n. sp.

Lateral antepronotals <8; hypopygium not as above 15

15. Inferior volsella with ventral part extended ventrally and laterally to dorsal part (Figs. 16, 18) 16

Inferior volsella with ventral part not extended, or only extended ventrally below dorsal part 17

16. Anal point with apical seta (Fig. 16); squamals >23 . . . . . *telochaetus* Langton

Anal point without apical seta (Figs. 18, 19); squamals <23 . . . . . *saxosus* (Tokunaga)

17. Inferior volsella with dorsal part arched convexly (Figs. 20, 21) ..... *rivulorum* (Kieffer)
Inferior volsella with dorsal part not arched convexly ..... *rivicola*-group 18

18. AR > 1.75 19
AR < 1.75 22

19. Inferior volsella with dorsal part wide, squared (Figs. 22, 23) 20
Inferior volsella with dorsal part narrow, long (Figs. 25, 28) 21

20. Europe, North America; hypopygium as in Fig. 23 ..... *luteipes* Goetghebuer (part)
Japan; hypopygium as in Fig. 22 ..... *kanii* (Tokunaga) (part)

21. Palpal segment 3>4; hypopygium as in Figs. 25, 26 ..... *calvus* Pinder
Palpal segment 3<4; hypopygium as in Figs. 27, 28 ..... *thienemanni* Kieffer

22. Inferior volsella with most of ventral part covered by dorsal part (Figs. 17, 22, 23) 23
Inferior volsella with most of ventral part extended below dorsal part (Figs. 29–33) 25

23. Palpal segment 3<4; hypopygium as in Fig. 17 ..... *suspensus* (Tokunaga)
Palpal segment 3>4; hypopygium as in Figs. 22, 23 24

24. Europe, North America; hypopygium as in Fig. 23 ..... *luteipes* Goetghebuer (part)
Japan; hypopygium as in Fig. 22 ..... *kanii* (Tokunaga) (part)

25. Inferior volsella with ventral part extended prominently below dorsal part (Fig. 31); Greenland ..... *difficilis* (Lundbeck)
Inferior volsella with ventral part less prominently extended below dorsal part 26

26. Sensilla chaetica absent on ta 1 of p 2; hypopygium as in Figs. 29, 20 ..... *ashei* n. sp.
Sensilla chaetica present on ta 1 of p 2; hypopygium as in Figs. 32, 33 .. *rivicola* Kieffer (part)

Key to Pupae (Exuviae) of *Orthocladius*

1. Anal lobe with 3 anal macrosetae ..... *Orthocladius (Orthocladius)*
..... *Orthocladius (Pogonocladius)*
..... *Orthocladius (Eudactylocladius)*
Anal lobe without anal macrosetae ..... *Orthocladius (Euorthocladius)* 2

2. Tergite II with median patch of hooklets along posterior margin (Figs. 38 a, 39) .....
..... *rivulorum*-group 3
Tergite II usually bare (Figs. 48, 49); if with median patch along posterior margin, then patch with straight spines and not hooklets (Fig. 37 a) ..... *rivicola*-group 8

3. Tergite III with central round patches of strong spines anteriorly (Figs. 38 a, 39 4
Tergite III without central round patches of strong spines anteriorly 6

4. Tergite III with large (>200 μm wide) round patch of spines anteriorly that reaches midline of tergite (Fig. 39) ..... *coffmani* n. sp.
Tergite III with small (<150 μm wide) round patch of spines anteriorly that does not reach midline of tergite (Fig. 38 a) 5

5. Thoracic horn bubbled (Fig. 34 b); tergites IV–VI with rows of spines along posterior margin ..... *rivulorum* Kieffer

Thoracic horn smooth; tergites IV–VI without rows of spines along posterior margins .... *suspensus* (Tokunaga)*

6. Anal lobe with spines on tips (Fig. 41) ..... *roussellae* n. sp.
Anal lobe without spines on tips 7

7. Frontal warts robust (Fig. 43); thoracic horn present (Fig. 34 e); hooklets on tergite II with >100 spines; hooklets in a large patch of 3–5 rows (Fig. 44) ..... *saxosus* (Tokunaga)
Frontal warts weak or absent; thoracic horn absent; hooklets on tergite II with <50 spines; hooklets in a small patch of 1–2 rows (Fig. 45) ..... *abiskoensis* Thienemann & Krüger

8. Tergite II with median patch of strong thorn-like spines along posterior margin (Fig. 37 a) ..... *calvus* Pinder
Tergite II bare 9

9. Pedes spurii A present on sternite VI; spines individually slender (Fig. 37 b) in rows on posterior margins of tergites (Figs. 46, 47) ..... *luteipes* Goetghebuer
Pedes spurii A absent on sternite VI; spines individually robust (Figs. 37 c, d, e) in rows on posterior margins of tergites 10

10. Tergite III with rows of spines on posterior margin (Fig. 42) ..... *thienemanni* Kieffer
Tergite III without rows of spines on posterior margin 11

11. Dorsocentrals thick, robust (Fig. 36); spines in spine rows on posterior margins of tergites IV–VIII individually robust (Fig. 37 e); spines on VI <40 (Fig. 48) ..... *ashei* n. sp.
Dorsocentrals normally developed (Fig. 35); spines in spine rows on posterior margins of tergites IV–VIII individually normally developed (Fig. 37 c); spines on VI >40 12

12. Europe, North America; abdomen as in Fig. 49 ..... *rivicola* Kieffer
Japan ..... *kanii* (Tokunaga)*

Key to Larvae (Fourth instar) of *Orthocladius*

1. Mentum with 2 teeth ..... *Orthocladius (Orthocladius) lignicola* Kieffer
Mentum with 13 or more teeth 2

2. Mentum with >13 teeth ..... *Orthocladius (Euorthocladius)* (part) 3
Mentum with 13 teeth 5

3. Mentum with 15 teeth (Fig. 50 e) mandible without seta interna (Fig. 50 c) ... *roussellae* n. sp.
Mentum with >15 teeth (Fig. 51 e); mandible with seta interna 4

4. Europe, North America; Fig. 51 ..... *rivulorum* Kieffer
Japan ..... *suspensus* (Tokunaga)*

5. Head capsule yellow ..... *Orthocladius (Orthocladius)*
Head capsule brown 6

6. Antenna 4-segmented; Lauterborn organs weak ..... *Orthocladius (Pogonocladius) consobrinus* (Holmgren)
Antenna 5-segmented; Lauterborn organs robust 7

* based on literature; specimens not seen

7. Head capsule dark reddish brown ..... *Orthocladius (Eudactylocladius)*
Head capsule light to dark brown, not reddish ..... *Orthocladius (Euorthocladius)* part 8
8. Mentum with median tooth >1.5X width of 1st lateral (MR > 1.5) 9
Mentum with median tooth <1.5X width of 1st lateral (MR <1.5) 12
9. AR >1.85 10
AR <1.85 11
10. Premandible bifid ..... *calvus* Pinder
Premandible simple ..... *thienemanni* Kieffer
11. Europe, North America; head capsule brown ..... *luteipes* Goetghebuer
Japan; head capsule dark brown ..... *kanii* (Tokunaga)*
12 AR lower (<1.80) ..... *ashei* n. sp., *rivicola* Kieffer
AR higher (>1.80) 13
13. Head capsule dark brown ..... *saxosus* (Tokunaga)
Head capsule light brown or brown ..... *abiskoensis* Thienemann & Krüger

Orthocladius (Euorthocladius) abiskoensis Thienemann & Krüger

Figs. 6–8, 45, 60

"*Orthocladius*" *abiskoensis* Thienemann & Krüger, 1937: 257–265, 267, figs. 1a, 3a, 4a, 5, 6a, 8a, 9a [pupal, larval description].
Lapporthocladius abiskoensis (Thienemann & Krüger), 1937: 266.
Orthocladius (s. str.) *abiskoensis* Edwards, 1937: 144–145 [adult description].
Lapporthocladius abiskoensis (Edwards). Zavřel, 1938: 8, 9 [comparative analysis of larvae]. Thienemann, 1941: 66, 68, 82, 150, 180 [ecology, distribution]. Thienemann, 1944: 564, 647, figs. 20, 21, 197a, 198a [in pupal, larval keys]. Thienemann, 1954: 182, 188, 355, 357 [notes]. Brundin, 1956: 103 [systematic placement]. Fittkau et al., 1967: 358 [checklist]. Fittkau & Reiss, 1978: 418 [checklist].
Orthocladius (O.) abiskoensis Edwards. Goetghebuer, 1942: 35, 37 [in male key, adult description].
"*Orthocladius*" *abiskoensis* Edwards. Saether, 1969: 65 [note].
Orthocladius (Lapporthocladius) abiskoensis Edwards. Pankratova, 1970: 173, 174, 182, 183, fig. 110 [pupal, larval description, in pupal, larval keys].
Orthocladius (Euorthocladius) abiskoensis Edw. Säwedal, 1978: 85, 86 [ecology].
Orthocladius (Euorthocladius) Type III Soponis, 1977: 15–17, fig. 122 [pupal, larval diagnosis, in pupal, larval keys].
[non] *Orthocladius (Euorthocladius)* Type III sp., Simpson & Bode, 1980: 52 [misidentification of *luteipes* and *rivicola*].

Type Locality: Sweden, Lappland nr. Abisko.

Type Material: Lectotype: Male pupa, Lappland, Sweden, 10 VI 1936, A. Thienemann, labelled by Thienemann as *Orthocladius abiskoensis* Edw. Lappland 1936 3d (ZSM). On a slide with paralectotypes, lectotype indicated in ink as in Fig. 7. Paralectotypes (23): same data as lectotype, 8Ex (7M, 1F), 1 larval head capsule, 3MP, 1FP, 1MP abdomen. Same data as lectotype except 3c, 4FP, 5L. The specimens are mounted in balsam on a total of 6 slides and kept at the ZSM. According to notes of Thienemann (pers. comm. F. Reiss), 3d indicates that diverse chironomid larvae were reared, but only 2 specimens hatched and the others died (as pupae); 3c indicates that isolated larvae of *abiskoensis* were reared. The specimens described above are hereby designated lectotype and paralectotype.

* based on literature; specimens not seen

Diagnosis

Orthocladius abiskoensis can be distinguished from other Holarctic species of *O. (Euorthocladius)* by a combination of characters. Adult Male: details of the hypopygium (Figs. 6–8). Pupa: thoracic horn absent, frontal warts weak or absent, tergites II–V with hooklets on posterior margins, hooklets in small patches of 1–2 rows; tergite III without central round patches of strong spines anteriorly. Larva: mentum with 13 teeth, MR<1.5, AR>1.80, head capsule brown.

Derivation of Name: Abisko; L. *ensis*, denoting place, locality.

Description

Adult Male (n=17)

Brown. Small to medium species. Head. Verticals 9–14, postorbitals 1–3. Palps long with 3≥4. AR 1.22–1.71. Thorax. Lateral antepronotals 2–6. Acrostichals 1–13, robust, begin within 2AW. Dorsocentrals 4–12. Prealars 4–7. Scutellars 7–14, usually uniserial, less often biserial (20%). Wing. Length 1.38–2.32 mm. R with 2–10 setae. Squamals 14–33. In one specimen 2 setae on R4+5. VR 1.03–1.12. Anal lobe moderately produced. Legs. LR1 0.57–0.67. LR2 0.44–0.53. LR3 0.48–0.59. Sensilla chaetica on ta1 of p2, 6–22 (15), and p3, 0–8 (15). Hypopygium (Figs. 6–8). Virga absent. Superior volsella triangular with pointed or blunt apices. Inferior volsella with dorsal part nose-like, covering most of ventral part. Crista dorsalis weak.

Variation. The material examined contains variants in 2 or 3 populations. Males of high arctic populations from Isachsen, Northwest Territories, are large specimens, with a robust anal point, squared inferior volsella, and full superior volsella (Fig. 8a). Males from more temperate populations of Caribou Bar Creek, Yukon Territories, (Fig. 8c) more closely resemble Edward's original material (Fig. 6) from Abisko in the superior volsella and slender anal point. At least one specimen from Abisko has a robust anal point. The immature stages of rearings from three Canadian sites (Hazen Camp, Banks Island, Caribou Bar Creek) agree with each other in diagnostic features. The scutellars can be either uniserial or biserial. The number of sensilla chaetica varies in this species. The crista dorsalis is not evident in all specimens.

Edwards (1937) separated *abiskoensis* by the relative lengths of palpal segments 5 to 4, a ratio of 1.5. Here (n=14), the ratio varies from 1.2 to 1.7. The color of the thorax or the patterns of the scutal stripes in *abiskoensis*, characters used by Edwards, were not analysed here because these characters cannot be accurately assessed in slide-mounted material. The shading of the scutellum is also unreliable in slide-mounted specimens, since it is essentially the same in all the material.

Pupa (Exuviae)

Light brown, with dark apophyses on II–VII (variable); length about 3.0–4.25 mm (10). Cephalothorax. Frontal warts weak and cephalic tubercles absent. Precorneals clumped; 2 median antepronotals, 1 lateral antepronotal, moderately developed; 4 dorsocentrals, slightly shorter than precorneals but thicker; arrangement varies. Thoracic horn absent. Thorax dorsally slightly wrinkled along eclosion line.

Abdomen (Fig. 45). Tergites: I bare; II–V with small central patch of recurved hooklets in 1–2 rows along posterior margin; III–VIII with large central patch of spinules separated from posterior spine patch. Sternites: I bare; II–VII with spinules anteriorly in varying amounts; VIII with 2 off-center patches of spinules anteriorly.

Setae on segments I–VIII:

D	4	5	5	5	5	5	5	2		L	1	3	3	3	3	3	4	4
V	1	4	4	4	4	4	4	1		Od	0	0	0	0	0	0	0	0

Anal lobe developed as slender processes with tendency for tips to curve inwards; 2 robust or fine setae, one on proximal half and one at midpoint; genital sheaths extended beyond lobe in male, not in female. Pedes spurii A, pedes spurii B absent.

Variation. Spine patterns are variable: the sternites may appear bare, and anterior spine patches on the tergites may be less developed than described here.

Larva (Fourth Instar)

Body yellow or brown. Head capsule brown. Eyespots bipartite or fused. Head capsule (Fig. 60c) widest midway between eyespots and postoccipital margin. Mentum (Fig. 60b) convex with 13 teeth, median tooth about as wide as 1st lateral; MR 1.0–1.3 (3); median tooth as high as 1st lateral. Ventromental plates extended anteriorly between 2nd and 3rd laterals. Epipharynx (Fig. 60a) with premandible simple, narrowed before enlarged apex; apex is notched in Thienemann material. Chaetula laterales sparse. Mandible (Fig. 60g) with apical tooth as long or longer than 1st inner tooth; outer margin notched opposite seta subdentalis, rest of margin smooth except for occasional notch posteriorly; seta interna present. Antenna (Fig. 60h) with robust Lauterborn organs; blade extended to 4th segment. AR 2.00–2.50 (3). Body bare except in one specimen, haired. Anal tubules (Fig. 60f) subequal.

Variation. Pankratova (1970) described the body as bare, greenish-brown, and the head capsule as dark brown. She described the premandible with 3 blunt teeth. In material examined here, the premandible appears simple.

Biology. Larvae and pupae were collected near Abisko in the moss of a spring. Pupae in gelatinous, half-ellipsoid cases were also collected on bare stones, without vegetation. The species occurs in cold rivers, streams, and springs. Males swarm beside *Micropsectra* (?) *brunippes* Zett. (Thienemann & Krüger, 1937, Thienemann 1941, 1954). *Orthocladius abiskoensis* was previously recorded only from high latitudes, but exuviae have also been collected in Kansas. Adults emerge in June and July in the arctic, and in March in Kansas.

Distribution. Palearctic: Sweden. Nearctic: Canada, USA.

Material Examined. Type material. Non-type Material: Canada (CNC). Northwest Territories: Isachsen, 14-VII-1960, J. F. Mc Alpine, CH1075, 10M, 3F; Hazen Camp, 81° 49'N 71° 18'W, 13-VII-1961, D. R. Oliver, CH1133, 1M w/Ex; same data except 27-VII-1961, Ch1047, 2MP, 2Ex; Banks Is., Masik R., 4-VI-1968, W. R. M. Mason, CH2063, M, F in copula; Harris River, 61° 52'N 121° 19'W, 18-V-1973, FWI Pipeline Proj., CH803.12, 1M w/Ex: CH803.23, 1MP; Bathurst Is., 75° 24'N, 100° 24'W, 25-VII-84, B. Hayes, 1M w/Ex, Yukon Territory: Caribou Bar Creek, 67° 28'N 140° 37'W, 11-VI-1973, D. R. Oliver, CH874, 3M, 1P, 7Ex; same data except 20-VI-1972, CH126, 1M; 19-VI-1972, CH128, 1M; 15-VI-1973, CH562.1, M w/Ex, LS; 18-VI-1973, J. Robillard, CH564.6, M w/Ex, LS, CH564.10, MP w/LS, 29-VI-1972, FWI Pipeline Proj., CH6205, 1L. Sweden: Lappland, 1936, 3d, Thienemann, 5P, 8Ex, 1LS; Lappland, 1938, No. 125, Thienemann, 7L (ZSM). USA. Kansas: Leavenworth Co., Plum Creek, 1.2 mi S, 0.2 mi E of Kickapoo, 24-III-1982, L. Ferrington, 2Ex (KSBS).

Remarks. This species was collected by Thienemann as adult and immature stages in the summer of 1936 at a spring among dwarf birches, near the road Abisko-Björkliden in Swedish Lappland (Thienemann & Krüger 1937, Edwards 1937, Säwedal 1978). Thienemann sent the adult males to Edwards, who initially determined them as „*Orthocladius* ? *rubicundus* Mg. var. or *decoratus* Holmgren?" (Thienemann & Krüger 1937). Thienemann questioned the determination of the adult because of the associated immature stages. The pupa of *rubicundus* belonged to Thienemann's *Rheorthocladius* (=*Orthocladius* s. str.), and Thienemann thought that the unusual pupa of *abiskoensis* belonged to a new species.

To provide Thienemann with a name for the new species, Edwards (1937) published a brief adult description, primarily distinguishing *abiskoensis* from *rubicundus* and *decoratus* by the shading of color on the thorax. He also used the lengths of palpal segments 3 and 4 (here 4 and 5) to distinguish *abiskoensis* from *rubicundus*, adding that the character is individually variable. Edwards regarded *abiskoensis* as a pupal species: "the pupae are so strikingly different, but the adults scarcely if at all distinguishable."

The same year Thienemann & Krüger (1937) provided a detailed description including figures of the pupa and larva of *abiskoensis*, comparing it with the immature stages of *rubicundus*. They cited Edwards's pending adult description, but their own paper was published first. Thienemann & Krüger (1937) was published 15 March 1937 and received in the BM(NH) 8 April 1937. Edwards (1937) was published July 1937 and received in the BM(NH) 16 July 1937 (pers. comm. P. S. Cranston). According to Article 50 of the rules of the International Code of Zoolo-

gical Nomenclature, i.e. the author of a name is the person who first validly publishes it, the authors of *abiskoensis* are Thienemann & Krüger.

Thienemann & Krüger (1937) used "*Orthocladius*" *abiskoensis* in the title and referred to the binomen *O. abiskoensis* once again in the paper. However, inthe last paragraph of the summary, they erected the genus *Lapporthocladius* to accommodate *abiskoensis*. Because the authors referred twice to *abiskoensis* as *Orthocladius*, and because the original specimens are labelled in Thienemann's handwriting as *Orthocladius abiskoensis*, this is interpreted to mean that the authors described *abiskoensis* in *Orthocladius*, and then erected *Lapporthocladius* for the species. Thienemann (1941, 1944, 1954) and others (Fittkau et al. 1967, Fittkau & Reiss 1978) placed *abiskoensis* in the monotypic genus *Lapporthocladius*. Säwedal (1978) synonymyzed *Lapporthocladius* with *Orthocladius*.

Hamilton et al. (1969) recommended that a genus should have all three life stages in a relatively discernible group. Because the male of *abiskoensis* is not distinguishable from other adult *Orthocladius* at the generic level, *abiskoensis* is not placed in another genus, i.e. *Lapporthocladius*. Also, *abiskoensis* is not placed in its own subgenus because the immature stages belong to *O. (Euorthocladius)* as defined here.

Zavřel (1938) considered the generic placement of *abiskoensis* in a description of the immature stages of *Orthocladius frigidus*. He concluded that the larva of *abiskoensis* is closer to the larvae of Thienemann's *Euorthocladius* (excepting *rivulorum*) than to the larva of *frigidus*, and that on the whole, *abiskoensis* belongs to *Euorthocladius*.

Pankratova (1970) redescribed the pupa and larva of *abiskoensis*, reproducing the figures of Thienemann & Krüger (1937). She placed *abiskoensis* in the genus *Orthocladius*, subgenus *Lapporthocladius*, and stated that the species would probably occur in the USSR.

Goetghebuer (1942), treating adults, followed Edwards (1937) and separated *abiskoensis* from *rubicundus* primarily on AR, thoracic color, and palpal proportions. He provided no figures.

Brundin (1956) reviewed the systematic position of *abiskoensis* as an example of incongruity of adult and immature chironomids. He examined two males (one a pupa) of Edwards's original material, specimens in poor condition due to long storage in alcohol. Brundin observed strewn scutellar setae that would place the adult in his subgenus *O. (Euorthocladius)*. However, he concluded that the position of *abiskoensis* was still unstable. Saether (1969) referred to the incongruity, and both Soponis (1977), as Type III, and Säwedal (1978) placed *abiskoensis* in *O. (Euorthocladius)*.

Until now, no figure of the hypopygium of *abiskoensis* has been available. It was impossible to identify the adult of this species without the associated pupal skin. The species is still difficult to identify in the adult male, but this situation occurs in other *Orthocladius*, not just *abiskoensis*.

Orthocladius (Euorthocladius) anteilis (Roback)

Fig. 10

Hydrobaenus anteilis Roback, 1957b: 14, figs. 41–45 [description of female]. Roback, 1959: 2–3, figs. 7–10 [description of male and female]. Cole, 1969: 101 [notes].
Orthocladius anteilis (Roback). Sublette & Sublette, 1965: 155 [checklist].

Type Locality: USA: Utah, Provo River.

Type Material: Holotype. Female, remounted by M. E. Roussel Dillon, in Canada balsam under 5 coverslips, genitalia in lateral view. Original white label: 8. ant. wing Hydrobaenus anteilis Roback 6803 det. S. S. Roback. Red label: Utah, Summit Co., South Fork of Provo River on Stewart's Ranch, 20 Feb. 1954, Gerald D. Brooks (ANSP). Paratype. Female, same data, not seen, reportedly in University of Utah collection.

Diagnosis: The male of *Orthocladius anteilis* can be distinguished from other males of *O. (Euorthocladius)* by palpal segment 3<4 and details of the hypopygium (Fig. 10). The pupa and larva are unknown.

Derivation of Name: ant; L. *ilis*, having the nature or quality of.

Description: See Roback (1957b, 1959).

Biology: Adults have been collected along rivers in western USA.

Distribution: Nearctic: USA.

Material Examined: Type Material. Non-type Material: Idaho: Freemont-Teton Co. border, north Fork of Teton R., Hwy. 32, 6-III-1965, A. v. Nebeker (MINN), 1 M. Photographs of males and females of Montana specimens of Roback (1959), supplied by J. E. Sublette.

Remarks: Roback (1957b) described this species from two females collected along the Provo River in Utah. Later Roback (1959) described the male and gave a further description of the female based on five males and two females collected along the Blackfoot and Clard Fork Rivers in Montana.

The holotype is an adult female, but the female of *anteilis* has never been associated through rearing or by copulation with the male. The males and females from Montana, also unassociated, do not convincingly belong to *anteilis*. Other species of *O. (Euorthocladius)*, e.g. *saxosus* and *coffmani*, occur in mountain rivers of the western USA so that locality and habitat cannot determine species in this subgenus. Although the study of females has advanced (e.g. Saether 1977) since Roback's description, it is still not possible to distinguish females of *O. (Euorthocladius)* to species.

To define the limits of *anteilis*, it is necessary to study reared females and reared males. Until such specimens become available, the males described by Roback (1959) are tentatively recognized as *anteilis*.

Orthocladius (Euorthocladius) ashei n.sp.

Figs. 29, 30, 36, 37e, 48, 54

Orthocladius rivicola Kieffer. Thienemann, 1911: 637 [pupa].
Orthocladius (Euorthocladius) cf. *thienemanni* (Kieffer). Halvorsen et al., 1982: 119 [record in Norway].
Orthocladius (Euorthocladius) rivicola β Rossaro, 1982: fig. 31 [pupa]. Langton, 1984: 142, fig. 49 [pupa].
Orthocladius (Euorthocladius) ? *rusticus* Goetghebuer. Murray & Ashe, 1983: 224, 225, 230 [checklist, pupa].

Type Locality: Ireland: River Flesk.

Type Material: Holotype. Reared male with larval skin and exuviae. Ireland, Kerry Co., Sta. 6, Clydagh Br., River Flesk, 16-V-1978, Drift D7, W114826, reared 16th–19th, P. Ashe, in gelatinous case. On slide, deposited in the National Museum of Ireland, Type No. NMI 106: 1984. Paratypes (83). Same data as holotype, 1 reared M w/LS, 1 reared M with LS, Ex Bulgaria, r. Bistriza, outfall, 14-IV-1971, N. Natchev, 1 Ex (NAT). Germany. River Isar, ca. 500 m oberhalb Loisach-Mündung, 3-IV-1986, F. Reiss, 5 Ex; Stauseen, Unterer Inn, drift, 6-IV-1978, EgIa, F. Kohmann, 1 Ex; Westfalia, Urf-Talsperre, Sta. I, 4-IV-1910, A. Thienemann, 5 Ex; Westfalia, Glor, 7-VI-1908, A. Thienemann, 2 Ex; Westfalia, Fulbecke-Talsperre, 14-IX-1909, Oberfl., A. Thienemann, 1 Ex Ireland. Kerry Co., River Flesk, Sta. 1a, V964894, Ranunculus, 14–17-V-1978, P. Ashe, 1 reared F w/Ex (slide), 2 reared F w/Ex (alcohol); same data except 14–19-V-1978, 1 F w/Ex (alcohol); River Doddler, above Bohemabroinne Bridge, 3-IV-1978, P. Ashe, 1 F w/Ex, probable LS (alcohol). Italy. Po River, 1975, 1976, B. Rossaro, 12 Ex (slides), 40 Ex (alcohol). Norway. Ekse, HOi: Vaksdal, "The Weir Project," 11-VI-1979, E. Wilassen, 1 reared M w/Ex, LS (ZMB) (data in Halvorsen et al., 1982). Sweden. Lappland, Thienemann: River Abisko, 24-IV-1936, 48a, ex mosses, 2 Ex; Lake Abisko, 23-IV-1936, 40, ex moses, 3 Ex; Lke Kanevegge, 17-VII.1937, 98c, surface drift, 2 Ex; delta of River, 17-VII-1937; Abisko, 19-VII-1937, 101, surface drift, 1 Ex (ZSM). Paratypes will be deposited as follows: 2 reared F, Ireland, alcohol (NMI, No. NMI 106: 1984); 1 reared F, Ireland, alcohol (BMNH); 1 reared M, Ireland, slide, 1 reared F, Ireland, alcohol (DUB); 1 reared M, slide Ireland (FSCA); 1 reared M, Norway, slide (ZMB); 1 reared F, Ireland, slide, (ZSM); Ex, Bulgaria, slide, (NAT); Ex, Italy, alcohol, (ROSS); Ex, Italy, slides (CNC, BMNH, FSCA, COFF); Ex, Sweden and Germany (ZSM).

Diagnosis:

Orthocladius ashei can be distinguished from other Holarctic *O. (Euorthocladius)* by a combination of characters. Adult male: low AR (<1.80), absence of sensilla chaetica on ta1 of p2, and details of the hypopygium (Figs. 29, 30). Pupa: tergite II bare, robust dorsocentrals and robust spines on margins of tergites IV–VIII. Larva: mentum with 13 teeth, MR<1.5; cannot be distinguished from *rivicola*.

Derivation of Name: this species is named after Patrick Ashe, for his help in providing reared material and for his interest in this new species.

Description

Adult Male (n=4)

Dark brown to light yellow. Small species. Head. Verticals 12–13, postorbitals 1–2 (3). Palps normal with 3≥4. AR 1.18–1.62. Thorax. Lateral antepronotals 5–7 (3). Acrostichals 5–8, robust, beginning within 1–2 AW. Dorsocentrals 8–11. Prealars 5–7. Scutellars 7–15 (3), weakly biserial (Norway) to multiserial. Wing. Length 1.68–1.90 mm (3). R with 6–10 setae. Squamals 8–18. VR 1.03–1.22 (2). Anal lobe slightly produced. Legs. LR1 0.69–0.77 (3). LR2 0.48–0.56 (2). LR3 0.53–0.59 (3). Sensilla chaetica absent. Hypopygium (Figs. 29, 30). Virga present, moderately well developed. Superior volsella collar-like. Inferior volsella with dorsal part nose-like, or squared, and ventral part weakly extended below. Crista dorsalis long.

Pupa (Exuviae)

Light brown; length 3.1–3.4 mm (5) .

Cephalothorax. Frontal warts absent; cephalic tubercles weak. Precorneals clumped, PC1, thick and almost 2x as long as PC2 and PC3; 1 median antepronotal, 1 lateral antepronotal, 3 dorsocentrals (Fig.36), slightly longer than PC1 and thicker. Thoracic horn ellipsoid, light brown, clear, stalked, length 30–60 μm (5). Thorax dorsally wrinkled to granulose along eclosion line and anterior to wing base.

Abdomen (Fig. 48). Tergites: I–III bare; IV–VIII with rows of individually heavy spines along posterior margin (Fig. 37e); V–VIII with central patches of robust spinules anteriorly. Sternites: I, VIII bare; II, III with large central patch of spinules; IV–VII with anterior patch of spinules.

Setae on segments I–VIII (robust):

D	2	5	5	5	5	5	5	2	L	1	2	3	3	3	3	3	2
V	1	4	4	4	4	4	4	0	Od	0	0	0	0	0	0	0	0

Anal lobe greatly reduced; 2 setae on distal half. Pedes spurii B and pedes spurii A absent. Genital sheaths extended beyond lobe in male, not in female.

Variation. Dorsocentrals can be forked. The spines in the posterior rows on tergites IV–VIII are individually robust (Fig. 37e), much more robust than those in *rivicola* (Fig., 37c). The number of spines in these rows are higher in females than in males, and are not significantly different.

	ashei females (n = 5)		*ashei* males (n = 5)		Student's t
IV	30.60 ± 11.04	(20–45)	22.60 ± 8.20	(14–33)	1.3009
V	33.20 ± 8.87	(27–48)	25.60 ± 5.86	(20–34)	1.5988
VI	28.20 ± 8.32	(22–40)	22.20 ± 6.26	(18–33)	1.2887
VII	22.20 ± 7.22	(16–30)	18.60 ± 2.97	(14–22)	1.0307
VIII	16.00 ± 5.20	(12–25)	14.60 ± 3.36	(11–20)	0.5058

The number of spines in these rows can be used to distinguish most specimens of *ashei* from *rivicola* ,and are significantly different.

	ashei (n = 10)		*rivicola* (n = 10)		Student's t
IV	26.60 ± 10.09	(14–45)	64.10 ± 25.30	(36–104)	4.3544
V	29.40 ± 8.14	(20–48)	69.30 ± 21.15	(47–100)	5.5676
VI	25.20 ± 7.63	(18–40)	62.10 ± 20.91	(41–103)	5.2428
VII	20.40 ± 5.54	(14–30)	50.70 ± 18.87	(33– 90)	4.8725
VIII	15.30 ± 4.19	(11–25)	35.40 ± 16.24	(20– 70)	*3.7893

(p >.001 except for *, p >.01)

Exuviae from Italy show variation in size, shade of color, and thickness and length of dorsocentrals. Generally *ashei* is lighter and more weakly chitinized than *rivicola,* and the cephalothorax of *ashei* is as light as the abdomen, whereas in *rivicola* the cephalothorax tends to be darker than the abdomen. Separation of exuviae of *ashei* from *rivicola* in alcohol is not foolproof, and slides should be made for positive determinations.

Larva (Fourth Instar)

Body green with blue tinge when live (Thienemann notebooks). Head capsule brown; preserved, yellow. Eyespots absent in reared specimens. Mentum (Fig. 54e) with 13 teeth, median tooth about as wide as 1st lateral; MR 1.3 (3); median tooth as high as 1st lateral. Ventromental plates extended anteriorly between 2nd and 3rd laterals. Premandible simple, with blunt or squared apex; apex may appear notched. Chaetula laterales sparse. Mandible (Fig. 54c) with apical tooth as long or longer than 1st inner; outer margin notched opposite seta subdentalis; rest of margin smooth except for occasional notch posteriorly; seta interna present. Antenna (Fig. 54d) with robust Lauterborn organs; blade extended to 4th segment. AR 1.80 (1). Body with simple setae, some short and stiff, some long and curved, apparently arranged like that of *saxosus.* Anal tubules not distinguishable.

Biology: The larvae live in gelatinous tubes in running water and are associated with plants. Ashe reared larvae from *Ranunculus,* and Thienemann collected exuviae from mosses in Lake Abisko and River Abisko. The species occurs with *rivicola* in Brehm, Italy, and River Isar, Germany (Ex). Adults emerge in April, May, and June.

Distribution: Palearctic: Bulgaria, France, Germany, Ireland, Italy, Norway, Sweden.

Remarks: This species was reared by Patrick Ashe from the River Flesk, Ireland. Originally Ashe (pers. comm.) suspected that this species might be *Orthocladius rusticus* Goetghebuer, based on a slide of an exuviae labelled *rusticus* in the Humphries collections (Murray & Ashe 1983). Professor Humphries reared larvae to adults, then sent the adults to Goetghebuer or Freeman for a positive determination to species. When the name was provided she labelled the associated immature material with the corresponding determination. The holotype male of *Orthocladius rusticus* Goetghebuer belongs to *Chaetocladius* (Soponis 1986) and is not conspecific with *Orthocladius ashei.*

Dr. Declan Murray (Murray & Ashe 1983) has seen material of *O. ashei* in the Humphries collection collected by Thienemann in "Norway", identified by Thienemann as *Euorthocladius thienemanni.* Murray has collected *ashei* in Norway and France.

Orthocladius ashei is morphologically similar in all stages to *rivicola:* the larvae of these two species could not be distingushed. These two species can most easily be distinguished as pupae.

Orthocladius (Euorthocladius) calvus Pinder

Figs. 25a, 26, 37a, 37f

Orthocladius (Euorthocladius) calvus Pinder, 1985: 235–241, figs. 1–3 [description of male, female, pupa, and larval].
Orthocladius (Euorthocladius) calvus Pinder. Ladle et al., 1985: 243–254 [biology].
Orthocladius (Euorthocladius) Pe1. Langton, 1984: 140, figs. 48b [in pupal key].
Spaniotoma (Orthocladius) thienemanni Kieffer. Edwards, 1929: 344, 345, fig. 6m.

Type Locality: England: Dorset, Waterston.

Type Material: Holotype (not seen). Male with associated exuviae, Dorset, Waterston experimental channel, 7 May 1981, J.A.B. Bass (BMNH). Assorted paratypes, BMNH and FBA (Pinder 1985).

Diagnosis:

Orthocladius calvus can be distinguished from other Holoarctic species of O. *(Euorthocladius)* by a combination of characters. Adult Male: high AR (1.73–2.08), palpal segment 3>4, and details of the hypopygium (Figs. 25, 26). Pupa: patch of straight thorn-like spines on tergite II (Fig. 37a) and rows of spines on posterior margins of tergites III–VIII. Larva: mentum with 13 teeth, MR>1.5, high AR (>2.00), and premandible bifid.

Derivation of Name: L. *calvus*, hairless. Pinder (1985) named this species for the absence of dorsal setae on the anal lobe of the pupa.

Description: See Pinder (1985).

Biology: Larvae are early colonizers of artificial recirculating streams where they inhabit gravel (Pinder 1985). For a detailed account of growth, development, and production of *calvus* see Ladle et al. (1985). Based on adult males, *Orthocladius calvus* occurs with *thienemanni* in the River Schwentine.

Distribution: Palearctic: England, Germany.

Material Examined: Paratypes. England, Dorset, Waterston Experimental Channel, 7-V-1981, coll. J.A.B. Bass, L.C.V. Pinder, 1M w/Ex, 1F w/Ex, 1L. Nontypes. England. Hitchin, Herts, 28-IV-1916, F. W. Edwards, 1916-105, 1 M (BMNH) (misident. of *thienemanni*); Gloucester, Minchinghampton, 16-IV-1893, Miss G. Ricardo, B. M. 1920-126, 1M (BMNH) (misident. of *thienemanni*). Germany. River Schwentine, East Holstein, 1935, leg. A. Thienemann, Schwentine 1935 S. 4, 1 M (ZSM) (misident. of *thienemanni*).

Remarks: Pinder (1985) described this species from several males and females with associated exuviae, and from larvae collected in an artificial recirculating stream system in southern England.

The adult males of *calvus* are very similar to *thienemanni* and will present problems in identification unless associated exuviae are available. The male of *calvus* can be distinguished from that of *thienemanni* by the relative lengths of palpal segments 3 and 4, and by the relatively straight margin of the dorsal part of the inferior volsella. Although this hypopygial character holds for the type material and one male from River Schwentine in Germany (Fig. 26), the margin in the *calvus* from Gloucester, England looks rounded (Fig. 25a) as in all *thienemanni* (Figs. 27, 28), and the margin in *thienemanni* from River Schwentine (Fig. 25b) looks like that in *calvus* (Fig. 26). The Herts material was identified as *O. thienemanni* by Edwards, but this material belongs to *calvus* based on the relative length of palpal segment 3 and 4. Brundin's (1956) figure of *O. thienemanni* looks like *thienemanni*.

The exuviae of *calvus* and *luteipes* (Figs. 46, 47) are morphologically similar; *calvus* can be distinguished by the central spine patch on the posterior margin of tergite II (Fig. 37a) and the less robust spines in the tergal spine rows (Fig. 37f) and shagreen. The bifid premandible of the larva is distinctive in *calvus*. However, whether or not the premandible is bifid is difficult to determine in *O. (Euorthocladius)*, and has not been clearly established for most species.

Additions to Pinder's (1985) description include: Male. Head female-like, scutellars, biserial, sensilla chaetica absent in paratype male, present on ta1 of p2 in nontype male. Pupa. Pedes spurii A on IV or V to VII.

Orthocladius (Euorthocladius) coffmani n. sp.

Figs. 9, 34a, 39

Orthocladius (Euorthocladius) species 2, Coffman & Ferrington, 1984: figs. 25.394, 25.395 [pupa].

Type Locality: USA Alaska, Portage.

Type Material: Holotype. Male pupa, USA, Alaska, Portage Glacial Pool, 20-VII-1977, #23, D. Wartinbee. Specimen dissected and parts placed in Canada balsam under 6 coverslips on a slide. Deposited in the FSCA. Paratypes (10). Canada. Alberta, Waterton Park, 21-VII-1967, A. L. Hamilton, A.3.1., 4 Ex (FWI). USA. Colorado, Gunnison Co., Beaver Dam on East R. 3.1 mi. N. of Gothic, 13-VII-1982, L. Ferrington No.-Co. #19, 3 Ex (KSBS). Idaho, East Fork Salmon River, 11-IV-1977, #PE 122, J. Sedell, 2 Ex (COFF). Montana, Beartooth-Absaroka Wilderness Area, 31-VII-1979, E.A. Wells, CH6965.1, 1FP (CNC).

Diagnosis:

Orthocladius coffmani can be distinguished from other Holarctic species of *O. (Euorthocladius)* by a combination of characters. Adult Male: palpal segment 3>4, multiserial scutellars, and details of the hypopygium (Fig. 9). Pupa: hooklets on II, large round patches of spines on III–VII, seta on anal lobe. Larva: Unkown.

Derivation of Name: This species is named after William P. Coffman, for providing associated material of this species and exuviae of other *Orthocladius* over the years.

Description

Adult Male (n=1)

Brown. Medium species. Head. Verticals 12, postorbitals 1. Palps long with 3>4. AR cannot be determined. Thorax. Lateral antepronotals 3. Acrostichals absent. Dorsocentrals 15. Prealars 5. Scutellars 16, multiserial. Wing. Squamals 20. Other characters cannot be determined. Legs. Measurements cannot be determined. Hypopygium (Fig. 9). Virga absent. Superior volsella collar-like. Inferior volsella with dorsal part squared and ventral part protruding like dorsal part, appearing double-lobed. Anal point weak with pointed apex. Crista dorsalis robust.

Variation. The virga is not visible, but it may be concealed in a mass of tissue.

Pupa (Exuviae)

Brown with darker apophyses on all tergites, and darker shading on cephalothorax and anal lobe. Length 3.7–4.8 mm (3). Cephalothorax. Frontal warts absent; cephalic tubercles weak; protuberances between bases of antennal sheaths below cephalic tubercles. Precorneals clumped, almost 3x as long as dorsocentrals; 1 median antepronotal, weak, 0 lateral antepronotals; 4 dorsocentrals, reduced spaced in a row. Thoracic horn (Fig 34 a) long, tubular, bubbled, light brown, length 220–310 μm. Thorax dorsally wrinkled along eclosion line.

Abdomen (Fig. 39). Tergites: I bare; II with large patch of recurved hooklets in about 15 rows; reduced patch of hooklets on III–V; III–VII with large circular patch of posteriorly-directed spines along anterior margin; patches of spinules on II–VIII. Sternites: I, IV, V bare, or at most with some spinules anteriorly; II, III with central patch of spinules along anterior margin; VI–VIII with 2 off-center patches of spinules anteriorly.

Setae on segments I–VIII:

D	4	4	5	5	5	5	5	1	L	1	3	3	3	3	3	3	3
V	2	2	2	3	3	3	3	1	Od	0	0	1	0	1	1	1	1

Anal lobe strongly developed into large, circular lobes; usually margin is smooth, at most margin is wrinkled along distal $^2/_3$; 1 ventral robust seta, on distal half. Pedes spurii A absent; pedes spurii B on II, weak. Genital sheaths extended beyond lobes in male, not in female.

Variation. Females appear larger than males.

Biology: Exuviae were collected from cold waters of mountain rivers and glacial pools. Adults emerge in April and July.

Distribution: Nearctic: Canada (Alberta); USA (Alaska, Colorado, Idaho, Montana)

Remarks: This species is a member of the *rivulorum*-group. The weak and pointed anal point is a distinguishing feature of the male, found only in one other species of *O. (Euorthocladius), abiskoensis*. The hypopygium resembles that of *O. (Orthocladius)* more than that of *O. (Euorthocladius)*. The pupa may be confused with *rivulorum*, but the spine patches on tergites III–VIII are much larger in *coffmani*. In Coffman & Ferrington (1984), this species will key to couplet 45. The female and larva remain unknown.

Orthocladius (Euorthocladius) difficilis (Lundbeck)

Fig. 31

Chironomus difficilis Lundbeck 1898: 282 [description of male, female].

Orthocladius difficilis Lundbeck. Kertész, 1902: 217 [catalogue]. Johannsen, 1905: 267, 277 [in adult key; description of male, female].

Orthocladius (Orthocladius) difficilis Lundbeck. Andersen, 1937: 63 [in adult key].
Orthocladius difficilis (Lundbeck). Sublette & Sublette, 1965: 156 [checklist].
Orthocladius (Euorthocladius) difficilis (Lundbeck). Oliver, 1970: 103, 104, figs. 4–6 [designation and description of lectotype male].

Type Locality: Greenland; Kangersuak.

Type Material: Lectotype: Adult Male, Greenland, Kangersuak, 22/9/1890. Mounted in balsam under 5 coverslips on slide (UCOP). Typed label Chironomus *difficilis* Ldbk. Written LECTOTYPE, D. R. Oliver 1969. Red label with Type written; also date written.

Diagnosis

The male of *Orthocladius difficilis* can be distinguished from other males of *O. (Euorthocladius)* by the low AR and details of the hypopygium (Fig. 31). The pupa and larva are unknown.

Derivation of Name: L. *difficilis*, not easy, troublesome.

Description: See Oliver (1970).
Biology: Unknown.
Distribution: Nearctic: Greenland.

Material Examined: Lectotype.

Remarks: This species was reported in the literature primarily as occurring in Greenland, and was not identifiable until Oliver's (1970) redescription, where he also designated a lectotype and provided a figure of the hypopygium.

The male is a typical *O. (Euorthocladius)* with female-like eyes, biserial scutellars, crista dorsalis on gonostylus, and collar-like superior volsella. Acrostichals are absent.

This species is part of the *rivicola*-group, and the male can be distinguished from *thienemanni* by the lower AR (1.24 in *difficilis*, >1.80 in *thienemanni*) and from *rivicola* by salient features of the hypopygium. Both *rivicola* and *thienemanni* occur in Greenland, and specimens from Greenland were examined: a single male of *rivicola* (acrostichals present, AR=1.35) and exuviae of *thienemanni*.

The immature stages of *difficilis* are unknown. Rearings of *difficilis* from southwest Greenland are needed to better understand the species.

Orthocladius (Euorthocladius) kanii (Tokunaga)

Fig. 22

Spaniotoma (Orthocladius) kanii Tokunaga, 1939: 315–318, figs. 13, 36, 53, 54, 68, 76, 86, 91, 104, 114, 121, 131, 142, 157 [description of male, female, pupa, and larva]. Tokunaga, 1959; 1973: 641 [pupa, larva, fide Sasa & Yamamoto, 1977]. Thienemann, 1954: 345 [note].
"Spaniotoma (Orthocladius)" kanii Tokunaga. Thienemann, 1944: 567, 649 [in pupal, larval keys].
Orthocladius (sen. str.) *kanii* Tokunaga. Tokunaga, 1964: 17, fig. 4 [male, female].
Orthocladius kanii (Tokunaga, 1939). Sasa & Yamamoto, 1977: 310 [checklist].
Orthocladius (Euorthocladius) kanii (Tokunaga, 1939). Sasa, 1979: 26–28, figs. 40–43 [description of male, female, pupa, and larva]. Sasa, 1981:87 [survey record].

Type Locality: Japan: Kyoto.

Type Material: Holotype. Male, Japan, Kyoto, Nishigamo, Jan 1936, M. Tokunaga (2 white labels, printed). Abdomen from segment II to hypopygium mounted on a slide in Canada balsam under one coverslip by A.R. Soponis. Paratypes (?8). Same data as holotype, parts of males and females mounted in Canada balsam on 4 slides. Slide 1: hypopygium with abdominal segments VII, VIII. Slide 2: hypopygium with abdominal segment VIII. Slide 3: 4 coverslips, with 4 thoraces, 3 thoraces, 8 heads (4M, 4F), and parts of antennae, legs, thoraces. All type materials are retained in the Entomological Laboratory of Kyushu University. The only locality data in the vials were those of the holotype, and paratypes were assumed to have the same data. Paratypes from other dates and localities were not located.

Diagnosis

Orthocladius kanii can be distinguished from other species of *O. (Euorthocladius)* by a combination of characters. Adult Male: details of the hypopygium (Fig. 22); distinguishable from *luteipes* by distribution. Pupa: tergite II bare; rows of spines on margins of tergites IV–VIII; distinguishable from *rivicola* by distribution. Larva: mentum with 13 teeth, MR>1.5, low AR (<1.85); head capsule brown; distinguishable from *luteipes* by distribution.

Derivation of Name: This species was named for Mr. T. Kani, who collected the type specimens with M. Tokunaga (Tokunaga 1939: 318).

Description: See Tokunaga (1939) and Sasa (1979).

Biology: The larvae are widely distributed in torrential streams throughout Japan (Sasa, 1979: 28). The larvae live in oval, clear, gelatinous cases, 8–10 mm long, 4–5 mm wide, and 3–5 mm high, often covered with diatoms, and closely adhering to surfaces of stones on these streams (Tokunaga, 1939).

Distribution: Japan.

Material Examined: Type material.

Remarks: Tokunaga (1939) described this species from an unspecified number of males, females, pupae, and larvae collected in torrential streams in the suburbs of Kyoto, Japan. Sasa (1979) gave another detailed description of the species in all stages.

Orthocladius kanii is morphologically similar to *luteipes* in the adult male and larva. However the pupae are different: weaker spines occur in rows on IV–VIII in *luteipes*, whereas stronger spines occur in rows on IV–VIII in *kanii*; pedes spurii A are present on sternites V–VII in *luteipes*, and entirely absent in *kanii*. There was no opportunity to examine pupal material of *kanii*; however, detailed illustrations of the pupal abdomen (Sasa 1979, fig. 42b) and the pupal sternite VII (Tokunaga 1939, fig. 76) show no pedes spurii A. It is unlikely that both authors would have missed these prominent structures in their drawings. In addition, the tergal spine patterns of *kanii* more closely resemble those of *rivicola* than of *luteipes*. Thienemann (1954) remarked that he knew of no European parallel of *kanii*.

The extant type series, which contains only parts of male and female adults, was slide-mounted and examined. Variation of the hypopygium can be seen here (Fig. 22), and in Sasa (1979, fig. 41), Tokunaga (1939, fig. 36), and Tokunaga (1964, fig. 4). The figure in Tokunaga (1964) looks distorted and the specimens have a much higher AR (1.5–2.2) than that recorded for the species (1.4–1.7).

Orthocladius (Euorthocladius) luteipes Goetghebuer

Figs. 1, 23, 24, 37b, 46, 47, 53

Orthocladius luteipes Goetghebuer, 1938: 457, 458, fig. 6 [description of male]. Reiss, 1983: 176 [checklist]. Rossaro, 1984: table 2 [record].

Euorthocladius luteipes Goetghebuer. Thienemann, 1939: 6, 7 fig. 2b [description of pupa, larva]. Thienemann, 1944: 559, 648, fig. 14b [in pupal, larval key]. Thienemann, 1954: 347 [ecology].

Orthocladius (Orthocladius) luteipes Goetghebuer. Goetghebuer, 942: 34, 49, fig. 75 [description of male; in key to males].

"*Orthocladius*" *luteipes* G. Fittkau et al., 1967: 363 [checklist]. Fittkau & Reiss, 1978: 422 [checklist].

Orthocladius (Euorthocladius) luteipes (Goetghebuer). Rossaro, 1978b: 184, 185 fig. 1 [record, notes on males and species]. Langton, 1984: 144, fig. 49b [in pupal key]. Şahin, 1984: 81, figs. 203–205 [in larval key].

Orthocladius (Euorthocladius) Type III sp. Simpson & Bode, 1980: 13, 52 [partim] [larval description, photograph, in larval key].

Orthocladius (Euorthocladius) cf. *luteipes*. Coffman, 1973: Table 1 [ecology].

Orthocladius (Euorthocladius) species 4 Coffman & Ferrington, 1984: figs. 25.410, 25.411 [pupa].

Type Locality: Austria.

Type Material: Holotype. Male, Basse-Autriche, Dr. Mitis, TN18 (1938) (2 original ink labels of Goetghebuer), R. I. Sc. N. B. 18.073. Mounted on slide in Canada balsam under 2 coverslips by A. R. Soponis; in poor condition, body still pressed between celluloid.

Diagnosis

Orthocladius luteipes can be distinguished from other Holarctic species of *O. (Euorthocladius)* by a combination of characters. Adult Male: details of the hypopygium (Figs. 23, 24). Pupa: Pedes spurii A on sternites V–VIII; tergites IV–VIII with rows of slender spines on posterior margins. Larva: mentum with 13 teeth, MR>1.5, AR<1.85 (separable from *Kanii* by distribution).

Derivation of Name: L. luteus, yellow; most likely refers to the color of the adult male as described by Goetghebuer (1938).

Description

Adult Male (n=3)

Dark brown (OD: yellow with black bands, abdomen brownish). Medium species. Head. Verticals 16–20 (2), postorbitals 2–3 (2). Palps normal with 3≥4. AR 2.00 (1) (OD: 2.04). Thorax. Lateral antepronotals 2–5. Acrostichals 0–4, robust, begin within 2 AW. Dorsocentrals 6–11. Prealars 6–8 (2). Scutellars 15–18, biserial or multiserial. Wing. Length 2.15–2.58 mm (2). (OD: 2.15). R with 7–11 setae. Squamals 24–31. Anal lobe cannot be determined in my material (OD: produced). Legs. LR1 0.69 (1). LR2 0.48 (1). LR3 0.53 (1). (OD: LR1 0.78). Sensilla chaetica on ta1 of p2 (7–11) (2). Hypopygium (Figs. 23, 24). Virga present. Superior volsella collar-like. Inferior volsella with dorsal part squared, covering ventral part. Crista dorsalis long.

Variation. The acrostichals are missing on the type, and a single male specimen has sockets but no setae. Acrostichals are present on the male pupa. Rossaro (1978b) reported that *luteipes* has an average AR of 1.6 and an average wing length of 2.8 mm.

Pupa (Exuviae)

Light brown to brown with darker apophyses on I–VI, variable; some parts of conjunctives V–VI and VII–VIII darker. Length 3.50–5.00 mm (20). Cephalothorax. Frontal warts weak and cephalic tubercles absent. Precorneals weak, $1^1/_2$x as long as dorsocentrals; 2 median antepronotals, 1 lateral antepronotal, weak to strong; 3 dorsocentrals, robust, thicker than procorneals. Thoracic horn ellipsoid, light brown, filled or clear, stalked but not often seen; length 80–110 μm (20). Dorsum of thorax usually smooth, may be wrinkled or sculptured, expecially along eclosion line with granular pattern mesad of wing base.

Abdomen (Figs. 46, 47). Tergites: I–III bare; IV–VIII with rows of straight, slender spines along posterior margin (Fig. 37b); V–VIII with central patch of spinules, more extensive on each succeeding tergite; VII, VIII with spinules along anterior margin. Sternites: I bare; II–V with spinules on anterior half; VI–VIII with 2 off-center patches of spinules anteriorly.

Setae on segments I–VIII:

D	4	5	5	5	5	5	4	1		L	1	3	3	3	3	3	3	3
V	2	3	3	3	3	3	3	0		Od	0	1	1	1	1	1	1	0

Anal lobe greatly reduced, setae absent. Genital sheaths extended beyond lobe in male and female. Pedes spurii B absent; pedes spurii A robust, on V–VII.

Variation. Tergites may have sculpturing; pedes spurii A may be absent on V, VII, always present on VI. Setae are weak (Germany) to strong (Italy). Shagreen may be a small to large patch (Figs. 46, 47). Specimens are small (North America) to large (Europe). European specimens have more spines in spine patch IV–VIII than North American specimens. North American specimens have more dark apophyses than European. Posterior spine rows are absent from IV in one specimen from Germany.

Larva (Fourth Instar)

Body yellow. Head capsule brown. Eye spots bipartite or fused. Mentum (Fig. 53c) with 13 teeth, median tooth about 2x as wide as 1st lateral; MR 1.6–2.4 (6); median tooth as high as 1st lateral. Ven-

tromental plates extended anteriorly between 1st and 2nd laterals. Premandible simple, with notched apex. Chaetula laterales sparse. Mandible (Fig. 53a) with apical tooth as long or slightly longer than 1st inner tooth; outer margin notched opposite seta subdentalis, rest of margin smooth except for occasional notch posteriorly; seta interna present. Antenna (Fig. 53b) with robust Lauterborn organs; blade extended to 4th segment. AR 1.50–1.88 (6). Body with simple setae, most likely arranged like that of *saxosus*. Anal tubules long, rounded, with dorsal pair shorter and thicker than ventral pair.

Biology: This species has been collected from rivers and creeks. It occurs with *rivicola* in habitats in Oregon (South Santiam River) and Pennsylvania (Delaware River, Big Bushkill Creek, and Linesville Creek). Thienemann (1939, 1954) reported free-living larvae and pupae in gelatinous cases on stones. Adults emerge in April in Pennsylvania (Coffman, 1973), and generally from February through May.

Distribution: Palearctic: Austria, Germany, Italy, Turkey. Nearctic: USA (Georgia, New York, North Carolina, Oregon, Pennsylvania).

Material Examined: Type material. Non-type Material: Germany: Lunzer – 1940, 2-IV-40, A. Thienemann, 25 Ex; Partenkirchen 1933 No. 72, A. Thienemann, 1L, Mitis No. 19, 3L (ZSM). Italy: t. Ticiur, 26-3-1973, Rossaro, 1M; Brembo 2, 1-III-1980, Rossaro, 2Ex; T. Piovena, 3-II-1976, Rossaro, 1MP (ROSS). USA: Georgia, Fanin Co., Noontootla Cr. at Newport Rd., IV-24-1979, B. A. Caldwell, 1L (CALD). New York, Lewis Co., Black River nr. Port Leyden, 7-VII-1976, 1L; Niagara Co., Niagara R. nr. Youngstown, 6 Oct. 1976, 5L (NYSH). North Carolina, Iredell Co., Buffalo Shoals Creek, Jan 1981, K. Dechart, 1L (NCNR). Oregon, South Santiam River, 18 May 1977, PE462, W. P. Coffman, 1Ex (COFF); Echo Creek, 3 Oct. 1978, W. P. Coffman, #25, 4Ex (COFF). Pennsylvania, Monroe Co., Delaware River, n. of Party's Beach, 15 April 1976, #1, D. Wartinbee, 3Ex (COFF); same data except 9 May 1976, #3, 9Ex (COFF); Lineville Creek, 13-IV-1971, W. P. Coffman, 2Ex (CNC). Monroe Co., Big Bushkill Creek, Resica Falls, 17-IV-1976, 3Ex (COFF).

Remarks: Goetghebuer (1938) described this species in *Orthocladius* from a single male collected in Austria. The figure of the hypopygium, with a haired, pointed anal point and squared inferior volsella, resembles males of *Orthocladius (Orthocladius)*. Goetghebuer (1942) later reproduced the figure and description, and placed *luteipes* in his heterogeneous *O. (Orthocladius)*. He separated *luteipes* from similar species of the subgenus by the VR and extension of the R4+5 and Costa, characters that are usually too variable for species determination in *Orthocladius* (Soponis 1977). However, having to use these characters showed the difficulty of separating the adult male of this species, as does the key given here.

Not only is the male difficult to identify, but the type was virtually impossible to view because it was melted by Goetghebuer between 2 pieces of celluloid. Although the celluloid is not completely dissolved, the type can now be examined clearly, but it is in poor condition. The type does agree with Goetghebuer's (1938, 1942) illustrations.

Thienemann (1939) described the larva and pupa of *luteipes*, and distinguished them from *rivicola*, a species with which it is still confused today. Thienemann distinguished the pupa of *luteipes* from *rivicola* by the more slender spines of the more numerous rows on tergites IV–VIII, and the larger thoracic horn. In the material examined here, the thoracic horn of *luteipes* (80–110 μm, n=20) is larger than that of *rivicola* (45–70 μm, n=20). It is easiest to identify *luteipes* by the pedes spurii A on sternites V–VII, which Thienemann described but did not use in his key. Later, Thienemann (1944) included *luteipes* in his larval and pupal keys.

Simpson and Bode (1980), in their diagnosis of *O. (Euorthocladius)* type III sp. larva, provided a photograph of a larva of *luteipes* with MR>1.5 and AR of 1.73. Examination of their material showed that *rivicola* was also present.

Easily identifiable only in the pupal stage, *luteipes* has not been recorded frequently in the literature. Fittkau et al. (1967) and Fittkau & Reiss (1978) recorded *luteipes* in Limnofauna Europeae as an uncertain *"Orthocladius"*. Rossaro (1978b) illustrated the hypopygium and provided notes on *luteipes*. In Coffman & Ferrington (1984), the pupa will key to couplet 55.

Orthocladius luteipes belongs to the *rivicola*-group and is most easily determined by the exuviae. Males will be difficult to determine without associated exuviae. Altough the type and the male from Italy have a high AR (2.00, 2.04), Rossaro (1978b) reported an average AR of 1.6 for *luteipes*. The pupae are easily separable from *rivicola* with the characters provided, and become distinctive when many specimens of both species are examined. The larvae are close to *thienemanni*, and *luteipes* can be distinguished by the wide median tooth (high MR) and lower AR.

This species occurs with other *O. (Euorthocladius)*, including *rivicola*, and has probably been misidentified as *rivicola* (pupa) and *thienemanni* (larva). Undoubtedly *luteipes* occurs more widely than documented here, although perhaps not as widely as *rivicola*, for example.

Orthocladius (Euorthocladius) rivicola Kieffer

Figs. 32, 33, 34g, 37c, 49, 55

Orthocladius rivicola Kieffer, 1911: 181 [original description; adult in key]. Thienemann, 1911: 637 [notes on pupa, locality data]. Thienemann, 1912: 74 [notes]. Potthast, 1914: 264, figs. 6–9 [pupa, larva]. Goetghebuer, 1932: 74, 88 [female, in key to females]. Thienemann, 1935: 203–205 [in pupal, larval key; synonymy]. Pankratova, 1970: 173, 174, 178, fig. 106 [in pupal, larval keys; pupal, larval descriptions]. Reiss, 1983: 176 [checklist]. Rossaro, 1984: table 2 [record]. Bitušík & Ertlová, 1985: 603, 606, table 2 [ecology].

Orthocladius (Chaetocladius) rivicola Kieffer. Goetghebuer, 1934: 89, 90, fig. 4 [male description].

Euorthocladius rivicola (Kieffer). Thienemann, 1936: 191 [record]. Thienemann, 1939: 7, fig. 2a [pupa]. Thienemann, 1941: 65, 68, 78, 79, 82, 153, 180 [ecology, distribution]. Thienemann, 1944: 559, 648, fig. 13, 14a, 195 [in pupal, larval keys]. Dittmar, 1955: 470, 481, 482, 484, table 30 [ecology]. Romaniszyn, 1958: 82 [in larval key]. Thienemann, 1954: 23, 31, 48, 49, 288, 301, 303, 333, 346, 347, 349, 355, 357, fig. 133e.

Orthocladius (Orthocladius) rivicola Kieffer. Goetghebuer, 1942: 32, 53, fig. 87 [male description, in male key].

Orthocladius ex gp. *rivicola* Kieff. Chernovskii, 1949: 205, 282 [in larval key, synonymy].

Orthocladius (Euorthocladius) rivicola Kieffer. Brundin, 1956: 101 [record]. Fittkau et al., 1967: 362 [checklist]. Saether, 1968: 463 [ecology]. Saether, 1969: 61 [record]. Lehmann, 1971: 486 [ecology]. Kloet & Hincks, 1975: (V)15 [checklist]. Rossaro, 1977: 122 [notes]. Rossaro, 1978a: 290, table 1 [distribution]. Rossaro, 1978b: 185 [distribution]. Säwedal, 1978: 87 [record]. Fittkau & Reiss, 1978: 421 [checklist]. Prat, 1979: 67, 68, fig. 19 [male description]. Kownacki & Zosidze, 1980: 75, 79–81, table 2 [ecology]. Halvorsen et al., 1982: 119 [record]. Rossaro, 1982: 42–44 [in pupal, larval keys]. Mason & Lehmkuhl, 183: 207, fig. 19 [ecology]. Murray & Ashe, 1983: 230 [checklist]. Mason & Lehmkuhl, 1985: 878, table 1 [distribution]. Caspers & Schleuter, 1986: 323 [checklist].

Orthocadius (Euorthocladius) rivicola α. Rossaro, 1982: fig 31 [pupa].

Orthocladius (Euorthocladius) Thienemann type I. Soponis, 1977: 15–17, figs. 84c, 90, 101, 120 [pupal, larval description; in pupal, larval keys].

Orthocladius (Euorthocladius) species 6 [partim]. Coffman & Ferrington, 1984: fig. 25.415 [pupa].

Orthocladius (Euorthocladius) cf. thienemanni-saxosus [partim]. Coffman, 1973: table 1 [ecology].

Orthocladius fusiformis Goetghebuer. Goetghebuer and Dorier, 1939: 30–32, fig. 1–5.

Type Locality: Germany.

Type Material: Could not be located, believed lost.

Diagnosis

Orthocladius rivicola can be distinguished from other Holarctic species of *O. (Euorthocladius)* by a combination of characters. Adult Male: lower AR (0.08–1.76), sensilla chaetica on midleg, and details of the hypopygium (Figs. 32, 33). Pupa: absence of pedes spurii A and hooklets on tergite II, presence of posterior spine rows on tergites IV–VIII, and normally developed dorsocentral setae; can be distinguished from *kanii* by distribution. Larva: mentum with 13 teeth, MR<1.5, AR<1.8; cannot be distinguished from *ashei*.

Derivation of Name: L. *rivus*, stream; L. cola, dweller, inhabitant.

Description

Adult Male (n = 27)

Small to medium species. Head. Verticals 9–20 (26), postorbitals 1–2 (21). Palps long with 3>4. AR. 1.00–1.76 (82). Thorax. Lateral antepronotals 1–9 (26). Acrostichals 0–10, weak, begin within 1 or more AW. Dorsocentrals 7–16. Prealars 4–7. Scutellars 8–26, often multiserial, also biserial, or multiserial. Wing. Length 1.30–2.80 mm (81). R with 2–9 setae. Squamals 10–36. VR 1.02–1.16 (25). Anal lobe slightly produced. Legs. LR1 0.61–0.75 (26). LR2 0.43–0.54 (26). LR3 0.47–0.59 (26). Sensilla chaetica (25) on ta1 of p2 (3–16). In addition, 3 specimens have sensilla chaetica on ta1 of p3, 2 (25). Hypopygium (Figs. 32, 33). Virga present or absent. Superior volsella collar-like or sightly triangular. Inferior volsella with dorsal part squared or rounded, and ventral part slightly extended below. Crista dorsalis long, robust.

Variation. The length of the terminal flagellomere is highly positively correlated with wing length in *rivicola* ($r=+0.943$, $p>.001$, $n=80$) as it is in most *Orthocladius* (Soponis 1977). However, wing length is not as highly correlated with either the length of the basal flagellomeres 1–12 ($r=+0.747$, $p>.001$, $n=80$) or with AR ($r=+0.753$, $p>.001$, $n=80$). Prat (1979) found a positive correlation between AR and wing length (WL 2.24 mm, AR 1.25; WL 3.00 mm, AR 1.6 to <1.8), and these were related to geographical locality. However, correlations with rations should be interpreted carefully and are not usually biologically meaningful (Soponis 1977).

In the 80 specimens measured, no obvious relatinship exists between wing length and locality. Considerable variation was found between specimens collected at the same locality, e.g. Trails Pond, Idaho, and at a general locality, e.g. Alaska. But little variation was also found between specimens collected at the same locality, Baffin Island.

The palps appear longer in some specimens, and for a small sample there is a fairly high positive correlation between interocular distance and total palpal length ($r=+0.810$, $p>.001$, $n=14$). In *rivicola*, at least, males with eyes more widely separated tend to have longer palps. Again, there was no apparent relation between locality and either of these two measurements.

Values from other studies of *rivicola* fall within the variation recorded in this material. AR: 1.40–1.50 (Rossaro 1978b); 1.50 (Lehmann 1971); 1.25–<1.80 (Prat 1979). Lower values of AR have been reported for high altitude specimens: 0.80 at 1100 m (Goetghebuer 1934) and 0.90, altitude presumably high (Rossaro 1978b). Rossaro (1978b) also reported 4–11 sensilla chaetica on ta1 of p2.

The hypopygium is highly variable, as seen here (Figs 32, 33), in Prat (1979), and in Goetghebuer (1934). In mature pupae (n=14), acrostichals were present or absent, and scutellars were uniserial, biserial, or multiserial.

Pupa (Exuviae)

Brown to pale brown, cephalothorax darker. Length 2.5–4.0 mm. Cephalothorax. Frontal warts and cephalic tubercles absent. Precorneals clumped, Pc1 usually longer and thicker than Pc2 and Pc3; 2 median antepronotals, 1 lateral antepronotal, 3 dorsocentrals, strong to weak, about as long as Pc1. Thoracic horn (Fig. 34g) small, ellipsoid, dark brown, filled or clear, stalked; length 45–70 μm (20). Thorax dorsally wrinkled along eclosion line.

Abdomen (Fig. 49). Tergites: I bare; IV–VIII with central rows of moveable straight spines along posterior margin (Fig. 37c); II–VIII with small patches of spinules anteriorly; IV–VIII with central patch of spinules anteriorly. Sternites: I bare; II–VIII with central patch of spinules anteriorly.

Setae on segments I–VIII:

D	4	4	5	5	5	5	5	1	L	1	3	3	3	3	3	3	2
V	2	3	3	2	2	3	3	0	Od	0	0	0	0	0	0	0	0

Anal lobe greatly reduced, with two seta, one on distal half and one at midpoint. Genital sheaths extended beyond lobe in males and females. Pedes Spurii A and B absent.

Variation. There is considerable variation in this widespread species. Spines in rows IV–VIII may be individually weak to robust; these spines may be in 1–5 rows on the tergites; spines may be spaced close together or far apart. The number of spines in the rows is higher in females than in males, but is not significantly different (t-test, $p>.001$*).

	rivicola females (n = 5)		*rivicola* males (n = 5)		Student's t*
IV	80.20 ± 21.19	(54–104)	48.00 ± 18.51	(36–80)	2.5590
V	79.60 ± 18.61	(60–100)	59.00 ± 19.87	(47–94)	1.6918
VI	69.80 ± 25.29	(44–103)	54.40 ± 13.99	(41–76)	1.19135
VII	57.40 ± 20.84	(39–90)	44.00 ± 15.95	(33–72)	1.1417
VIII	41.20 ± 19.80	(23–70)	29.60 ± 10.83	(20–47)	1.1491

Lehmann (1971) found two distinct types of *rivicola* pupae in the Fulda. One type had 2 or more rows of spines on the posterior margins of tergites IV–VIII, the other had only a single row of spines. In the Plön (now ZSM) collection he found many transitional forms between his two basic types, and he attributed these differences to intraspecific variation. It is possible that *ashei* was confused with *rivicola*, and *ashei* was the species with the single row of spines.

Setae on the abdomen are generally robust and easy to see in this species. Dorsocentrals can be forked or branched, weak to robust, but never as robust as in *ashei*. The thoracic horn can be filled or clear, small or large. The size of the thoracic horn is unreliable for distinguishing *rivicola* from *thienemanni* or *ashei*. However, all *luteipes* have larger thoracic horns than *ashei, rivicola*, and *thienemanni*.

There is considerable variation in the exuviae of *rivicola*. Several undescribed species may exist, including one from northwestern North America with individually robust spines on IV–VIII.

Larva (Fourth Instar)

Body yellow or brown. Head capsule brown. Eye spots fused. Mentum (Fig. 55d) with 13 teeth, median tooth about as wide as 1st lateral; MR 1.00–1.50 (7); median tooth as high or lower than 1st lateral. Ventromental plates extended anteriorly between 2nd and 3rd laterals. Epipharynx (Fig. 55a) with premandible simple. Chaetula laterales sparse. Mandible (Fig. 55b) with apical tooth as long or slightly longer than 1st inner tooth; outer margin notched opposite seta subdentalis, rest of margin smooth except for occasional notch posteriorly; seta interna present. Antenna (Fig. 55c) with robust Lauterborn organs; blade extended to 5th segment. AR 1.38–1.80 (7). Body with simple setae, some short and stiff, some long and curved, and arranged like *saxosus*. Anal tubules moderately long, rounded, with dorsal pair thicker than ventral pair.

Variation. The variation of the larvae is underestimated in this material. Consequently, larvae associated with pupae will be most accurately determined.

Biology: The larvae live on stones in currents of springs, brooks, streams, and rivers (Thienemann 1935, 1941, 1954; Dittmar 1955; Lehmann 1971). Larval and pupal tubes are similar to those of *thienemanni* (Fig. 40). Larvae usually live in individual gelatinous tubes covered with sand grains and detritus, cemented along their lengths to the stone. Pupae usually live in individual, clear, half-ellipsoid, gelatinous tubes with holes at both ends for the current. Larvae are rheobionts and eurytherms (Thienemann 1912, fide Dittmar 1955). Illies (1952, fide Dittmar 1955) found larves of *rivicola* in the mud, but such finds may be accidental for rheobionts like *rivicola*. Thienemann (1941, 1954) observed large numbers of free-living mature larvae and prepupae in submerged reeds (*Hydrurus*) collected in Switzerland.

Based on exuviae, *rivicola* occurs with *thienemanni* in at least 7 different sites: Ottawa River, Ontario, Canada; River Fulda, Germany; Linesville Creek, Pennsylvania; East Fork of Chattoga River, South Carolina; Fall Creek, South Carolina; Seneca Creek, South Carolina; and, Pigeon River, Tennessee. Bitŭsík and Ertlová (1985) found *rivicola* and *thienemanni* in the River Rajčianka. They concluded that *rivicola* occurs in small numbers in every lotic zone studied, but *thienemanni* is largely confined to the 2. zone of high diatom density, occurring in high numbers. Kownacki & Zosidze (1980) found *rivicola* dominant in certain zones of rivers and streams of the Little Caucasus Mountains.

The adults emerge from November to May in Italy, and can be found at higher altitudes in July and August (Rossaro 1977, 1978a, b). Dittmar (1955) found adults in Germany from January to April. Thienemann (1954) found two generations in the Lunzer Gebiet: at the beginning of June, and from August to October. Lehmann (1971) recorded two emerging generations from the Fulda in Germany; the first from March to May/June, and the second in October/November. In Canada, Mason and Lehmkuhl (1938) found *rivicola* emerging from April to October, with only slight differences between emergence upstream and downstream of a hydroelectric development. In South Carolina, adults emerge from December to May.

This species also occurs at high altitudes and high latitudes (Thienemann 1936, 1941, 1954; Rossaro 1978b; Goetghebuer 1934).

Mites have been associated with *rivicola* (Thienemann 1954).

Distribution: Palearctic: England, France, Germany, Ireland, Italy, Poland, Sweden, Switzerland. Nearctic: Canada, Greenland, USA.

Material Examined: Non-type material: Austria. Lunz, Thienemann, 2M, 3Ex (ZSM). Bulgaria. Blagoevgrad, r. Bistriza, 28-II-1978, N. Natchev, 1Ex (NAT). Canada. Alberta: Waterton Natl. Park, 21-VII-1967, A. L. Hamilton, A.3.1, 4Ex (FWI); A. L. Hamilton and O. A. Saether, 1M, 1M w/Ex (FWI); Calgary, 4-VIII-1970, J. Martin, 1M (CNC). Manitoba: Duck Mtns, South Duck, 14-V-1980, 1M; 16-V-1980, 1M; Duck Mtns, Cowan G., 24-V-1980, 1M (FWI); Edwards Cr. Stn. 1, Riding Mtn. Natl. Pk., 50°59'15", 100°04'00", 4-VII-1975, 1M (CNC). Ontario (CNC): Ottawa, 21-X-1971, J. R. Downes, 1M; Ottawa, Central Expmntl Farm, 28-X-1966, J. Martin, 4M; Ottawa, Britannia Flitration Plant, 5-V-1971, D. R. Oliver, 1M; Ottawa, Ottawa R. Beach at Woodrufe, 9-V-1972, A. R. Soponis, 1M; Ottawa R. at Ottawa, 22-IV-1966, J. Martin, 1Ex; Ottawa, Ottawa R. at Rumic Rapids, drift, 16-IV-1985, P. S. Cranston, 13Ex; Green Creek, coll. 31-V-1979, em. 2-VI-1967, DRO, LHS, RDM, 1F w/Ex. Quebec (CNC): Ile Ste. Hélène, Montreal, 2-3-VII-1964, A. Nimmo, Shadfly Project, 1M; 16-17-VI-1964, 1M. Northwest Territories (CNC): Oscar Creek, 25-V-1972, FWI Pipeline Project, 2FP, 5MP; Trail R., 11-VIII-1972, FWI Pipeline Project, 1MP; Ft. Laird, 60°15'N 123°28'W, 5-VI-1973, D. R. Oliver, 1M; Bathurst Is., J. Bissett, 4-VIII-1977, 2M; 5-VIII-1977, 2M; 6-VIII-1977, 3M; 12-VIII-1977, 5M; Bathurst Is., 75°24'N 100°24'W, 25-VII-1984, B. Hayes, 1M w/Ex; Martin R., FWI Pipeline Project, 10-VIII-1972, 3M; 18-VIII-1972, 1M; Masik R., Banks Is., W. R. Mason, 18-VII-1968, 1M; Head of Clyde Inlet, Baffin Is., 7-VIII-1958, G. E. Shewell, 1M.

Yukon-Territory: Caribou Bar Creek, FWI-Pipeline Project, 19-VI-1972, 4M; 2FP, 1MP; 20-VI-1972, 2MP, 3FP, 15M; 12-VII-1972, 1M; J. Robillard, 18-VI-1973, 1M w/Ex, LS; Driftwood River, 19-VII-1972, 1L (CNC); Little Bear Creek, Mile 1022 Alaska Hwy, 3-VI-1978, D. R. Towns, 1M w/Ex (FSCA). Germany. Partenkirchen 125, 167, 94e, 1934, A. Thienemann, 5Ex (ZSM); Fulda, 10-III-1964, E. J. Fittkau, 1M, 1Ex, 1FP; Rhuhr, 8-V-11, bei Oloberg, A. Thienemann, 2MP, 1FP; Pullach, 26-II-1978, E. Ott, 1M w/Ex; River Isar, ca. 500 m oberhalb Loisach-Mündung, 3-IV-1986, F. Reiss, 5Ex (ZSM). Greenland. Nedre Midsommer So, 10-VII-1966, Can. Pearyland Expd., 1M (CNC). Italy. Po River, 1975, 1976, B. Rossaro, Ex; Brembo, 1-IX-1980, B. Rossaro, 3Ex, 1MP (ROSS); 21-VII-1980, 2M (ROSS). Norway. Ekse, HOi: Vaksdal, 9-VII-1979, E. Willassen, 1 reared M; same data except 11-VI-1979, 2 reared M; same data except 9-VII-1979, 1 reared M (ZMB). Sweden. Stordalen Sta., 7-VII-1958, D. R. Oliver, 3Ex (CNC); Lappland, 1936–1937, A. Thienemann, 2Ex, 1MP, 3FP (ZSM). Switzerland. Nationalpark Nadig, No 417, in Hydranus, A. Thienemann, 3FP, 1MP (ZSM). USA. Alaska: K. M. Sommermann, jeep trap (USNM): Palmer, VI-1964, 4M; Kenai Pen., Johnson L.-Soldatna, 19-VI-1965, 1M; Matanuska Eklutna Hwy, 22-VI-1964, 4M; Palmer-Anchorage Hwy., 22-VI-1964, 3M; Anchorage-Potter-Mt. Alyeska, 21-IX-1966, 2M; Anchorage-Eagle R.-L. Susitna R., 22-IX-1966, 7M; 24-IX-1964, 4M (USNM); Unnamed creek above Galbraith Camp 208075, 9-VII-1976, drift net, USGS, 2L, 1Ex (CALD). Arkansas: Benton Co., Prairie Cr., NW $^1/_4$, Sec. 2. T19N, R29W, 4-I-1963, O. A. Hite and L. K. Aggus, on bridge, 1M (SUB). Colorado: Delta Co., 1 mi. N Hotchkiss, 9-VIII-1971, M. Beard, at light, 1M (SUB). Georgia: Fannin Co., Noontootla Creek at Newport Rd., 24-IV-1979, B. A. Caldwell, 2L, 1M w/Ex (CALD); Stekoa Creek at Wolf Creek Rd. (Savannah R. Drng.), 13-X-1973, E. P. D., 1L (CALD). Idaho: Latah Co., Trails Pond, 7-III-1969, J. M. Gillespie, found on ice and vegetation, 8M (MINN). Kansas: Kiowa Co., Rezeau Ranch, spring fed creek, 19-III-1982, No. 31, B. G. Coler, J. K. Gelhaus, 17Ex (SBSK). Minnesota: Minneapolis, 4-VI-1969, D. E. Maschwitz, at light, 1M; Cook Co., Min. F. S. Hovland, 9-VI-1969, E. F. Cook NJ Mosquito Trap, 1M; Ramsey Co., St. Paul, 21-V-1968, R. A. Hellenthal, U of M vacuum trap, 1M; St. Louis Co., U of M Duluth, 6-VIII-1968, E. F. Cook, NJ Mosquito Trap, 1M (MINN). Montana: Hamilton, outside lab bldg., 19-III-1960, C. B. Philip, 2M (SUB); Rock Creek, 17-VIII-1974, W. P. Coffman, 2Ex (COFF). New York: Erie Co., Cazenovia Creek at East Aurora, 80 m upstream Mill Rd. bridge, multiplate sample, 29-VII-1976, K. W. Simpson, L (NYSH); Green Co., Gooseberry Creek nr. Tannersville, coll. 10-VI-1978, em. 11-VI-1978, R. W. Bode, scraped from rock, 1Ex w/wing (NYSH); Niagara Co., Niagara R. nr. Youngstown, 6-X-1976, L, 1Ex (NYSH); Rensselaer Co., Cropseyville, Route 2, Quackenkill Creek, 23-IV-1985, R. Bode, 3Ex (NYSH); St. Lawrence Co., St. Lawrence River nr. Waddington, 4-X-1977, L (NYSH); Ithaca, Apr., 1M (SUB). Tompkins Co., Ellis Hollow, 15-VI-1963, C. O. Berg, LT, 4M (USNM); Wash. Co., Hudson R. at Hudson Falls, 1km. upstrm. Bakers Falls dam, 8-VI-1976, K. W. Simpson, L (NYSH). North Carolina: Orange Co., Little River, II-1979, D. Lenat, S. Mozley, 1L (NCNR); Transylvania Co., Horsepasture R., 20-II-1976, P. Hudson, 2M (HUD); Wake Co., Cane Creek, II-1980, D. Lenat, S. Mozley, 1L (NCNR). Oregon: Aumsville, 22-II-1963, K. Goeden, light, 3M (USNM). Pennsylvania: Crawford Co., Lindesville Creek, 7-IV-1971, W. P. Coffman, 4Ex (CNC); same date except 13-IV-1971, 5Ex (CNC); stream nr. PA 285/I79 btwn. Cochranton and Geneva, 28-V-1975, #4, W. P. Coffman, 2Ex (COFF); Shawnee, stream, 4-IV-1976, #2, D. Wartinbee, 2Ex (COFF); Monroe Co., Big Bushkill Creek, Resica Falls, 17-IV-1976, 4Ex (COFF). South Carolina (HUD): Oconee Co., East Fk. Chattooga R., Nat. Fish Hatchery, 28-I-1981, P. L. Hudson, 4M; same data except 27-XII-1979, 1Mw/Ex; 15-II-1976, 1M w/Ex, 1M; Oconnee Co., Seneca, Fall Creek, Lake Keowee, 30-IV-1974, P. L. Hudson, 1Ex; same data except 10-X-1975, 1Ex; Oconee Co., Seneca Creek, 22-I-1976, 1FP, 2M, 1L; same data except 10-II-1977, 1MP; 26-III-1977, 1MP; 1-V-1977, 1MP; Oconee Co., Salem, Horsepasture River, 20-II-1976, P. L. Hudson, 3Ex; 18-XI-1977, 1M w/Ex; Pickens Co., Six Mile Creek, 4-II-1976, P. L. Hudson, 1M. South Dakota: Clay Co., Missouri R., Vermillion, 26-IV-1976, P. L. Hudson, channel, 1MP (HUD). Tennessee: Pigeon R., Gattlinburg, 3-V-1977, P. L. Hudson, 1Ex (HUD). Virginia: Falls Church, Holmes River, 17-VI-1960, W. W. Wirth, light trap, 1M (USNM). Washington: Benton Co., Hanford, Columbia R., D. R. Oliver, 20-III-1952, 1M w/Ex; 27-III-1952, 2MP; 3-IV-1952, 1M w/Ex (CNC); Yakima Co., 17-18-XII-1971, B. J. Landis, ex yellow water traps, 1M (SUB).

Remarks: Kieffer (1911) described this species in a key to adults of *Orthocladius*. He distinguished *rivicola* by the greenish-white abdomen, bare wings and veins, and cubitus not extended. He stated that the specimens were collected in Germany and were obtained by rearing the immature stages, which would subsequently be described by Thienemann. Kieffer did not mention the sex or number of specimens, nor did he designate a holotype. In correspondence between Thienemann and Kieffer, Kieffer wrote *Dactylocladus rivicola* nsp ♂♀ for specimens collected 8.IX.09 from Lenne bei Schmallenberg. This same material was cited by Thienemann (1911/12:74) as *Orthocla-*

dius rivicola Kieffer, so most likely this was the original material that Kieffer used to describe *rivicola*. A search of the ZSM collection resulted in no specimens from this locality that could qualify for lectotype designation. Specimens from other localities mentioned by Thienemann (1911/12:74) were also not found. Consequently a neotype for *rivicola* will not be designated here because this is not an exceptional circumstance (Rules of ICZN, Article 75 a), and suitable (reared) material from the type locality in Germany does not exist.

Goetghebuer (1932) briefly described the color and wings of the female of *rivicola*, and included the species in a key to females. Later Goetghebuer (1934) described the male of *rivicola*, and placed it in the subgenus *Orthocladius (Chaetocladius)*. He included characters of body length, wing variation, AR, and LR. The figure of the hypopygium shows the dorsal lobe of the gonocoxite rounded and in a low position, which closely resembles a male from Idaho (Fig. 33 a). Goetghebuer noted the similarity of the males of *rivicola* and *thienemanni*, and separated them by the high AR of *thienemanni* (2.00). The AR of 0.80 is low for *rivicola*, and this may be linked to high altitude. Later Goetghebuer (1942) reproduced essentially the same figure and description of the male, and placed it in *Orthocladius (Orthocladius)*.

Prat (1979) provided the most recent figure of the hypopygium of *rivicola*, which he distinguished from the male of *thienemanni* by the lower AR (1.50). Most Nearctic specimens have a more squared dorsal part of the basal lobe of the gonocoxite (Fig. 32, 33b) than Prat's figure.

The immature stages of *rivicola* have been recorded more often than the adults. Potthast (1914) described and figured the larva and pupa, and included the distribution. Potthast could not separate the larva of *rivicola* and *thienemanni*, but separated the pupae by differences in the spine rows and the larger thoracic horn of *rivicola*. In the material examined here, both species have similarly-sized thoracic horns (30–60 μm for *rivicola*, 30–70 μm for *thienemanni*).

Thienemann (1944) separated *rivicola* larvae from other *Euorthocladius* by the equally long anal tubules, low AR, small body length, and distribution. Chernovskii (1949) distinguished the *rivicola* group from the *thienemanni* group in his larval keys by the lower AR (1.10 versus 2.00) and the smaller body size (5 versus 8 mm). Romaniszyn (1958) uses AR and body length in his larval keys. Pankratova (1970) used Thienemann's figures, and separated the larvae of *rivicola* and *thienemanni* on the AR alone (1.40 versus 2.00) She also mentioned that the premandible was bifurcate and showed a crenulated margin on the mandible, characters not seen in this material. Soponis (1977) briefly described *rivicola* as *O. (Euorthocladius)* Type I and included it in subgeneric larval and pupal keys. Rossaro (1982) provided larval keys but did not separate *rivicola* from *luteipes*.

Thienemann (1939) distinguished the pupae of *luteipes* and *rivicola* by the stronger, shorter, darker, and denser spines in the posterior spine rows and the smaller thoracic horn of *rivicola*. Later, in his pupal keys, Thienemann (1944) used these same characters but he could not distinguish the pupae of *rivicola* and *fusiformis*. An exuviae of *fusiformis* determined by Dorier deposited in the ZSM collection was examined, and it is a good *rivicola*.

Pankratova (1970) did not distinguish between the pupae of *thienemanni, rivicola*, and *saxosus*.

Rossaro (1982) provided an excellent review of the Italian species in the subgenus with workable keys and figures of the species. He distinguished two forms of the pupae of *rivicola*, called α and β. Some of this material has been examined, and form α is *rivicola*, whereas form β is the new species *ashei*.

Coffman and Ferrington (1984) included *rivicola* in their pupal keys; *rivicola* will key to couplet 55.

Orthocladius (Euorthocladius) rivulorum Kieffer

Figs 20, 21, 34b, 38a, 51

Orthocladius rivulorum Kieffer, 1909: 48 [adult description]. Kieffer & Thienemann, 1909: 32 [notes]. Potthast, 1914: 264–266, figs 10–14 [larval, pupal descriptions]. Thienemann, 1935: 203, 204, fig. 1 [in pupal, larval keys, synonymy]. Pankratova, 1970: 173, 174, 178, 179, fig. 107 [larval, pupal descriptions]. Brennan et al., 1981: 149, table 2, 4 [ecology]. Reiss, 1983: 176 [checklist]. Rossaro, 1984: table 2 [record].

Orthocladius (Dactylocladius) rivulorum Kieffer. Goetghebuer, 1933: 215, 216, 218, figs 7, 7a [description of male, female; in keys to males, females].

Spaniotoma (Orthocladius) rivulorum Kieffer. Johannsen, 1937: 56, 58, 62, 72, fig. 240 [in larval, pupal keys].

Euorthocladius rivulorum Kieffer. Thienemann, 1935: 201–204, fig. 1 [in pupal, larval keys, distribution, synonymy]. Thienemann, 1936: 191 [ecology]. Thienemann, 1944: 558, 648, figs 9, 11, 201 [in pupal, larval keys]. Thienemann, 1954: 23, 49, 108, 147, 191, 301, 303, 309, 344, 345, 347, 349, 356, 360, 670, figs 30, 142a. Romaniszyn, 1958: 27, 82 [in larval key].

Orthocladius (Orthocladius) rivulorum Kieffer. Goetghebuer, 1942: 33, 53, fig. 88 [description of male, female, in key to males].
Orthocladius ex gp. *rivulorum* Kieffer. Chernovskii, 1949: 205, fig. 129a [in larval key].
Orthocladius (Euorthocladius) rivulorum Kieffer. Brundin, 1956: 101, fig. 64 [record]. Fittkau et al., 1967: 362 [checklist]. Saether, 1968: 464 [record]. Lehmann, 1971: 486 [ecology]. Lindegaard-Petersen, 1972: 482 [ecology]. Fittkau & Reiss, 1978: 421 [checklist]. Pinder, 1978: 70, figs 35G, 111B [in key to males]. Rossaro, 1978a: 290, table 1 [ecology]. Rossaro, 1978b: 185 [ecology]. Kownacki & Zosidze, 1980: table 2 [ecology]. Cranston, 1982: 102, fig. 39e [in larval key]. Drake, 1982: 234, fig. 6 [ecology]. Rossaro, 1982: 42, figs 30, 31 [in pupal, larval keys]. Murrary & Ashe, 1983: 230 [checklist]. Langton, 1984: 142, fig. 49a [in pupal key]. Sahin, 1984: 80, figs 198, 199 [larval description, in larval key].
Hydrobaenus rivulorum ? (Kieffer). Roback, 1957a: 76, 80, figs 183, 184 [in pupal, larval keys].
Orthocladius (Euorthocladius) sp. 1 Oliver et al., 1978: 18, fig. 167 [in larval key].
Orthocladius (Euorthocladius) cf. *rivulorum-suspensus*. Coffman, 1973: table 1 [ecology].
Orthocladius (Euorthocladius) Alaska sp. III Tilley, 1979: 138, 139, fig. 8 [larva].
Orthocladius (Euorthocladius) species 1 Coffman & Ferrington, 1984: figs 25.391–25.393 [in pupal key].
Orthocladius (Euorthocladius) sp. Coffman & Ferrington, 1984: fig. 25.203 [in larval key].
Chironomus (Orthocladius) sordidellus Zetterstedt sensu Taylor, 1903: 521–523, figs 1, 2 [ecology] [misidentification].
Orthocladius sordidellus Zetterstedt sensu Kieffer & Thienemann, 1906:148, 152, 153, figs 7–9 [misidentifikation].

Type Locality: Germany, Ennepe, in Westphalia.

Type Material: Lectotype: A single female exuviae, labelled by Thienemann as Ennepe, *Orthocladius sordidellus*, then later labelled by Thienemann as *Orthocladius rivulorum* n.sp. These two labels were the only labels on the slide. The lectotype is circled on the slide as the lower exuviae under the right cover slip when the labels are on the left side. A paralectotype female exuviae is under the same coverslip: a damaged male exuviae (non-type material) is under a broken cover slip on the same slide.

Based on Thienemann's correspondence it's certain that this is the material associated with the adult females that Kieffer (1909) used to describe *rivulorum*. In a letter sent to Kieffer dated 17-VI-1908 Thienemann wrote: „*Orthocladius sordidellus*, Ennepe, dicht unter der Sperre 5.VI.08, Gallertgehause wie sie von Taylor u. Lauterborn beschrieben". Kieffer's answer written in the same letter, in his own handwriting, was "*Orthocladius rivulorum* n.sp. ♀". According to Opinion 1147, Ruling 1 (ICZN 1981), this material qualifies for lectotype designation. I am hereby designating this material described above as lectotype and paralectotype. There was no other material from Ennepe collected by Thienemann in the ZSM.

Diagnosis

Orthocladius rivulorum can be distinguished from other Holarctic species of *O. (Euorthocladius)* by a combination of characters. Adult Male: lower AR (1.30) and details of the hypopygium (Figs 20, 21). Pupa: hooklets along posterior margin of tergite II, small round spine patches on tergites III–VIII, and bubbled thoracic horn. Larva: 17–21 teeth on mentum, weak Lauterborn organs, squared head capsule, isolated 4th tooth of mandible, slender shape of mandible, and distribution.

Derivation of Name: L. *rivulus*, a small brook.

Description

Adult Male (n = 4)

Brown (O. D.: yellow body with black bands). Medium to large species. Head. Verticals 12–16, postorbitals 0–4. Palps long with 3›4 (1). AR 1.29–1.30 (2). Thorax. Lateral antepronotals 5–9 (3). Acrostichals absent. Dorsocentrals 5–9. Prealars 4–5 (3). Scutellars 15–27, biserial to multiserial. Wing. Length 2.05–2.38 mm (2). R with 6–9 setae (2). Squamals 21–31 (3). VR 1.11–1.12 (2). Anal lobe slightly produced. Legs. LR1 0.73 (2). LR2 0.50–0.53 (2). LR3 0.55–0.56 (2). Sensilla chaetica on ta1 of p2, 7–8 (2) and p3, 7–8 (2). Hypopygium (Figs 20, 21). Virga present but difficult to see. Superior volsella collar-like. Inferior volsella with dorsal part arched convexly, nose-like, and ventral part covered or slightly extended below.

Variation. The variation in the adult male is not understood. Apparently the immature stages of *rivulorum* are recognized more often than the adults. The reared male from Ireland (Fig. 20) is typical of this species.

Pupa (Exuvia)

Light brown; apophyses on I–VI, variable; length 2.5–4.3 mm. Cephalothorax. Frontal warts weak or absent; cephalic tubercles absent. Precorneals spaced from each other evenly, 2–3x as long as dorsocentrals; 2 median antepronotals, 0 lateral antepronotals, 4–5 dorsocentrals, weak but often with large sockets; spacing variable (1–1–1–1, 1–1–2, 2–1–1, 2–2). Thoracic horn (Fig. 34b) long, tubular, filled, with bubbled surface; length 170–260 μm. Thorax dorsally smooth with some sculpturing and/or rugosity mesad of wing base and posteriorly along eclosion line.

Abdomen (Fig. 38a). Tergites: I bare; II–V with median patch of recurved hooklets along posterior margin; III-VII with small anterior circular patch of posteriorly-directed spines; on VIII a patch is indicated; IV–VI with strong spines in horizontal patch on either side of medial patch; anterior patch of spinules on II-VIII, most extensive on VI–VIII. Sternites: I, VIII bare; II–III with central patch of spinules anteriorly; IV, VII with spinules anteriorly; VIII with 2 off-center patches of spinules anteriorly.

Setae (weak) on segments I–VIII:

D	3	5	5	5	5	5	5	2	L	1	3	3	3	3	3	3	4
V	2	2	3	3	3	3	3	1	Od	0	1	1	0	1	0	1	0

Anal lobe strongly developed into large, circular lobes; setae absent. Genital sheaths slightly extended beyond lobe in male, not in female. Pedes spurii B on II; pedes spurii A absent.

Variation. The patches of hooklets are moveable. The arrangement of the dorsocentrals is variable. The thoracic horn can be weakly or strongly bubbled.

Larva (Fourth Instar)

Body yellow, brown, or green. Head capsule brown; preserved, yellow. Eye spots bipartite or fused. Head capsule (Fig. 51f) squared. Mentum (Fig. 51e) with 17–21 teeth, usually 19; median tooth more than 4x as wide as 1st lateral; MR 4.8–8.5 (10); median tooth much higher than 1st lateral. Ventromental plates extended anteriorly between 2nd and 3rd laterals, less commonly between 1st and 2nd or between median and 1st. Epipharynx (Fig. 51a) with premandible simple, slender, and similar to that in *Orthocladius (Orthocladius)*. Cheatula laterales full, moustache-like. Mandible (Fig. 51c) with apical tooth longer that combined length of 3 inner teeth; 4th tooth separated by space from rest of mandible; outer margin notched opposite seta subdentalis; rest of margin smooth except for small notch posteriorly; seta interna present. Antenna (Fig. 51b) with moderately developed or weak Lauterborn organs; blade extended to 5th segment. AR 1.88–2.22 (8). Body with simple, single setae and possibly arranged like that of *saxosus*. Anal tubules long, rounded, subequal, with dorsal pair thicker than ventral pair.

Variation. Chernovskii (1949) and Pankratova (1970) reported an AR of 2.5.

The number of teeth on the mentum are highly variable. Based on figures in the literature, these numbers of teeth were counted: 17 (Tilley 1979; Sahin 1984); 18 (Romaniszyn 1958; Coffman & Ferrington 1984; Cranston 1982); 19 (Potthast 1914, reproduced in Thienemann 1944, Chernovskii 1949, Pankratova 1970; Johannsen 1937); 21 (Oliver et al. 1978, Rossaro 1982); and 23 (Kieffer & Thienemann 1906). In 18 examined specimens, the number of teeth on the mentum were: 21 (3), 20 (1), 19 (10), 18 (2), and 17 (2). Sometimes the number of teeth are not symmetrical (here, and cf. Coffman & Ferrington 1984). Whether the variation in mental teeth is due to instar age, species differences, or other factors remains to be determined.

Biology: The larvae usually live on stones and sometimes on moss in fast flowing waters of brooks, streams, and rivers (Thienemann 1935, 1936, 1954). The gelatinous, cylindrical larval tube is attached

to the substrate at one end, and is often overgrown with one or more species of diatoms (Taylor 1903, Lauterborn 1905, Thienemann 1954). The tube is transformed into a pear-shaped pupal case, suspended by an anchor at one end (Fig. 51 d). Mites and mermithids have been found associated with *rivulorum* (Taylor 1903, Thienemann 1954).

The adults emerge during the winter or early spring. They emerge March to May in the Fulda, Germany (Lehmann 1971); May in Denmark (Lindegaard-Petersen 1972); November, February and April in Italy (Rossaro 1978a, b); and April and May in Pennsylvania, USA (Coffman 1973).

This species also occurs at high altitudes; e.g. alpine brooks (Thienemann 1936, 1954).

Distribution: Palearctic: Austria, Denmark, England, Germany, Ireland, Poland, North Africa (Lehmann 1971), Norway, Sweden, Switzerland, Turkey. Nearctic: Canada, USA.

Material Examined: Lectotype and paralectotypes. Non-type material: Canada (CNC). Quebec: R. Blanche, S. of Perkins, 9-V-1972, A. R. Soponis and J. Robillard, 1MP. New Brunswick: Kouchibouguac Nat'l Park, 30-V-1978, D. R. Oliver and M. E. Roussel, 1M. N. W. T.: Oscar Creek, 25-V-1972, FWI Pipeline Project, 1L. Yukon Territory: (FWI Pipeline Project) Bluefish River, 14-VIII-1972, 2L; Old Crow River, 25-V-1972, 2L; Driftwood River, 16-VIII-1971, 1L; Lord Creek, 19-VII-1972, 1L; Caribou Bar Creek, 20-VI-1972 1L; 10-VIII-1972, 1L. Denmark: Jutland, Linding Å., 14-V-1964, Claus Lindegaard: 14-V-1964, 1L; 22-V-1965, 1F; 3-VII-1968, 1F; V-1968, 1Ex; 20-V-1969, 2L (UCOP). England: East Sussex, Marsh Green, 17-IV-1978, P. S. Cranston, 5L (BMNH); Tadnoll Brook, 17-V-1976, L. C. V. Pinder, 1 reard M, 1 reared F (FBA). Germany. A. Thienemann: Bach Kossau, Ostholstein, IV-1936, 1Ex; Partenkirchen, Oberbayern, 3L (ZSM). Ireland. River Flesk, Clydagh Bridge, drift, 16-19-V-1978, P. Ashe, 1M w/Ex (DUB). Italy. (B. Rossaro, ROSS): Brembo, 16-III-1981, 3L, 1Ex; 23-XII-1975, 3L; 9-I-1980, 1Ex; Lot Entraygnes passerelle, 22-IX-1977, 1Ex; 26-II-1979, 1Ex. USA. Arkansas: Wash. Co., Tuttle Branch off Rt. 74, 10-I-68, Allen and Fuller, 1M (INHS). Colorado: Arapahoe Co., S. Platt River, 5-XI-1981, M. W. Heyn, 2L (HEY); same locality, 6-XI-1981, P. Guthrie, 1L (GUT). Minnesota (MINN): Cook Co., Min. F. S. Hovland, N. J. Mosquito Trap, 13-V-1968, E. F. Cook, 1M; Mississippi River, Montecello, 19-II-1976, 1M; same locality, 23-II-1978, 1M North Carolina: Mitchel Co., N. Toe River, 2-II-1978, K. Dechart, 3L (NCNR). Oregon: Metolius River, 3-X-1978, W. P. Coffman, 4Ex (COFF). Pennsylvania: Crawford Co., Linesville Creek, 13-IV-1971, W. P. Coffman, 2Ex, (CNC); 7-IV-1971, 2Ex (CNC); 6-V-1971, 2Ex (CNC); Delaware River, 9-V-1976, D. Wartinbee, 6Ex (COFF); Monroe Co., Big Bushkill Creek, Resica Falls, 17-IV-1976, 1Ex (COFF). South Carolina: Oconee Co., Horse Pasture River, Salem, 17-III-1977, P. L. Hudson, 1M (HUD).

Remarks: Kieffer (1909) described this species from Germany using adult specimens reared by Thienemann. He separated *rivulorum* from *O. pedestris* by the wings, yellow body with black legs and black markings, cubitus not extended, and non-branched antennal sensillae, adding that the larvae live in gelatinous tubes. He did not provide figures, he did not mention how many specimens he had, and he did not designate a holotype.

Goetghebuer (1933) placed *rivulorum* in *Dactylocladius* based on the adult characters, and provided the first figure of the hypopygium and female antenna, as well as a more complete description. He used characters such as body length, AR, LR, wing venation, and hypopygium. In his material the AR was about 1.00. In his figure of the hypopygium, the anal point is not haired, although the drawing looks like *rivulorum*. However, the examination of several Goetghebuer types shows that Goetghebuer did not always draw setae on the anal point when present. Later, Goetghebuer (1942) essentially reproduced the same hypopygial figure and description, and included the male in a key with AR of 1.00.

Brundin (1956) included *rivulorum* in his subgenus *Euorthocladius* and provided a more accurate figure of the hypopygium, with haired anal point and slight crista dorsalis. Pinder (1978) provided the most recent figure of the hypopygium, and included *rivulorum* in his key to males of Britain.

The tubes of the larva and pupa of *rivulorum* were described as belonging to *Chironomus (Orthocladius) sordidellus* by Taylor (1903, figs. 1, 2) and to an unnamed chironomid by Lauterborn (1905, fig. 15). Taylor's figures were reproduced in Thienemann (1954, fig. 30) and here (Fig. 51 d).

Potthast (1914) described the larva and pupa of *rivulorum*, along with its habits, and provided figures of the mandible, mentum, proleg claws, exuviae, and thoracic horn. In his figure of the exuviae, tergite II appears bare. The patch of recurved spines on II most likely overlapped with the rounded spine patch of III (cf. Fig. 38a).

Thienemann, in Kieffer & Thienemann (1906), provided a figure of the mentum, mandible, pupal spines, and setae of *rivulorum*. He treated the immature stages as *sordidellus*, based on the description of the larval and pupal tubes by Taylor (1903). Thienemann compared his material with the descriptions of the immature stages of *sordidellus* by Johannsen (1905), who actually described a species of *Orthocladius (Orthocladius)*. Within a few years, Kieffer & Thienemann (1909) knew they had *rivulorum* and not *sordidellus*.

Thienemann (1935) placed *rivulorum* in his genus *Euorthocladius*, and gave synonymy, distribution, and keys to larvae and pupae. He distinguished the larvae by the 8–9 pairs of lateral teeth on the mentum, unequal apices of SI, moustache-like epipharynx, and unique tubes. He distinguished the pupae by the spines on tergites III–VIII, tho-

racic horn, and unique tubes. Thienemann (1944) used these characters in his keys. He distinguished the larvae of *rivulorum* from those of *suspensus* by distribution; the pupa, by the thoracic horn and spine patterns.

Johannsen (1937) used the thoracic horn and 8–9 pairs of lateral teeth on the mentum to distinguish the immature stages in his keys, and Roback (1957a) largely followed him, and figured the simple premandible.

Chernovskii (1949) included *rivulorum* in his larval keys, and noted an AR of 2.5, green body color, and body length of 5 mm. Romaniszyn (1958) reproduced the figures of Potthast (1914) and distinguished *rivulorum* by the 8–10 pairs of lateral teeth on the mentum. Pankratova (1970) also reproduced Potthast's (1914) figures and used the 9 lateral teeth on the mentum and the long thoracic horn to distinguish *rivulorum* in her larval and pupal keys. She recorded the larval body as brown, the AR as 2.5, and the premandible as bifurcate.,

Oliver et al. (1978) included *rivulorum* as *O. (Euorthocladius)* sp. 1 in a key to larvae, with a photograph of the mentum.

Rossaro (1982) included the larva and pupa of *rivulorum* in his keys, and provided figures. He distinguished the larvae by the 8–10 lateral teeth on the mentum and the moustache-like epipharynx, and the pupae by the spines on III–VIII. Sahin (1984) included *rivulorum* in his larval keys, along with figures of the mentum and mandible. Coffman & Ferrington (1984) included the pupa and larva in their keys; the pupa keys to couplet 45, the larva keys to couplet 43.

Orthocladius (Euorthocladius) roussellae n.sp.

Figs. 11, 13–15, 34c, 34d, 41, 50

Orthocladius (Euorthocladius) type II Soponis, 1977: 15, 17, figs. 20, 84e, 92, 100, 121, 107b [larval, pupal descriptions; in larval, pupal keys].

Orthocladius (Euorthocladius) species 3 Coffman & Ferrington, 1984: figs. 25.406, 25.407 [in pupal key].

?*Orthocladius (Euorthocladius)* sp. Ferrington, 1984: table 7 [drift].

Type Locality: Canada, Northwest Territories, Axel Heiberg Island.

Type Material: Holotype. Male, Canada, NWT, Axel Heiberg Island, 79°25'N, 90°45'W, Gypsum Hill, 20-VII-1963, H. K. Rutz, CH3635 (CNC). Paratypes (78). (From CNC unless indicated otherwise). Canada. Alberta, Highwood Pass, 16-VII-1977, D. R. Oliver, CH7131, 1FP w/LS, 1 M w/Ex,LS, 1 F w/Ex,LS; Marmot Creek, 29-VI-1977, D. R. Oliver, CH7079, 1MP w/LS, 2FP w/LS. Northwest Territories. Melville I., Bailey Point, J. E. H. Martin: 27-VII-1965, CH25, 3M; 24-VII-1965, CH23, 1M; 20-VII-1965, CH21, 3M; 25-VII-1965, CH27, 1M. Baffin I., Head of Clyde Inlet, 7-VIII-1958, G. E. Shewell, CH1162, 3M; Frobisher Bay, 5-VIII-1948, F. G. Dilabio, CH3653, 1M; Banks I., Masik R., 9-10-VII-1968, W. R. Mason, CH265, 1FP w/LS; Axel Heiberg I., H. K. Rutz, 21-VII-1963, CH 1164, 1M; Slop E, 7-8-1963, CH3656, 3M; Expedition R., 26-VII-1963, CH3634, 4M; 4-VIII-1963, CH1281, 3M; Creek SE Gypsum Hill, 21-VII-1963, CH 1164, 2M; Hazen Camp, 81°49'N, 71°18'W, D. R. Oliver: 14-VIII-1961, CH3619, 7M 5-VIII-1961, CH3329, 6M; 1M (ZMB); CH3631, 1 male; NE217, 11-VIII-1961, CH3649, 1M, 1MP; 31-VII-1961, CH3594, 1M; Alert, 24-VIII-1963, D. R. Oliver, CH3627, 4M; Alert, Parr Creek, 25-VIII-1963, D. R. Oliver, CH3627, 3MP, 6Ex. Greenland. Nedre Midsommer So, Can. Pearyland Expd.: 16-VII-1966, CH 3632, 2M, 19-VII-1966, CH1102, 2M, CH1417, 1M. USA. Alaska. Portage Glacier-Pool, 20-VII-1977, #16, D. Wartinbee, 3Ex (COFF). Wyoming, Inlet Run to Frozen lake, algal mats, 8-VIII-1981, W. P. Coffmann, #3, 3Ex, #8, 4P, 4LS (Coff).

Diagnosis

Orthocladius roussellae can be distinguished from other Holarctic *Euorthocladius* by a combination of characters. Adult Male: low AR (1.02–1.56), numerous and multiserial scutellars, numerous lateral antepronotals and prealars, and details of the hypopygium (Figs. 11, 14, 15). Pupa: spines on the tips of anal lobe, hooklets along posterior margin of tergite II, and the long, tubular thoracic horn. Larva: mentum with 15 teeth, premandible bifid, Lauterborn organs weak, and mandible without seta interna.

Derivation of Name: This species is named after my friend Mary E. Dillon, formerly Mary E. Roussel.

Description

Adult Male (n = 24)

Dark brown. Large species. Head. Verticals 11–30, postorbitals 1–5. Temporals doubled or clumped medially by coronal suture (Fig. 13). Palps long with 3>4. AR 1.02–1.56. Thorax. Lateral antepronotals 9–27. Acrostichals 1–23, robust, beginn within 1 or 2 AW. Dorsocentrals 6–21, sometimes biserial. Prealars 6–18. Scutellars 25–60, multiserial. Wing. Length 2.52–3.35 mm. R with 6–12 setae. Squamals 19–37. In one specimen, 1 seta on R4+5. VR 1.00–1.08. Anal lobe produced. Legs. LR1 0.68–0.72. LR2 0.46–0.56. LR3 0.55–0.60. Sensilla chaetica on ta1 of p3 (6–18, 21). Hypopygium (Figs. 11, 14, 15). Virga absent or, if present, weakly developed, often difficult to see. Superior volsella collar-like. Inferior volsella with dorsal part long or short, rounded or square, covering ventral part. Crista dorsalis long.

Variation. There is not a high correlation between interocular distance and total palpal length ($r = +0.641$, $p > 0.02$, $n = 15$).

Pupa (Exuviae)

Brown, with darker apophyses on II–VII, variable. Length 4.6–6.5 mm (10). Cephalothorax. Frontal warts moderately developed, cephalic tubercles weak or absent. Precorneals clumped, 2x as long as dorsocentrals; 2 median antepronotals, 1 lateral antepronotal, 4 dorsocentrals, weak, arranged 1–1–2 or 2–2. Thoracic horn tubular, bare, brown, with expanded base usually smooth (Fig. 34d); sometimes collapsed (Fig. 34c) or partially bubbled; length 230–440 μm. Thorax dorsally extensively rugose.

Abdomen (Fig. 41). Tergites: I bare; II with large central patch of recurved hooklets in 5–6 rows along posterior margin; III–V with central patch of spines anteriorly, separated from small horizontal patch of spines along posterior margin; VI as V but without posterior patch; large patch of spinules on III–VI, small patch of spinules along anterior margin on VII, VIII. Sternites: I with spinules laterally; II–IV with large central patch of spinules; V–VIII with 2 off-center patches of spinules anteriorly.

Setae on segments I–VIII:

D	3	5	5	5	5	5	5	2		L	2	2	3	3	3	3	4	4
V	2	3	3	4	4	4	4	1		Od	0	0	1	1	1	1	1	1

Anal lobe slightly extended with heavy spines on tips; 3 dorsal setae, 2 at midpoint, often branched, and one on inner margin of distal half. Genital sheaths extended beyond lobe in male, not in female. Pedes spurii B on II, III, developed with tubercles; pedes spurii A on IV–VI.

Variation. Sculpturing occurs on tergites VII, VIII. On one male pupa there are 5 L setae on VII. In the three exuviae from Alaska (COFF) the thoracic horns have the surface partially collapsed and bubbled, but not bubbled as uniformly as in *rivulorum* (Fig. 34b).

Larva (Fourth Instar)

Body yellow or brown. Head capsule dark brown. Eye spots bipartite or fused. Mentum (Fig. 50e) with 15 teeth, median tooth as wide or slightly wider than 1st lateral (Fig. 50d); MR 1.2–1.5 (7); median tooth as high or lower than 1st lateral. Ventromental plates extended anteriorly between 1st and 2nd laterals. Epipharynx (Fig. 50a) with premandible bifid. Chaetula laterales sparse. Mandible (Fig. 50c) with apical tooth as long or longer than 1st inner; outer margin notched opposite seta subdentalis and crenulated on posterior half on margin; rest of margin smooth, except for notches posteriorly; seta interna absent. Antenna (Fig. 50b) with weak to moderately developed Lauterborn organs; blade extended to 5th segment. AR 2.08–3.08 (14). Body with simple setae, short and stiff and long and curved, at least on I, II; arranged most probably like those in *saxosus* (Fig. 57). Anal tubules long, rounded, subequal.

Variation. The anterior extension of the ventromental plates is difficult to determine in this species. It merges into thickenings of the mentum and appears to end between the 1st and 2nd laterals.

Biology: Reared larvae were collected from creeks (Alberta) and rivers (NWT), and from algal mats in an inlet run to a lake (Wyoming).

Distribution: Nearctic: Canada, Greenland, USA.

Additional Material Examined: Northwest Territories: Axel Heiberg Island, 4M; no label, 1M. Yukon Territory: Caribou Bar Creek, 5L. Alaska: 2L.

Remarks: This species could be confused in the adult male with two sympatric species possessing remarkably similar hypopygia, *O. (Orthocladius) frigidus* and *O. (Pogonocladius) consobrinus*. The male of *roussellae* can be distinguished from *frigidus* by the female-like eyes, and from *consobrinus* by the numerous, multiserial scutellars, absence of a fore tarsal beard, and the normally produced anal lobe of the wing. The clumped temporals will separate males of *roussellae* from most males of *frigidus* and *consobrinus*. However, at least one *frigidus* and one *consobrinus* were examined that have clumped, multiserial temporals instead of the normal uniserial arrangement.

Orthocladius roussellae occurs with *frigidus* primarily in mountains of temperate regions, and with *consobrinus* in the high arctic. The immature stages of these three species are easily separable.

Soponis (1977) incorrectly stated certain characters of the new species. For pupae, PSA occur on IV–VI, not on IV–VII; frontals are absent, not present. For larvae, the seta interna of the mandible is absent, not present.

Coffman and Ferrington (1984) included the pupa in their keys; *roussellae* will key to couplet 53.

Ferrington (1984) collected an unnamed species of *O. (Euorthocladius)* from Inlet Run, Wyoming, where both *roussellae* and *saxosus* have been collected.

Orthocladius (Euorthocladius) saxosus (Tokunaga)

Figs. 18, 19, 34e, 43, 56–59

Spaniotoma (Orthocladius) saxosa Tokunaga, 1939: 326–329, figs. 16, 39, 61, 77, 97, 109, 117, 125, 134, 146, 153 [description of male, female, pupa, and larva]. Tokunaga, 1959; 1973: 642 [pupa, larva, fide Sasa & Yamamoto, 1977].

Euorthocladius sp. Thienemann, 1941: 180 [record from Lappland].

Euorthocladius saxosus (Tokunaga). Thienemann, 1944: 558, 649 [in pupal, larval keys]. Thienemann, 1954: 301, 303, 345, 511.

Orthocladius (Euorthocladius) saxosus (Tokunaga). Brundin, 1956: 101, fig. 65 [male]. Fittkau et al., 1967: 362 [checklist]. Fittkau & Reiss, 1978: 421 [checklist]. Kownacki & Zosidze, 1980: table 2 [ecology].

Orthocladius saxosus (Tokunaga, 1939). Pankratova, 1970:173, 174, 180, 181, fig. 108 [pupal, larval descriptions; in pupal, larval keys]. Sasa & Yamamoto, 1977:310 [checklist]. Rossaro, 1984: table 2 [record].

Orthocladius (Euorthocladius) sp. Säwedal, 1978:87 [record of Abisko].

Orthocladius (Euorthocladius) species 5 Coffman & Ferrington, 1984: figs. 25.412–25.414 [pupa].

?Orthocladius (Euorthocladius) sp. Ferrington 1984: table 7 [drift].

Type Locality: Japan, Kyoto, Kibune.

Type Material: Holotype. Male, Japan, Kyoto, Kibune, Mar 25, 1936, M. Tokunaga (two white labels, one printed). Only the hypopygium and abdominal segments VI–VIII exist, mounted on a slide under one cover slip in Canada balsam by A. R. Soponis. Paratypes (?8). Same data as holotype. Parts of male and female, including genitalia, and exuviae; mounted in Canada balsam under eight coverslips on two slides by A. R. Soponis. Previously mounted, two larvae on two slides and parts of female on two slides.

Diagnosis.

Orthocladius saxosus can be distinguished from other Holarctic species of *O. (Euorthocladius)* by a combination of characters. Adult Male: details of the hypopygium (Figs. 18, 19). Pupa: hooklets along posterior margin of tergite II, with >100 spines, and frontal warts robust. Larva: head capsule dark brown, mentum with 13 teeth, MR<1.5, and AR>1.80.

Derivation of Name: L. *saxum*, rock; L. *osus*, having the nature of, usually indicating abundance. This is probably a reference to the larvae that aggregate on rocks.

Description

Adult Male (n = 2)

Brown to black. Medium species. Head. Verticals 15–19, postorbitals 1. Palps long with 3>4. AR. 1.19–1.20 (OD: 1.3). Thorax. Lateral antepronotals 4–5. Acrostichals absent. Dorsocentrals 8–9. Prealars 3–4. Scutellars 13–19, biserial to multiserial. Wing. Length 2.08–2.20 mm. R with 6 setae. Squamals 18–19. VR 1.00–1.03. Anal lobe not produced. Legs. LR1 0.76 (OD: 0.80). LR2 0.55–0.56. LR3 0.60 (OD: 0.61). Sensilla chaetica on ta1 of p2 (5) and p3 (8–11). Hypopygium (Figs. 18, 19). Virga present, weak to well developed. Superior volsella collar-like. Inferior volsella with dorsal part squared, ventral part prominently extended laterally and ventrally below.

Pupa (Exuviae)

Dark to pale brown. Length 2.5–4.0 mm. Cephalothorax. Frontal warts (Fig. 43) large to small; cephalic tubercles absent. Cephalothoracic setae weak and difficult to see. Precorneals short, about $1^1/_2\times$ as long as dorsocentrals, with light sockets; 1 median antepronotal, 0 lateral antepronotals, 0–4 dorsocentrals, weak; arrangement of dorsocentrals varies. Thoracic horn (Fig. 34e) ellipsoid, dark to light brown, filled, stalked; length 50–100 μm. Thorax dorsally granulose anteriorly and along eclosion line.

Abdomen (Fig. 44). Tergites: I, II bare. II–V with central patch of recurved hooklets along posterior margin; patch on II almost 2× as large as other patches; VI, VII with patch of straight spines along posterior margin; III–VIII with patch of spinules anteriorly. Sternites: I, VIII bare; II–VI with central horizontal patch of spinules anteriorly; VI with spinules along posterior margin; VI, VII with 2 off-center patches of spinules anteriorly.

Setae on segments I–VIII:

D	4	5	5	5	5	5	5	1	V	0	2	2	3	3	3	2	1
L	1	2	3	3	3	3	4	3	Od	0	1	1	1	1	1	1	1

Anal lobe greatly reduced, setae absent. Genital sheaths extended beyond lobe in male and female. Pedes spurii B on I, II, III, and sometimes IV; pedes spurii A on VI, VII.

Variation. The size and color of the thoracic horn, and the size and shape of frontal warts vary. Setal counts here do not agree with the original diagnosis. Hooklets are moveable, but the direction of hooklets on tergites is not diagnostic. The arrangement of the DC is variable, and the number of DC varies from 0–4. The body setae are weak. Small frontal tubercles are found in the type material, and in the material from Wyoming and Sweden. Large frontal tubercles are found in the material from Alberta, Montana, and Alaska (glacial). The dimorphism does not appear to be sexual.

Larva (Fourth Instar)

Body yellowish-brown, reddish-brown, or (OD) greenish-brown. Head capsule dark brown; preserved, yellow. Eye spots fused. Mentum (Figs. 58c, 59c) with 13 teeth, median tooth about as wide as 1st lateral; MR 1.2–1.5 (6); median tooth as high as 1st lateral. Ventromental plates extended anteriorly between 2nd and 3rd, 3rd and 4th, or 4th and 5th laterals; less commonly, between 1st and 2nd laterals. Epipharynx (Fig. 56) with premandible simple, blunt, with enlarged apex. Chaetula laterales sparse. Mandible (Figs. 58a, 59a) with apical tooth as long or longer than 1st inner tooth; outer margin notched opposite seta subdentalis; rest of margin smooth except for occasional notch posteriorly. Seta interna present. Antenna (Figs. 58b, 59b) with robust Lauterborn organs; blade extended to 5th segment or beyond. AR 1.80–2.22 (6). Body with setal arrangement in 4 different patterns (Fig. 57): those on I, II, III and IV–X. Anal tubules moderately long, rounded, with dorsal pair shorter and thicker than ventral pair.

Variation. The apical tooth of the mandible is variable, appearing more reduced in Nearctic than in type material, but this may be due to orientation. Also, the mandible has 5 true teeth in the type material and in the Montana material, but 4 true teeth and a false tooth in the Alberta material. The premandible is deeply bifid in a single reared larva from Montana.

Distribution: Palearctic: Italy, Sweden. Japan. Nearctic: Canada (Alberta). USA (Alaska, Colorado, Montana, North Carolina, Oregon, Wyoming).

Material Examined: Type material. Non-type material: Canada. Alberta: Marmot Creek, 29-VI-1977, D. R. Oliver, 7079, 5MP w/LS; 1FP w/LS (CNC). Japan. Mt. Hikosan, Kyushu, III-18-1980, L. T., M. Yamamoto, 2M, 1F (YAM). Sweden. Lappland 1936, 41, orig. Thienemann material, 4Ex (ZSM). USA. Alaska: Portage glacial pool, 20-VII-1977, #19, D. Wartinbee, 2Ex (COFF). Colorado: Gunnison Co., Beaver Dam on East R., 3.1 mi. N of Gothic, 13 July 1982, L. Ferrington, No.Co. #9, 6Ex, 1P (SBSK). Montana: Beartooth-Absaroka Wilderness area, 31-VII-1979, E. R. Wells, CH6965.1, 1 MP w/LS (CNC). Glacier Nat'l Park, small stream in west meadow w of Logan Pass (Continental Divide), 11-VIII-1975, R. W. Lichwardt, MBL-13, 27a, 1Ex, 1FP w/LS, 14a, 1FP w/LS (ANSP). North Carolina. Richmond Co., Forest Creek, 24-I-1981, D. Lenat, 1L; Wake Co., Cane Creek, 9-II-1980, D. Lenat and S. Mozley, 1L; Wake Co., Reedy Creek at US 40, 28-XII-1979, D. Lenat and K. Eagleson, 2L (NCDNR). Oregon: Deschutes Co., Century Drive, Goose Creek, Headwater Springs, 20-VIII-1983, B. Wisseman, gelatinous sheat, wood, 4L; Lane Co., H. J. Andrews Exp. For., Mack Cr., 11 mi. NE of Blue River, 20-V-1982, 1M; 26-V-1984, 1M; 18-19-II-1977, B. B. Frost, drift sample, 6pm–9am, clearcut, 1Ex (OSU). Wyoming: Trib. to Beartooth Lake, 19-VIII-1974, S1.2, W. P. Coffman, 4Ex (COFF); Park Co., "Inlet Run"-Frozen Lake nr. Beartooth Pass, 5-VIII-1978, L. Ferrington, 20Ex (SBSK).

Biology: Larvae live in clear, irregular gelatinous tubes 10–16 mm long and 3–5 mm wide, closely adhering to stones along small crevices in rapid mountain streams. Pupal tubes are more oval, 7–10 mm long and 4–6 mm wide, with 3 mm long stems. Larvae are common in winter (Tokunaga 1939). This species occurs with *suspensus*. Mites have been associated with *saxosus* (Thienemann 1954). Ferrington (1984) collected an unnamed species of *O. (Euorthocladius)* from Inlet Run, Wyoming, where both *saxosus* and *roussellae* have been collected.

Remarks: Tokunaga (1939) described this species from an unspecified number of males, females, pupae, and larvae collected in a rapid stream at Kibune, Kyoto, Japan. Type material of all stages still exists.

Thienemann (1944) recognized *saxosus* as belonging to his genus *Euorthocladius* and included the pupae and larvae in his keys. He separated the pupae primarily by the patches of hooklets on tergites II–V, and the larva by the anal tubules and labrum. He also recognized that his pupal skins in the 1941 Lappland work belonged to this species.

Brundin (1956) placed *saxosus* in the subgenus *Orthocladius (Euorthocladius)* and provided the first complete illustration of the hypoygium. Pankratova (1970) provided a description of the pupa and larva with figures reproduced from Tokunaga (1939). In the pupal keys she did not separate *saxosus* from *thienemanni* and *rivicola*, but did so in the larval keys using the dorsal pair of anal gills which are shorter than the ventral pair.

Pankratova (1970) mentioned that the larval premandible is bifurcate, seen only in one examined specimen from Montana.

This species has been included in several checklists (Fittkau et al., 1967, Fittkau & Reiss 1978, Sasa & Yamamoto, 1977), probably because it could be easily identified. The male and pupa of *saxosus* are very distinctive. In addition, Brundin's (1956) illustration of the hypopygium and Thienemann's (1944) pupal key have contributed to the relative ease of identification of the species.

Coffman & Ferrington (1984) included the pupa in their keys; *saxosus* keys to couplet 55.

Orthocladius (Euorthocladius) suspensus (Tokunaga)

Fig. 17

Spaniotoma (Orthocladius) suspensa Tokunaga, 1939: 323–326, figs. 15, 38, 63, 64, 70, 80, 85, 100, 118, 122, 135, 145, 151 [description of male, female, pupa, and larva]. Tokunaga, 1959; 1973: 642 [pupa, larva, fide Sasa & Yamamoto, 1977].

Euorthocladius suspensus (Tokunaga), Thienemann, 1944: 558, 649 [in pupal, larval key.]. Thienemann, 1954: 345 [note].

Orthocladius (sen.str.) *suspensus* (Tokunaga). Tokunaga, 1964: 17, fig. 2 [notes on adult].

Orthocladius suspensus (Tokunaga, 1939). Sasa & Yamamoto, 1977: 310 [checklist].

[non] *Orthocladius suspensus* (Tokunaga, 1939) sensu Ree & Kim, 1981: 176, 177, plate 27 [misidentification].

Type Locality: Japan, Kyoto, Kibune.

Type Material: Holotype. Male, mounted on a slide under 5 coverslips in Canada balsam by A. R. Soponis. Japan, Kyoto, Kibune, Mar. 25, 1936, M. Tokunaga (typed label). Preserved in Kyushu University.

Diagnosis

Orthocladius suspensus can be distinguished from other Holarctic species of *O. (Euorthocladius)* by a combination of characters. Adult Male: low AR (<1.8) and details of the hypopygium (Fig. 17). Pupa: hooklets along posterior margin of tergite II, small patches of spines on tergites III–VIII, smooth thorcic horn, absence of spine rows on posterior margins of tergites IV–VI. Larva: mentum with about 19 teeth; distinguishable from *rivulorum* by distribution.

Derivation of Name: L. suspendere, to hang up. This is probably a reference to the larval tube, which is suspended from stones by one end.

Description: (See also Tokunaga 1939)

Adult Male (n = 1, holotype)

Brown (OD: black). Large species. Head. Verticals 12. postorbitals 0. Palps long with 3<4. AR 1.68 (OD: 1.5–1.7). Thorax. Lateral antepronotals 3. Acrostichals absent, but sockets may be present. Dorsocentrals 10. Prealars 4. Scutellars 23, multiserial. Wing. Length 3.28 mm. R with 6 setae. Squamals 34. VR 1.08. Anal lobe not produced, almost right-angled. Legs. (OD: LR1 0.69. LR3 0.57). Sensilla chaetica could not be determined. Hypopygium (Fig. 17). Virga absent or vestige present. Superior volsella collar-like. Inferior volsella with dorsal part nose-like, covering most of ventral part. Crista dorsalis long.

Biology: The larvae occur in mountain streams in Japan. They live in cylindrical tubes, 20–37 mm long, 2.6–3.5 mm wide, coated with a thick growth of diatoms that makes the tubes look green. Pupal tubes are smiliar in size to larval tubes, with an oval chamber at the free and. The oval chamber is pointed at the distal end, with one respiratory opening at either end of the chamber, 7 mm long and 3.2 mm wide (Tokunaga, 1939). Both Taylor (1903) and Lauterborn (1905) have described tubes of *rivulorum* smilarly. This species occurs with *saxosus*.

Distribution: Japan.

Material Examined: Holotype.

Remarks: Tokunaga (1939) described this species from an unspecified number of males, females, pupae, and larvae collected in a mountain steam at Kibune, Kyoto, Japan. Only the holotype, a complete male, was located among the original type material at Kyushu University (Dr. Y. Hirashima, pers. comm.).

It has not been easy to identify *suspensus* in the adult male. Tokunaga (1939, fig. 38) illustrated only part of the hypopygium. Later, Tokunaga (1964, fig. 2) illustrated a hypopygium that was dorsoventrally compressed with the ventral part of the inferior volsella pushed below the dorsal part. He had placed *suspensus* in *Orthocladius* (s.s.) without comment, probably influenced by the distorted inferior volsella. In addition, these specimens had an AR of 3.00, a record for the species and for the genus *Orthocladius*. This may prove to be a misidentification, but because the figured specimen was distorted, and only the holotype has been examined, it is difficult to decide.

Ree & Kim (1981), most likely following Tokunaga's (1964) work, described as *suspensus* the male and female of a species of *Orthocladius (Orthocladius)*. This species belongs to the subgenus *Orthocladius* because of the uniserial scutellars, presence of acrostichals, pointed anal point, and double-lobed inferior volsella.

The immature stages of *suspensus* are morphologically similar to those of *rivulorum*, and the larvae of both species live in similar tubes. The adult male of *suspensus* has a distinctly different hypopygium (Fig. 17) from that of *rivulorum* (Figs. 20, 21), particularly in regard to the inferior volsella. Tokunaga (1939) provided characters to separate the pupae of *rivulorum* from *suspensus*, and so did Thienemann (1944), based on Potthast's (1914) description of *rivulorum*. Characters used in the keys are based on the original description.

Thienemann (1954) briefly commented on the similarity of *suspensus* and *rivulorum*.

Orthocladius (Euorthocladius) telochaetus Langton

Fig. 16

Orthocladius (Euorthocladius) telochaetus Langton, 1985: [description of male].

Type Locality: Spitzbergen: Advent Bay.

Type Material: Holotype. Male, Spitzbergen, Advent Bay, Holmgren (two white labels), 116 79 (pink label), Riksmuseum Stockholm (green label), "These 2 ♂ apparently = *decoratus*-F. W. E." (tan label), "*Ch. limbatellus* Holmgren 1869 ♂ PARALECTOTYPE *Orthocladius (Euorth.) telochaetus* n. sp. Langton P. H. 1985 HOLOTYPE" (white label). Paratype. Male, similar green and white labels with 115 79 on pink label.

Diagnosis

The male of *Orthocladius telochaetus* can be distinguished from other males of *O. (Euorthocladius)* by details of the hypopygium (Fig. 16), primarily the apical seta on the anal point. The pupa and larva are unknown.

Derivation of Name: Gr. *telos*, end; *chaite*, seta. Langton named this species for the apical seta on the anal point of the hypopgyium.

Description: See Langton (1985). Additional characters include: head female-like; VR 1.09; acrostichals absent; >5 dorsocentrals, uniserial; 3 prealars; anal point with microtrichia.

Biology: Unknown.

Distribution: Palearctic: Spitzbergen.

Material Examined: Type material. Non-type material: Spitzbergen: Gipsdalen, 17-VII-1954, Tage Roos, CH3659, 1M (CNC).

Remarks: Langton (1985) described this species from two males in the mixed type series of *Chironomus limbatellus* Holmgren. One aspect of the hypopygium makes this species unique in *Orthocladius*: a single apical seta on the anal point. Microtrichia on the anal point, while rare, occur in other *O. (Euorthocladius)* from high latitudes.

The male of *telochaetus* is morphologically similar to *saxosus*, as Langton (1985) pointed out. These two species can be distinguished by these characters of *telochaetus*: the more numerous squamals (27–31, 3; *saxosus* 13–19, 2); absence of sensilla chaetica on ta1 of p3, lower LR's, and more robust virga. Both species occur at high latitudes, although *saxosus* is found in low arctic (Lappland) and *telochaetus* is found in high arctic (Spitzbergen).

Orthocladius (Euorthocladius) thienemanni Kieffer

Figs. 25b, 27, 28, 34f, 37d, 40, 42, 52

Orthocladius thienemanni Kieffer. Kieffer & Thienemann, 1906: 143, 144, 146–149, figs. 1–5 [description of adult, pupa, larva]. Kieffer & Thienemann, 1909: 32 [ecology]. Potthast 1914: 263, figs. 1–5 [pupa, larva]. Thienemann, 1935: 203–205, fig. 2[synonymy, in pupal, larval keys, notes, distribution]. Pankratova, 1970: 173, 174, 177, 178, fig. 105 [pupal, larval descriptions; in pupal, larval keys]. Illies, 1971: 46, table 5 [ecology]. Drake, 1982: 231, 234, 240, fig. 6 [ecology]. Reiss, 1983: 176 [checklist]. Rossaro, 1984: table 2 [record]. Bitůsík & Ertlová, 1985: 604, 606, table 2 [ecology].

Orthocladius (Orthocladius) thienemanni Kieffer. Goetghebuer, 1932: 75, 89, fig. 144 [adult description, in adult key]. Goetghebuer, 1942: 34, 36, 55, fig. 95 [male, female descriptions; in male, female keys].

Spantiotoma (Orthocladius) thienemanni Kieffer. Johannsen, 1937: 56, 60, 62, 72 [in pupal, larval keys; notes].

Euorthocladius thienemanni Kieffer. Thienemann, 1944: 559, 648, fig. 12 [in pupal, larval keys]. Romaniszyn, 1958: 27, 82, fig. 122, 126, 127 [in larval key]. Thienemann, 1954: 146, 182, 345, 349, 356, 360, 364, fig. 102 [notes].

Hydrobaenus (Bryophaenocladius) thienemanni (Kieffer). Kloet & Hincks, 1945: 337 [checklist].

Hydrobaenus thienemanni (Kieffer). Roback, 1957a: 76 [in pupal, larval keys].

Orthocladius ex gp. *thienemanni* Kieffer. Chernovskii, 1949: 205, 282, fig. 129b [synonymy, in larval key].

Orthocladius (Euorthocladius) thienemanni Kieffer. Brundin, 1956: 95, 96, 101, fig. 63 [notes, distribution]. Fittkau et al., 1967: 362 [checklist]. Lehmann, 1971: 486 [ecology]. Kloet & Hincks, 1975: (V)15 [checklist]. Rossaro, 1977: 122 [distribution]. Rossaro, 1978a: 290 [distribution]. Rossaro, 1978b: 185 [distribution]. Fittkau & Reiss, 1978: 421 [checklist]. Pinder, 1978: 70, fig. 35E, 111C [in key to males]. Cranston, 1982: 102, figs. 39a, c, f [in

larval key]. Moubayed & Laville, 1983: 223 [distribution]. Murray & Ashe, 1983: 230 [checklist]. Langton, 1984: 144, fig. 49d [in pupal key]. Sahin, 1984: 82, figs. 200–202 [in larval key]. Michailova, 1985: 149, 158, 159, 163, 164, pl. v, viii [cytology].

Orthocladius (Euorthocladius) cf. *thienemanni-saxosus* [partim]. Coffman, 1973: table 1 [ecology].

Orthocladius (Euorthocladius) species 6 [partim]. Coffman & Ferrington, 1984: fig. 25.415 [pupa].

[non] *Spaniotoma (Orthocladius) thienemanni* Kieffer sensu Edwards, 1929: 344, 345, fig. 6m [partim] [in key to males] [misident.].

[non] *Orthocladius (Euorthocladius)* cf. *thienemanni* (Kieffer). Halvorsen et al., 1982:119 [record].

Type Locality: Germany: Insel Rügen: Thuringen (see Cranston 1984).

Type Material: Lectotype. Male, original label hand-written, *Orthocladius thienemanni* K.; printed label, R. I. Sc. N. B. 18.073, coll et det M. Goetghebuer; typed label. Boîtes no 6 Types Kieffer. Previously mounted in balsam under two coverslips on a slide; overcleared. Abdomen III–IX dissected from body; hypopygium intact. Wings crumpled and folded over; head squashed; only antennal flagellomeres 1 and 2 present; parts of legs missing. Hereby designated as lectotype.

Presumably original labels have been replaced, and other labels added to the lectotype in routine curation, because "coll et det M. Goetghebuer" makes no sense in a species reared by Thienemann and described by Kieffer. Presently there appear to be no other sepcimens that unquestionably belong to the original type series.

Diagnosis

Orthocladius thienemanni can be distinguished from other Holarctic species of *O. (Euorthocladius)* by a combination of characters. Adult Male: high AR (>1.75), relative lengths of palpal segments (3≐4), and details of the hypopygium (Figs. 27, 28). Pupa: rows of spines on anal margins of tergites III–VIII; thoracic horn present; absence of hooklets on II and absence of pedes spurii A. Larva: 13 teeth on the mentum, wide median tooth (MR>1.5), and high AR (>1.8).

Derivation of Name: Kieffer named this species after A. Thienemann.

Description

Adult Male (n = 5)

Dark brown. Large species. Head. Verticals 10–23, postorbitals 1–3 (4). Palps long with 3≤4 (4) (Type: 3=4). AR 1.75–2.15 (2). Thorax. Lateral antepronotals 2–7 (4). Acrostichals absent. Dorsocentrals 4–16. Prealars 3–7. Scutellars 15–26, biserial to multiserial (Type: 22, multiserial). Wing. Length 2.80–3.18 mm (4). R with 4–10 (3) setae. Squamals 30–40 (4). VR 1.06–1.14 (4). Anal lobe moderately produced (OD: right-angled). Legs. LR1 0.68–0.74 (3). LR2 0.45–0.53 (4). LR3 0.53–0.56 (4). Sensilla chaetica on ta1 of p2 (7–13) (4), absent on p3. Hypopygium (Figs. 27, 28). Virga present. Superior volsella collar-like. Inferior volsella with dorsal part slender, inner margin rounded, apex rounded or squared, and ventral part covered or extended below. Crista dorsalis long, robust.

Variation. Only six specimens, two originally collected and identified by Thienemann, have been examined. Lehmann (1971) reported the AR of *thienemanni* as 1.80–2.00 from his Fulda material.

Pupa (Exuviae)

Light brown, with darker apophyses on I–VIII, variable. Length 3.15–4.29 mm (10). Cephalothorax. Frontal warts weak to moderately developed; cephalic tubercles absent. Precorneals clumped, weak to strong, $1^1/_4\times$ as long as dorsocentrals; 2 median antepronotals, 1 lateral antepronotals, 3 dorsocentrals in a row, thicker than precorneals. Thoracic horn (Fig. 34f) ellipsoid, light brown, filled or clear, stalked; length 30–70 μm (10). Thorax dorsally wrinkled to granulose anteriorly along eclosion line.

Abdomen (Fig. 42). Tergites: I bare; III–VIII with 2–4 rows of strong spines along posterior margin (Fig. 37d); II–VIII with central patch of spinules anteriorly. Sternites: I, VIII bare; II–VII with 2 off-center patches of spinules anteriorly.

Setae on segments I–VIII:

D	4	5	5	5	5	5	5	1		L	1	3	3	3	3	3	3	4
V	1	3	3	3	3	3	3	0		Od	0	0	0	0	0	0	0	0

Anal lobe greatly reduced, one seta at midpoint. Genital sheaths extended beyond lobe in male and female. Pedes spurii A and B absent.

Variation. Associated exuviae from the Fulda (collected by Lehmann) and from Bathurst Island, NWT, as well as pupae from Kansas were examined here. The European material is more robust than the North American material. Anterior shagreen may be absent on tergite II.

Larva (Fourth Instar) (n = 11)

Body yellow, brown, or green. Head capsule brown; preserved, yellow. Eye spots fused. Mentum (Fig.52c) with 13 teeth, median tooth about 2× as wide as 1st lateral; MR 1.5–2.3; median tooth higher than 1st lateral. Ventromental plates extended anteriorly between 2nd and 3rd laterals. Premandible simple. Chaetula laterales sparse. Mandible (Fig.52a) with apical tooth as long or longer than first inner tooth; outer margin notched opposite seta subdentalis, rest of margin smooth except for occasional notch posteriorly; seta interna present. Antenna (Fig.52b) with robust Lauterborn organs; blade extended to 4th segment. AR 1.85–2.56. Body with simple, long setae, most likely arranged like that in *saxosus* (Fig. 57). Anal tubules subequal, moderately long, all same length and thickness, weakly pointed (Thienemann 1944: rounded).

Variation. Cranston (1982) recorded the head capsule as yellow-brown, and figured the mandible without the margin notched opposite the seta subdentalis. In one specimen excamined here, the premandible appears notched.

Material from Sabina Creek, Arizona, shows considerable variation in the width of the median tooth. With a lower MR, theese larvae will key to *saxosus*. The larvae of both of these species occur gregariously on stones.

Thienemann (Kieffer & Thienemann 1906) described the larva as green. In the material examined here, all preserved on slides, the body is either yellow, green, or brown.

Biology: Larvae live on the surfaces of larger stones in fast-flowing brooks, streams, and rivers (Kieffer & Thienemann 1906, Thienemann 1935, 1944, 1954, Lehmann 1971). Larvae live in clear gelatinous tubes encrusted with sand grains, often in fissures and depressions of the stone. Larvae are also associated with algal growth on stones (Thienemann 1954) and with the common bulrush, *Schoenoplectus lacustris* (Drake 1982). In a chalk stream of southern England, Drake (1982) found that *thienemanni* was the most abundant species of larval chironomid in the cold months. In his study, larvae were present during high discharge, but absent in low flow.

Pupae live in the enlarged larval tubes: half-ellipsoid, 6 mm long, 3 mm wide, 2 mm high, clear gelatinous tubes covered with small particles. The pupa undulates, causing water to flow through openings at both ends of the tube, as figured here (Fig.40) and in Thienemann (1954, fig.102) after Miall and Hammond (1900, fig.5). The pupal stage lasts 3–7 days (Kieffer & Thienemann 1906, Thienemann 1954).

Gregarious pupation of *thienemanni* in a spring-fed tributary of Sabina Creek near Pigeon Springs, Arizona, was observed by Jan Doughman (pers. comm.). In February, 1984, water temperature was 4°C with ice on the surface. Larvae were feeding on a thin film of diatoms on rocks. Larvae congregated in small (0.5 cm diam) vertical depressions on a 1' × 1' granite rock, then stopped feeding, and spun a gelatinous sheath over themselves (up to eight larvae under one sheath). Mature pupae alone, or pupae with mature larvae were found under some sheaths.

This species occurs with *rivicola* (based on exuviae) in seven localities (see *rivicola);* and with *calvus* (based on adults) in Germany.

Adults swarm in large numbers (Thienemann & Kieffer 1906). Thienemann (1935) reported adults appearing in the first of spring. Illies (1971) recorded emergence of adults from April to August in Breitenbach, Germany. Lehmann (1971) reported two generations in the Fulda: the first from January

to May, the second in October. In southern England, Drake (1982) found two generations in 1976 and 1977, the first emerging January to April, the second in March and April. In South Carolina, adults emerge from January through April.

Doughman (pers. comm.) has observed that the adults of *thienemanni* hold their wings rooflike over the abdomen.

Distribution: Palearctic: Denmark, England, Germany, Ireland, Lebanon, Switzerland, and Turkey. Nearctic: Canada, Greenland, USA.

Material Examined: Lectotype. Non-type material: No locality: coll. et det. M. Goetghebuer, R.I.Sc.N.B. 18.073, 1M (BRUX). Canada. Northwest Territories: Oscar Creek, 25-V-1972, FWI-Pipeline Project, CH6475, 2P. Ontario: Ottawa, Ottawa River, 22-IV-1966, Jon Martin, 0122-1, 2PEx (CNC); Rushing River, 9-V-1978, W.P. Coffmann, 2PEx (COFF). Denmark. Zealand, Lellinge Å, 20-V-1968, C. Lindegaard, 3Ex, 2L (? COP). England. East Sussex, nr. Forest Row, 51414347, 17-IV-1978, P. S. Cranston, BM1978-197, 1L (BMNH); Bucks, River Chess, 16-II-1982, W. R. Karsteter, 1L (FSCA). Germany. River Schwentine, East Holstein, 1935, A. Thienemann, 1M; Insel Rügen, A. Thienemann, 1M, 2P, Baumberge, bei Münster, Westfalen, 2-II-1908, Thienemann, 1M; Fulda, Hessen 10-I-1969, Nr. 27b, J. Lehmann, 1M w/ PEx; Fulda, Br. Sandlofs, 17-X-1952, E. J. Fittkau, 12 PEx (ZSM). Greenland. Tilloe Narssag Elv. hole 740, 24-VIII-1981, C. Lindegaard, 3PEx; 9DR, 11-12-VII-1981, M w/Ex (? COP). Switzerland. Stein am Rhein, 20-III-1966, F. Reiss, 1M (ZSM). USA. Alaska. N.Fk. Chena R., 11-VII-1978, D. Wartinbee, 1Ex (COFF); Jim River above Prospect Camp, left bank, 095073, USGS, 1Ex (CALD). Arizona. coll J. Doughman: Pima Co., Sabino Creek at Summerhaven (0.6 mi up forest rd.) on Mt. Lemmon nr. Tucson, from rocks, 5-II-1984, 840205, 1FP, 1MP, 10L; 26-II-1984, 840226, 1MP, 1FP, 1L; Pinal Co., Boyce-Thompson Arb., Queen Cr., Cladophora zone, 840201, 1FP, 4L (USGS). Georgia. Fannin Co., Noontootla Creek at Newport Rd., 24-IV-1979, 1L, 1FP (CALD). Kansas. Johnson Cop., Cedar Creek, 29-XII-1977, P.L., 4FP,4MP; Douglas Co., Deer Creek, 0.5 mi S of Stull, 20-III-1981, L. Ferrington, 13PEx; Atchinson Co., stream 5.5mi S, 0.2 mi Atchinson, 24-III-1982, L. Ferrington, 1F w/Ex, 1M w/Ex (SBSK). North Carolina. Yancey Co., Cane R., Sta. 4, XI-1980, K. Dechart, 1L; Macon Co., Calor Fork, 15-I-1981, K. Dechart, 1L; Mitchel Co., N. Toe R., 2-II-1978, K. Dechart, 1L; Iredell Co., Buffalo Shoals Creek, Jan 1981, K. Dechart, 1L; Haywood Co., Pigeon R., May 1980, site #4, 1L, Surry Co., Ararat R., 14-IV-1981, K. Eagleson, 1L; Transylvania Co., French Broad R., nr. Rosman, 25-IV-1978, D. Penrose, 1L (NCNR). Pennsylvania: Linesville Creek, 7-IV-1971, W.P. Coffmann, 1Ex (CNC). South Carolina. Oconee Co., Seneca Cr., Seneca, 22-I-1977, P.L. Hudson, 1Mw/Ex (HUD); 10-II-1977, 1M w/Ex; Oconee Co., East Fk, Chattoga River, Natl Fish Hatchery, 9-III-1978, P.L. Hudson, 1MP (HUD); Oconee Co., Seneca, Flat Shoals River, 9-II-1977, P.L. Hudson, 1M, 2Ex (HUD); Oconee Co., Fall Creek, Lake Keowee, 30-IV-1974, P.L. Hudson, 1Ex (HUD). Tennessee. Pigeon River, Gatlinburg, 3-V-1977, P.L. Hudson, 1 Ex (HUD).

Remarks: In a joint publication (Kieffer & Thienemann 1906), Kieffer named and described this species from the adult male and female. He did not designate a holotype, nor give any information on his material. He did describe general body characters, but gave no figures or details of the genitalia. In the same paper, Thienemann described the pupa and larva of the named species. The description of the immature stages was sufficiently complete to allow the species to be understood, particularly in the pupal stage.

Edwards (1929) included *thienemanni* under his Group C, or *Orthocladius* (s.str.) of his subgenus *Spaniotoma (Orthocladius).* He separated the males of *thienemanni* and *O. glabripennis* by the absence of a fore tarsal beard and an AR of 2.00 in *thienemanni.* His figure 6m was the first available reproduction of the hypopygium. Until recently this figure was interpreted as representing *O. thienemanni.* However, I have examined some of Edwards's material from Herts and Gloucester that he used for his 1929 work. Some of these specimens belong to a recently described species, *O. (Euorthocladius) calvus* Pinder, which can be distinguished from *thienemanni* in adult male essentially by the relative lengths of palpal segments 3 and 4.

Goetghebuer (1932) reproduced Edwards's (1929) figure of *O. thienemanni* and separated it from other *O. (Orthocladius)* by color, AR, LR, and hypopygial details. Later Goetghebuer (1942) essentially reproduced the same figure and description, and included females in his keys to adults.

Brundin (1956) provided a figure of the hypopygium and listed *thienemanni* as type of the subgenus *O. (Orthocladius)* without providing other characters of the species. Pinder (1978) provided the most recent illustration of the hypopygium of *thienemanni,* and included the species in a key to males on the British chironomids.

The immature stages, particularly the pupa, have received more attention in the literature than the adults. Thienemann's larval description (Kieffer & Thienemann 1906) was brief and without drawings. He compared the larva of *thienemanni* to the larva of *O. sordidellus* as described by Johannsen (1905), probably an *Orthocladius (Orthocladius).* It had an AR of 1.66, an MR of 1.5, and the Lauterborn organs were either weak or absent, based on Johannsen's figures. The pupa of *sordidellus* was certainly not *O. (Euorthocladius),* but Thienemann made no mention of this. His pupal description of *thienemanni* was more complete, but Thienemann mistakenly recorded the diagnostic spine rows as present on tergites II-VII, although his figure 2 correctly shows them on tergites III-VIII.

Thienemann (1935) erected the genus *Euorthocladius* with *thienemanni* as type. He gave a synonym for *thienemanni* and its known distribution as Germany, England, and Switzerland. In his larval keys he separated *thienemanni* from *rivicola* by the higher AR (1.85 versus 1.28) and the longer body. In his pupal keys Thienemann separated *thienemanni* from *rivcicola* by the spine rows on III, smaller thoracic horn (see remarks under *rivicola),* and longer body.

Johannsen (1937) treated *thienemanni* in the group *Euorthocladius* under his subgenus *Spaniotoma (Orthocladius).* He distinguished the larva of *thienemanni* from the larva of *rivulorum* by the equally long forks of the SI (after Thienemann 1935, figs. 1, 2), and from *obumbratus* by the robust Lauterborn organs and sparser pecten. He distinguished the pupa of *thienemanni* from the pupa of *rivulorum* by the thoracic horns.

In keys, Thienemann (1944) separated the pupa of *thienemanni* from other *Euorthocladius* pupae by the arrangement of spines on the abdominal tergites, the structure of the thoracic horn, and the body length. He separated the larva from other *Euorthocladius* by the length of the anal tubules, AR (1.85), teeth on the mentum, SI, and pecten.

Chernovskii (1949) largely followed Thienemann (1935) and treated the *thienemanni* group in a larval key, distinguished from *rivicola* by higher AR (2.00 versus 1.10) and longer body (8 mm).

Roback (1957a) included *thienemanni* in his keys and separated the larvae (on a subgeneric level) from other *Orthocladius* (as *Hydrobaenus)* by the large Lauterborn organs. He distinguished the pupae by the thoracic horns and the spine patterns of the abdominal tergites.

Pankratova (1970) separated the larvae of *thienemanni* from *rivicola* by the higher AR (2.00 versus 1.40), but did not distinguish the pupa of *thienemanni* from *rivicola* or *saxosus.* She gave a complete description of both larva and pupa, and reproduced figures from Chernovskii (1949), and mentioned that the premandible was bifurcate. A notched premandible was seen in only one specimen here, but this is a difficult character to assess in *O. (Euorthocladius).* A morphologically similar species, *calvus,* can be distinguished from *thienemanni* by the bifid premandible.

Cranston (1982) separated *thienemanni* from *frigidus* and *rivicola* by the Lauterborn organs and SI of the mandible, and provided figures of the mentum (MR>1.5) and the antenna (AR=1.8).

Romaniszyn (1958) used Potthast's (1914) figures and separated *thienemanni* from *rivicola* by AR and body length. Coffmann & Ferrington (1984) included the pupa in their keys; *thienemanni* will key to couplet 55. Halvorsen et al. (1982) referred to their material of *O. ashei* as cf. *thienemanni.*

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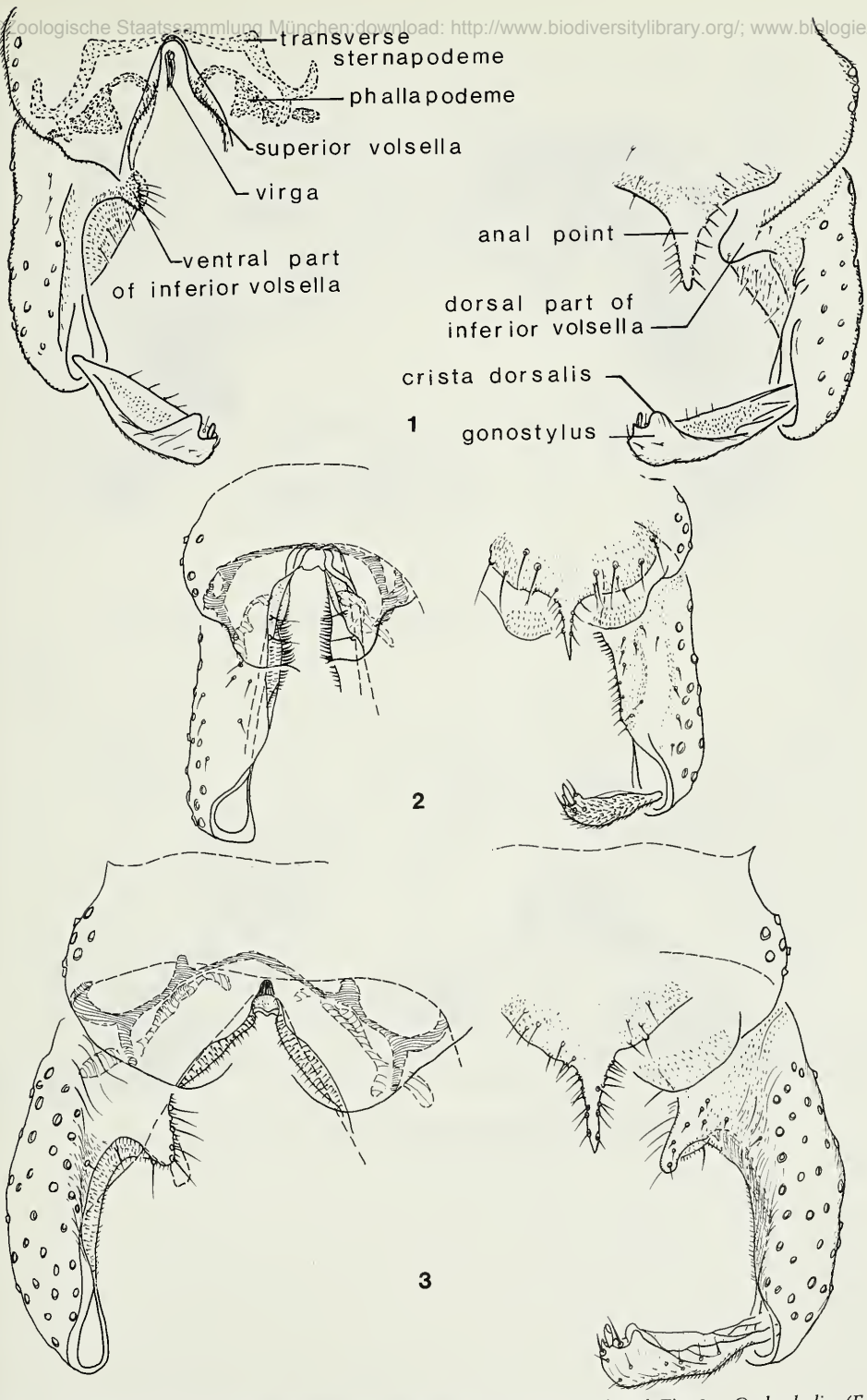


Fig. 1. *Orthocladius (Euorthocladius) luteipes* Goetghebuer, hypopygium, dorsal. Fig. 2. *Orthocladius (Eudactylocladius)* sp., hypopygium, dorsal. Fig. 3. *Orthocladius (Pogonocladius) consobrinus* (Homgren), hypopygium, dorsal.

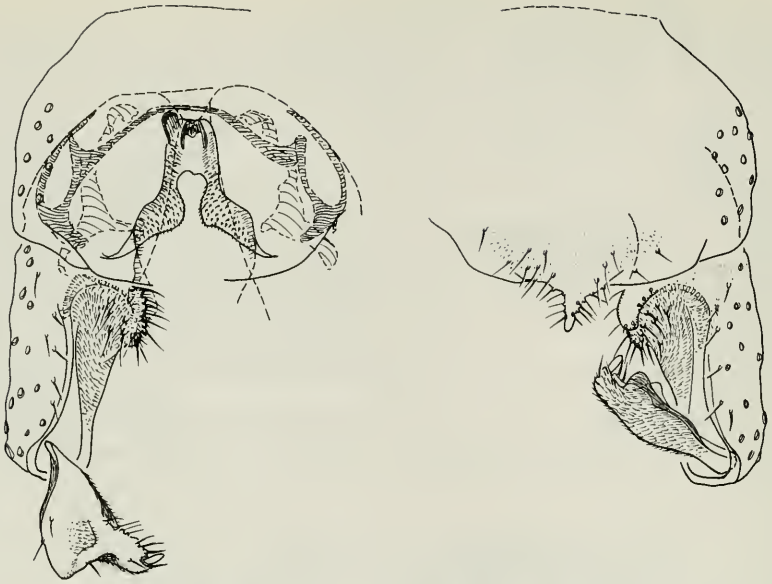
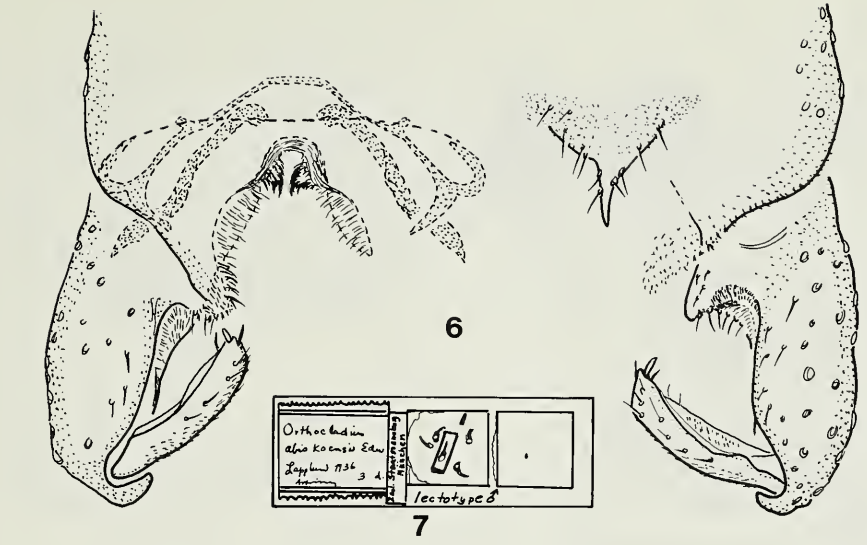
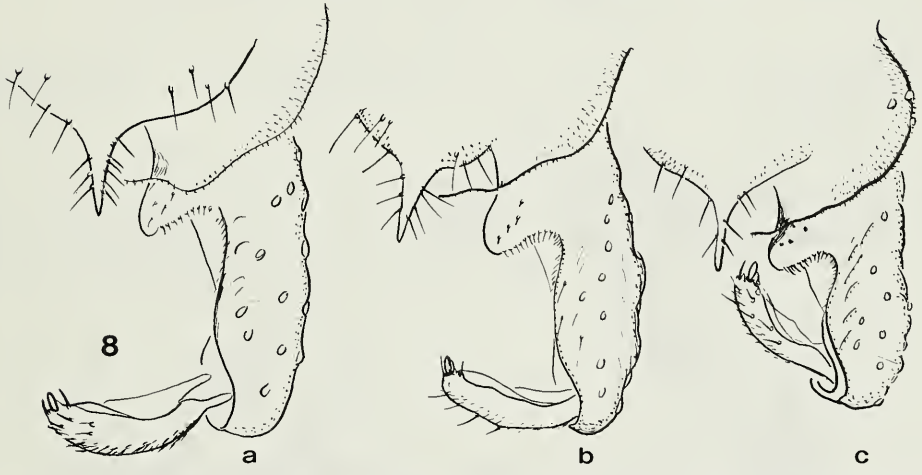


Fig. 4. *Orthocladius (Orthocladius) trigonolabis* Edwards, hypopygium, dorsal.

Fig. 5. *Orthocladius (Orthocladius) ferringtoni* Soponis, hypopygium, dorsal.

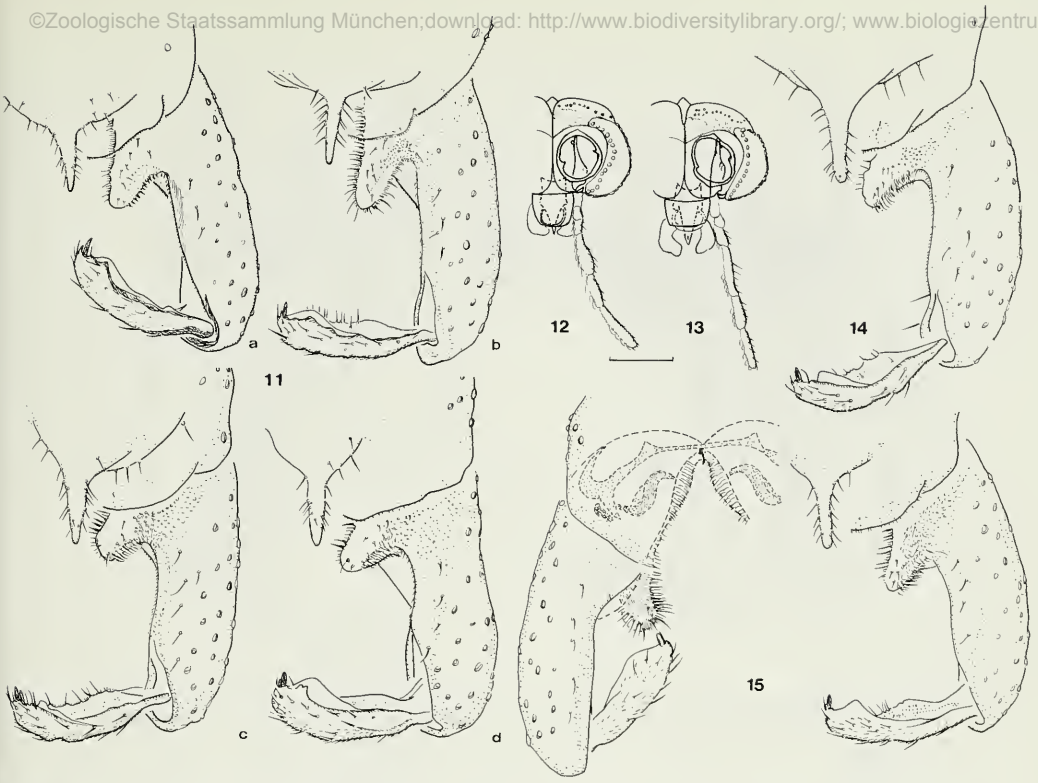




Figs. 6–8. *Orthocladius (Euorthocladius) abiskoensis* Thienemann & Krüger. 6. Hypopygium, dorsal, Edwards type material. 7. Lectotype slide. 8. Hypopygia, dorsal. a. Isachsen, NWT b. Hazen Camp, NWT c. Caribou Bar Creek, NWT.

Fig. 9. *Orthocladius (Euorthocladius) coffmani* n.sp., hypopygium, dorsal, holotype.

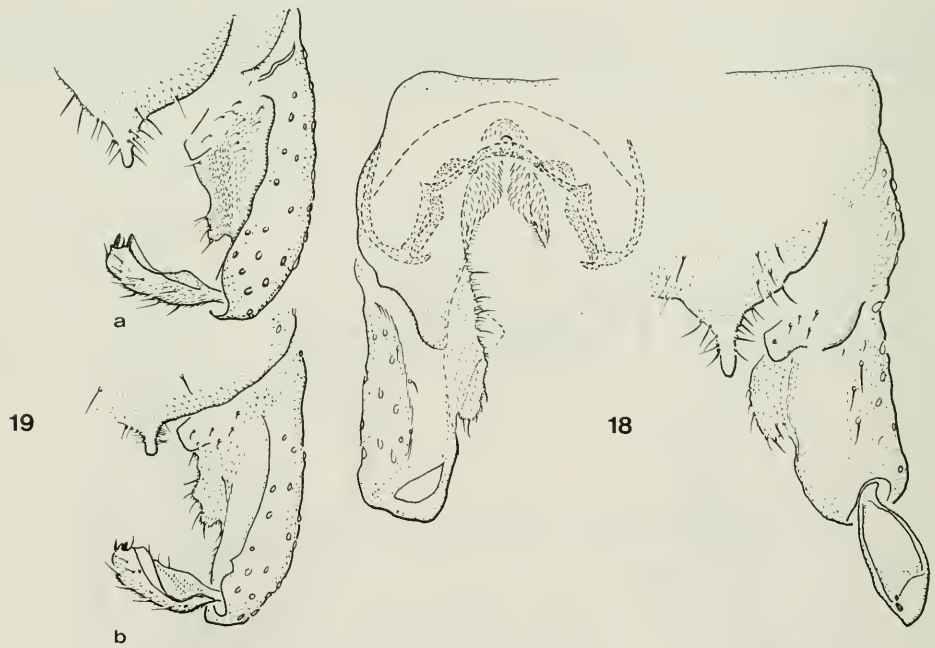
Fig. 10. *Orthocladius (Euorthocladius) anteilis* (Roback), hypopygium, dorsal, Idaho.



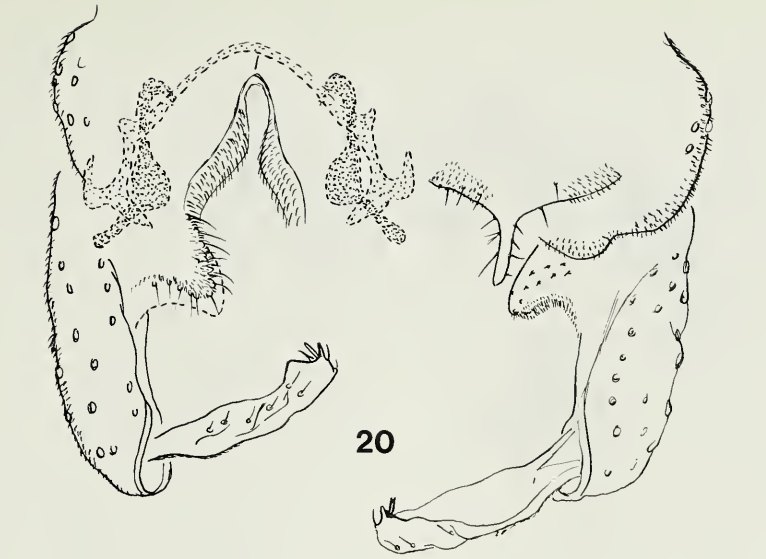
Figs. 11–15. 11. *Orthocladius (Euorthocladius) roussellae* n.sp., hypopygia, dorsal, partypes. a. Baffin Island, NWT b. Axelheiberg Island, NWT c. Greenland d. Melville Island, NWT. 12. *Orthocladius (Orthocladius) frigidus* (Zetterstedt), head, frontal. 13–15. *Orthocladius (Euorthocladius) roussellae* n.sp. 13. Head, frontal. 14, 15. Hypopygia, dorsal, paratypes, Hazen Camp, NWT.

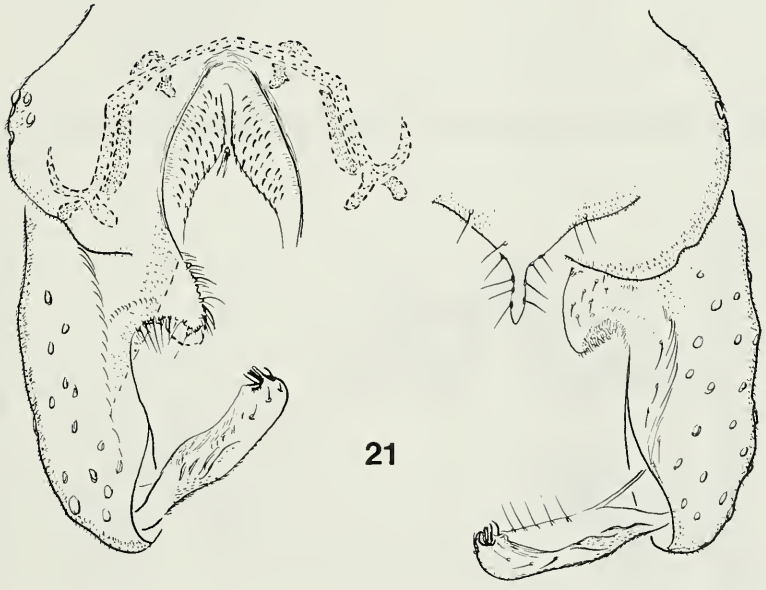
Fig. 16. *Orthocladius (Euorthocladius) telochaetus* Langton, hypopygium, dorsal, holotype.

Fig. 17. *Orthocladius (Euorthocladius) suspensus* (Tokunaga), hypopygium, dorsal, holotype.



Figs. 18–19. *Orthocladius (Euorthocladius) saxosus* (Tokunaga), hypopygia, dorsal. 18. holotype. 19. a, b. Japan, non-type material.





Figs. 20–21. *Orthocladius (Euorthocladius) rivulorum* Kieffer, hypopygia, dorsal. 20. Ireland. 21. England.

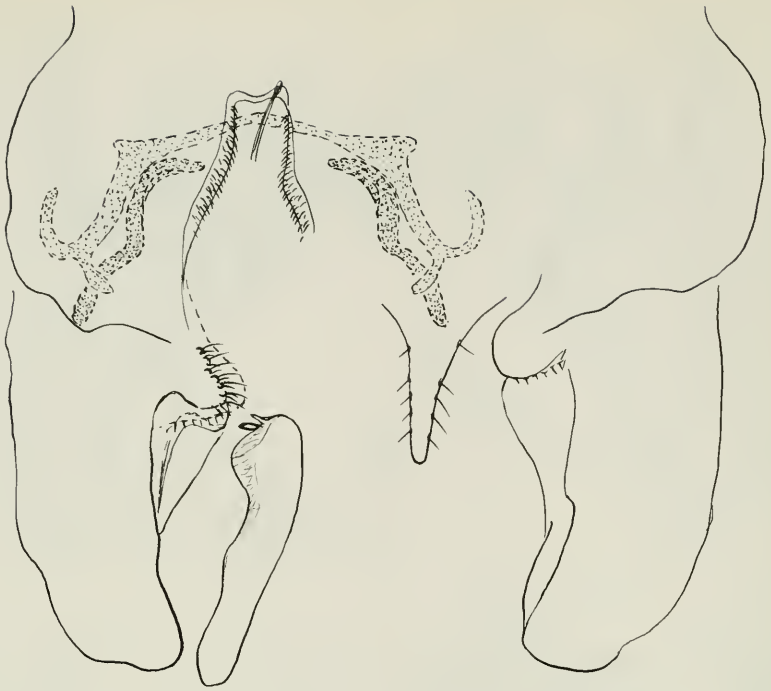


Fig. 22. *Orthocladius (Euorthocladius) kanii* (Tokunaga), hypopygium, dorsal, paratype.

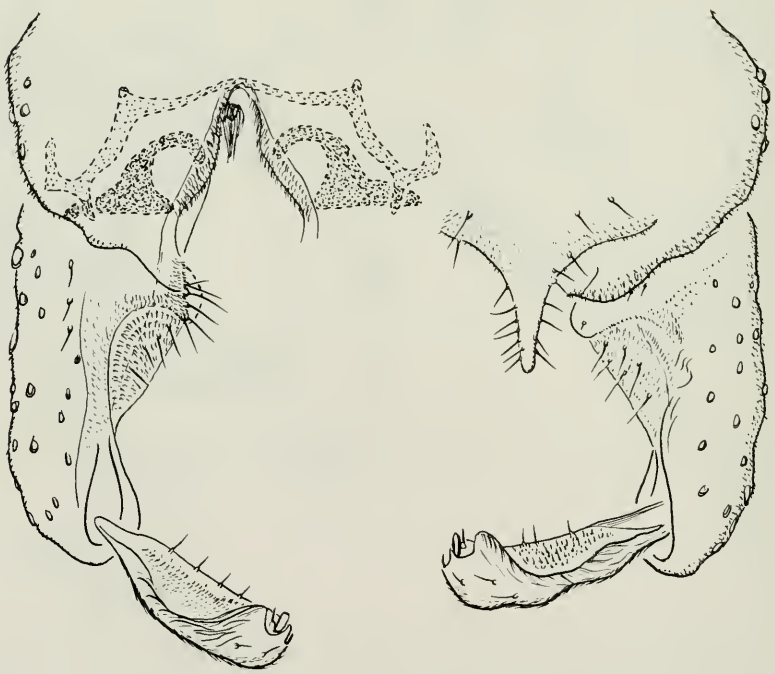


Fig. 23. *Othocladius (Euorthocladius) luteipes* Goetghebuer, hypopygium, dorsal, Italy.

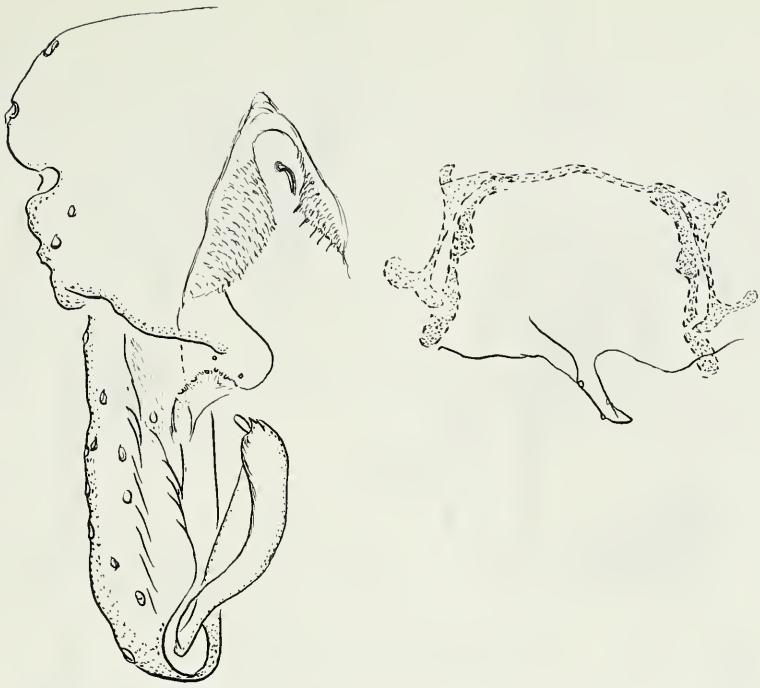
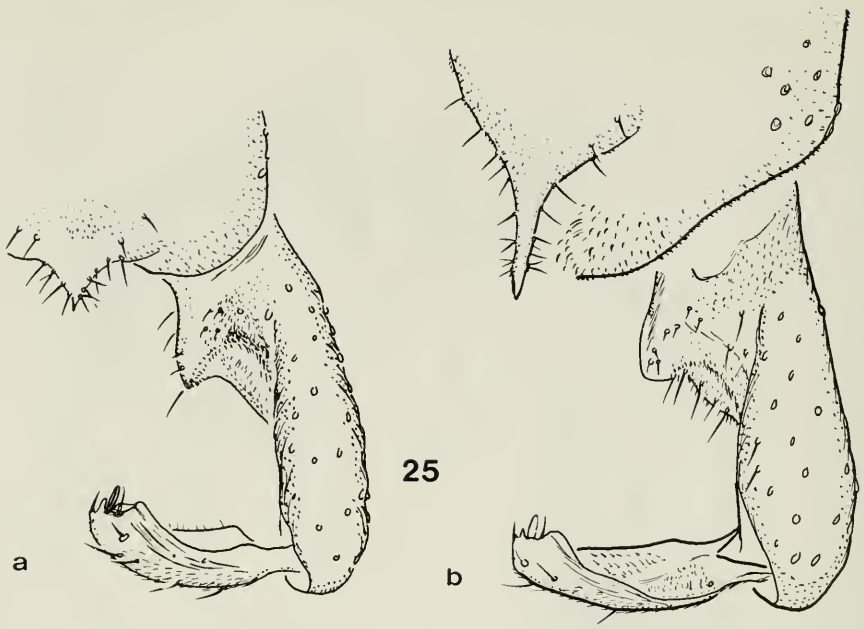
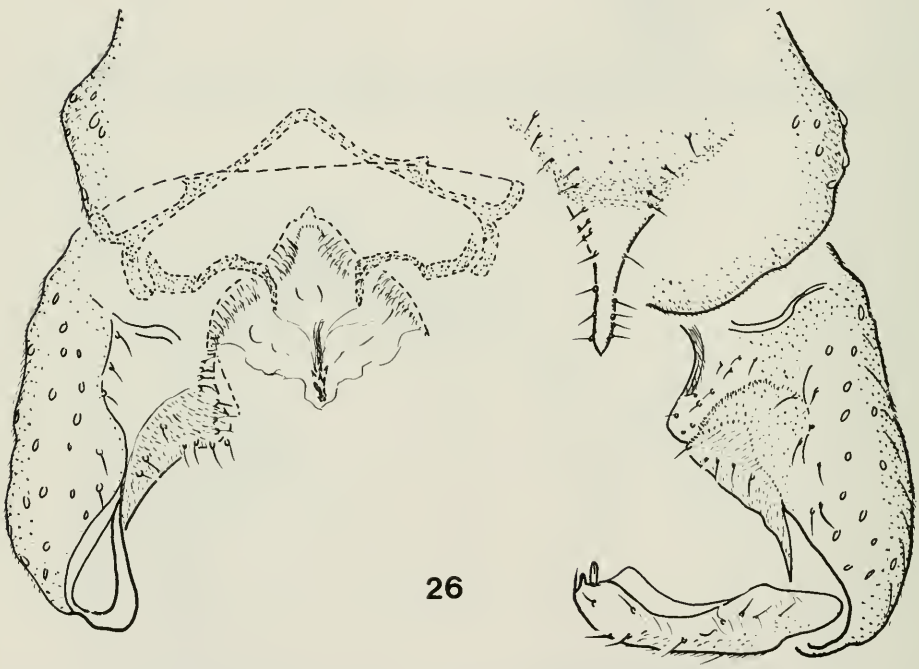
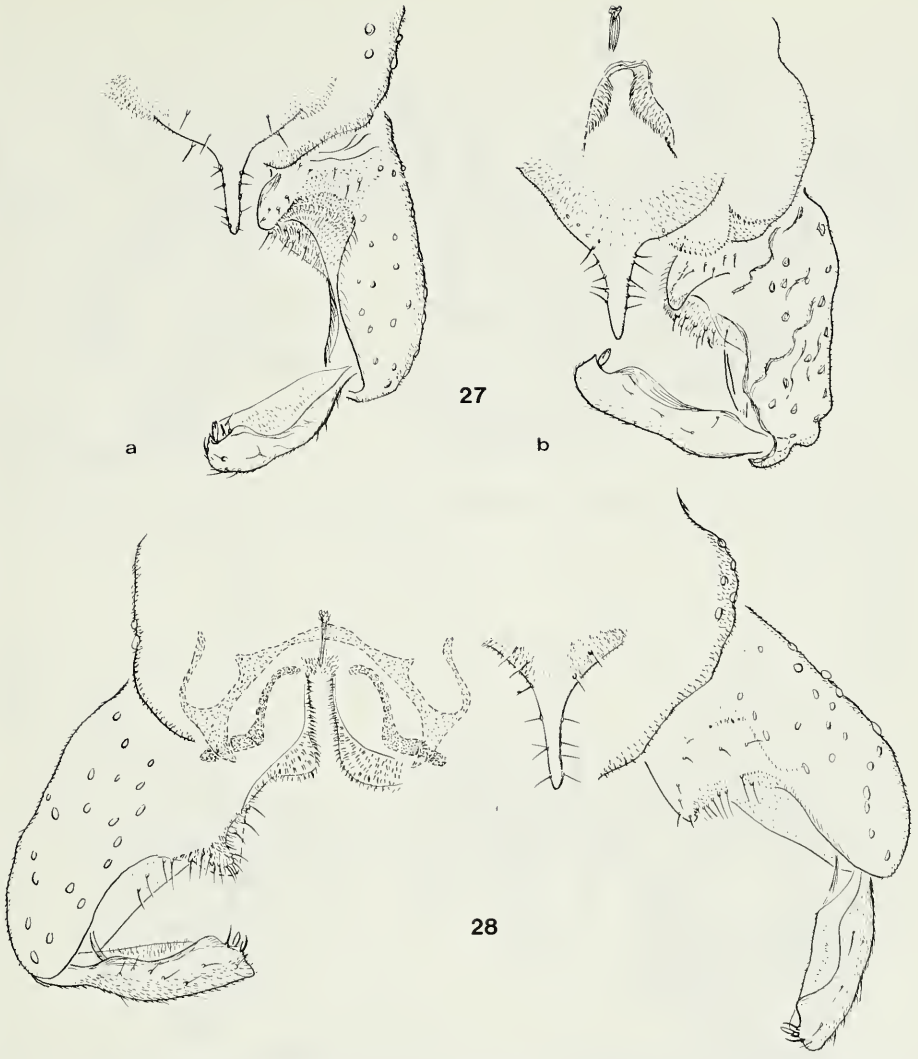


Fig. 24. *Orthocladius (Euorthocladius) luteipes* Goetghebuer, hypopygium, dorsal, holotype.

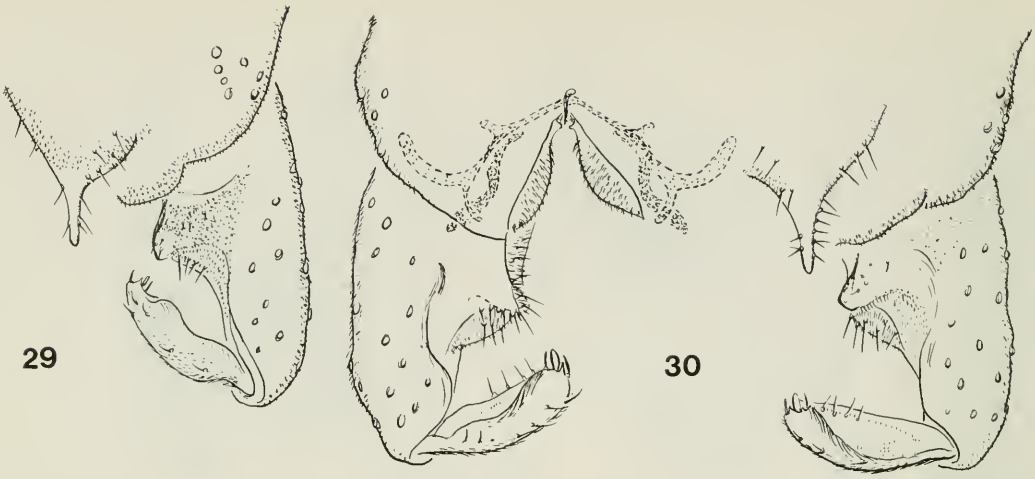




Figs. 25–26. *Orthocladius (Euorthocladius) calvus* Pinder, hypopygia, dorsal. 25. a. Gloucester, England. 26. River Schwentine, Germany. 25. b. *Orthocladius (Euorthocladius) thienemanni* Kieffer, hypopygium, dorsal. River Schwentine, Germany.



Figs. 27–28. *Orthocladius (Euorthocladius) thienemanni* Kieffer, hypopygia, dorsal. 27. a. Switzerland b. det. Goetghebuer. 27. lectotype.



Figs. 29–30. *Orthocladius (Euorthocladius) ashei* n.sp., hypopygia, dorsal, paratypes. 29. Norway. 30. Ireland.

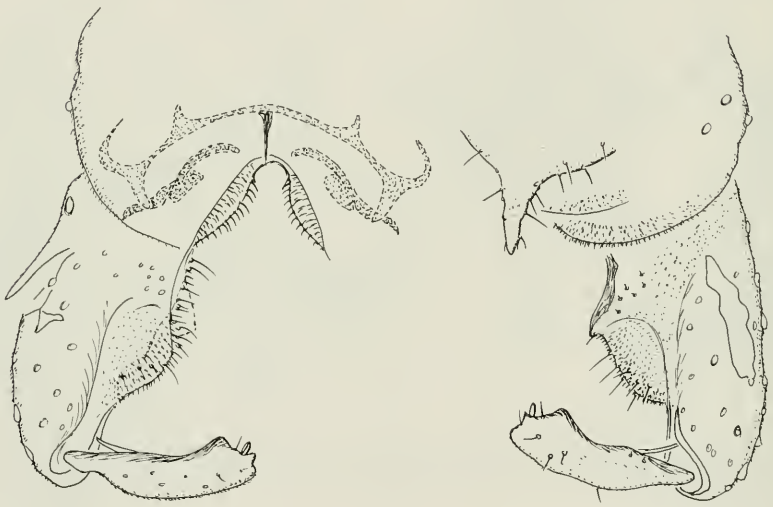
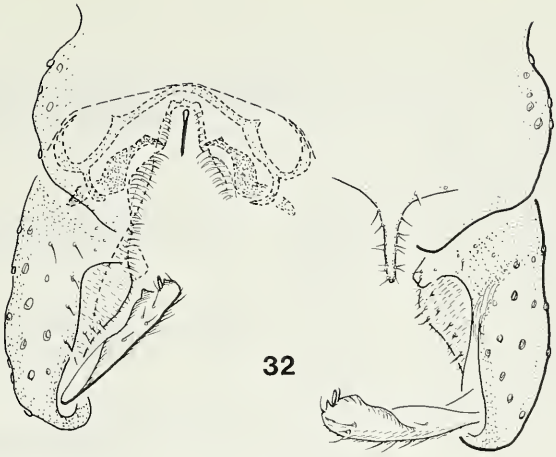
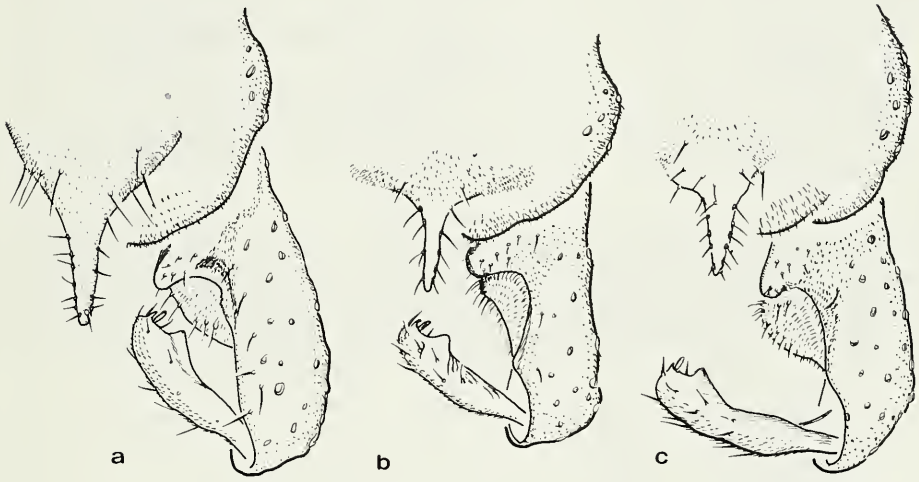


Fig. 31. *Orthocladius (Euorthocladius) difficilis* (Lundbeck), hypopygium, dorsal, lectotype.





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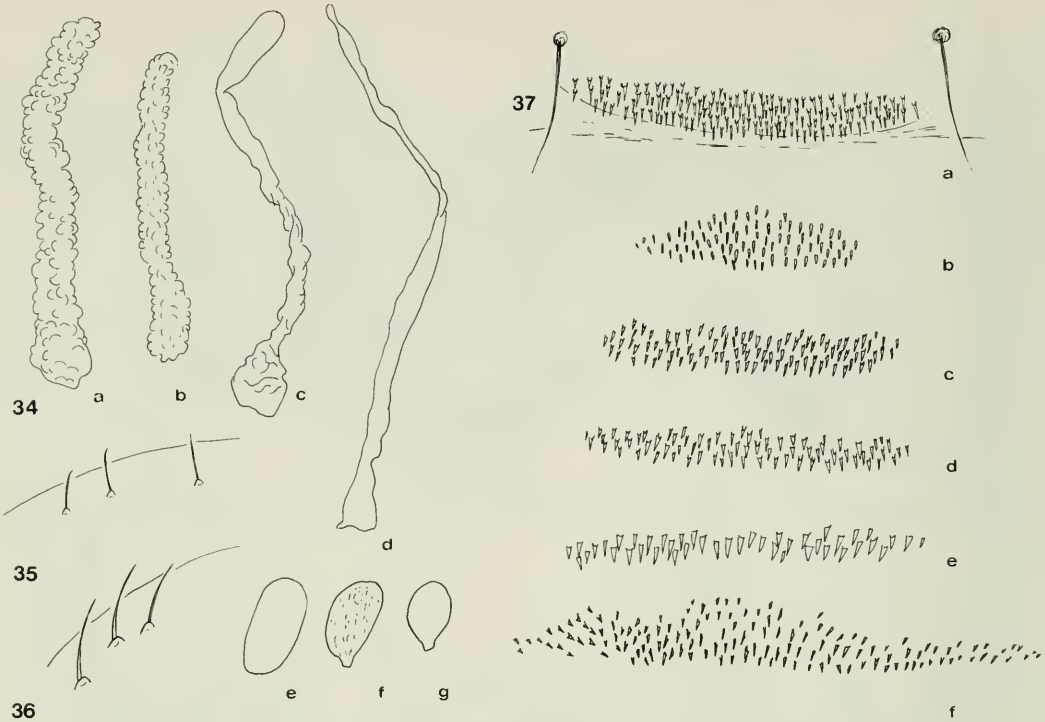
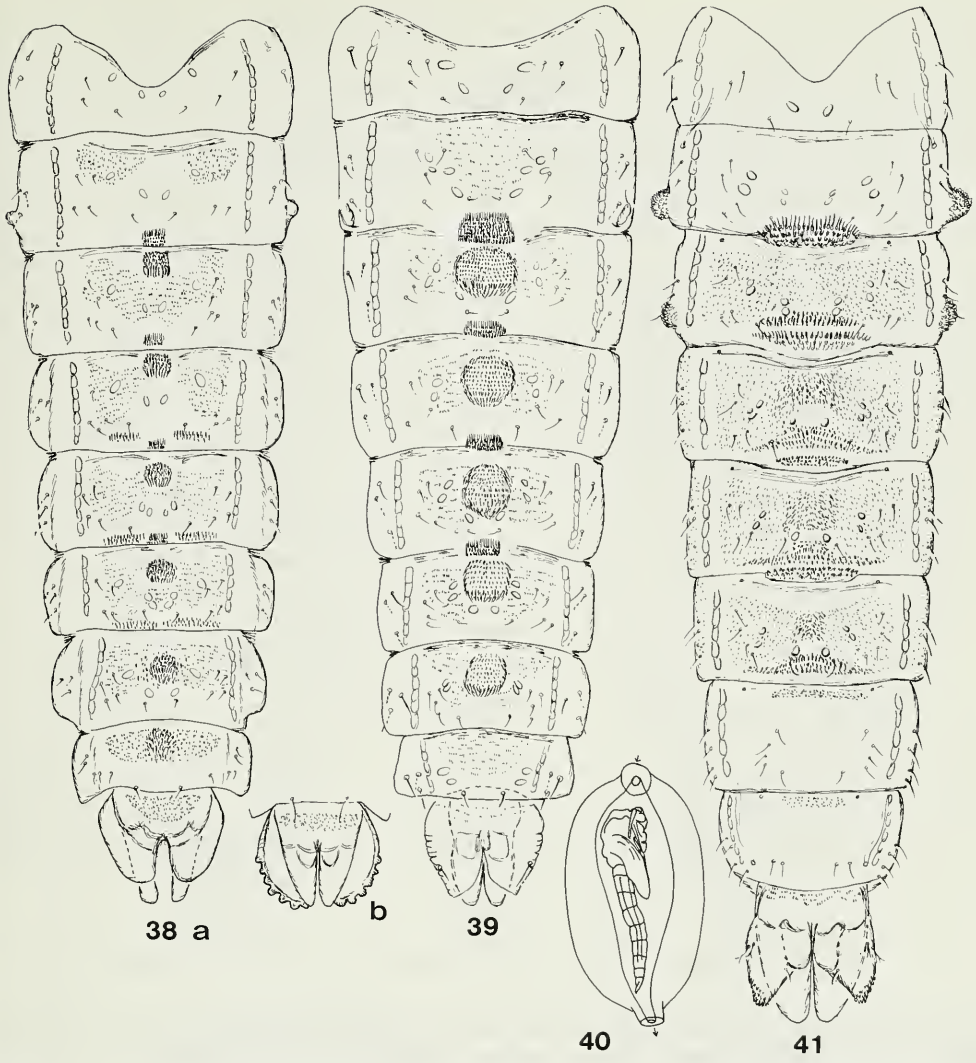
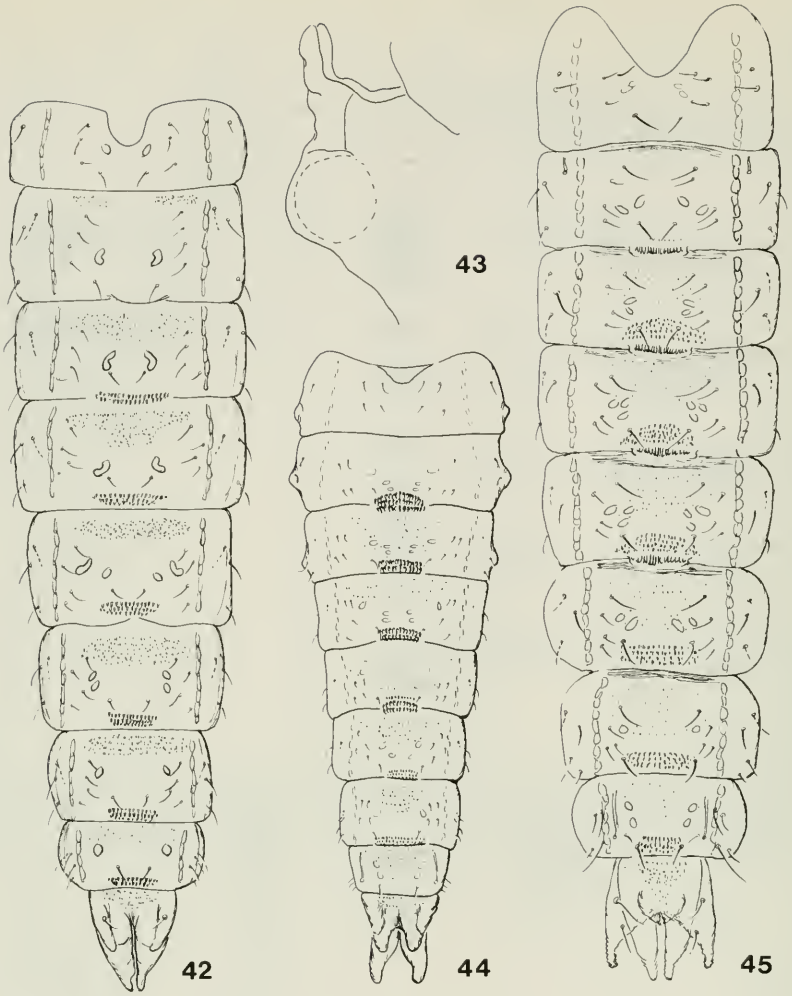
Figs. 32–33. *Orthocladius (Euorthocladius) rivicola* Kieffer, hypopygia, dorsal. 32. Ottawa. 33. a. Idaho b. South Carolina c. NWT.



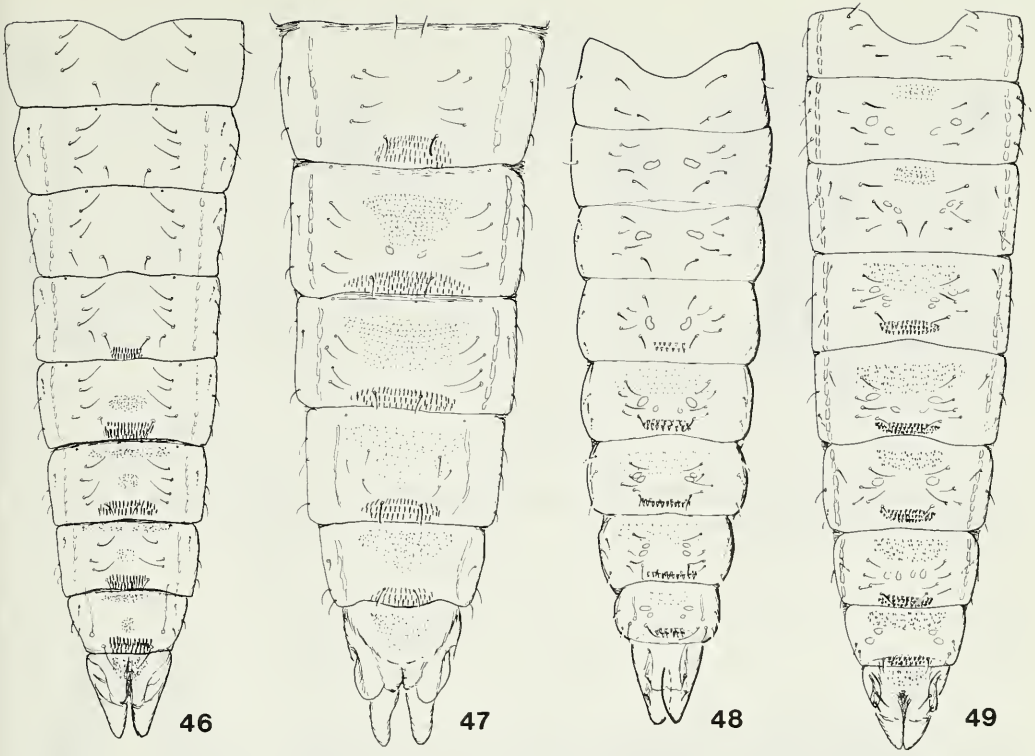
Figs. 34–37. *Orthocladius (Euorthocladius)*, pupal thoracic horns. a. *coffmani* n.sp. b. *rivulorum* Kieffer c–d. *roussellae* n.sp. c. Alberta d. NWT e. *saxosus* (Tokunaga) f. *thienemanni* Kieffer g. *rivicola* Kieffer. 35–36. *Orthocladius (Euorthocladius)*, pupal dorsocentral setae. 35. *rivicola* Kieffer. 36. *ashei* n.sp. 37. pupal spines. Tergite II: a. *calvus* Pinder. Tergite IV: b. *luteipes* Goetghebuer c. *rivicola* Kieffer d. *thienemanni* Kieffer e. *ashei* n.sp. f. *calvus* Pinder.



Figs. 38–41. *Orthocladius (Euorthocladius)*, pupal abdomen, dorsal. 38a. *rivulorum* Kieffer. 39. *coffmani* n.sp. Anal lobe. 38b. ?n.sp. nr. *rivulorum*. *Orthocladius (Euorthocladius)*, pupae. 40. *thienemanni* Kieffer, pupa in tube, after Miall and Hammond (1900). 41. *rousselae* n.sp., pupal abdomen, dorsal.



Figs. 42, 44, 45. *Orthocladius (Euorthocladius)*, pupal abdomen, dorsal. 42. *thienemanni* Kieffer. 44. *saxosus* (Tokunaga). 45. *abiskoensis* Thienemann & Krüger, frontal warts, lateral. Fig. 43. *saxosus* (Tokunaga).



Figs. 46–49. *Orthocladius (Euorthocladius),* pupal abdomen, dorsal. 46. *luteipes* Goetghebuer, Pennsylvania, USA. 47. Goetghebuer, Italy, segments IV–IX. 48. *ashei* n.sp. 49. *rivicola* Kieffer.

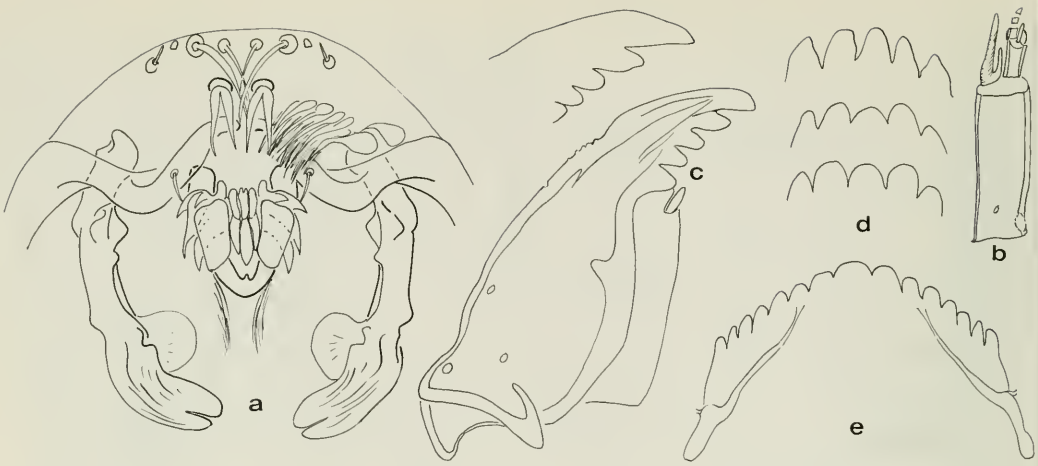


Fig. 50. *Orthocladius (Euorthocladius) roussellae* n.sp., larva. a. epipharynx b. antenna c. mandible, with variation d. variation of mental teeth e. mentum.

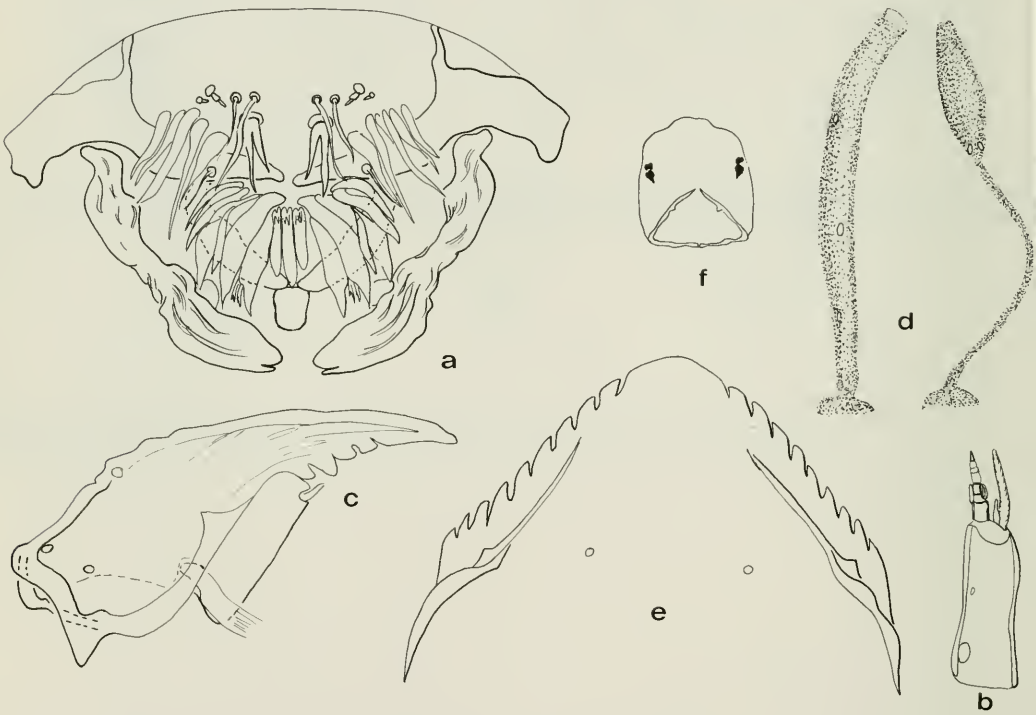
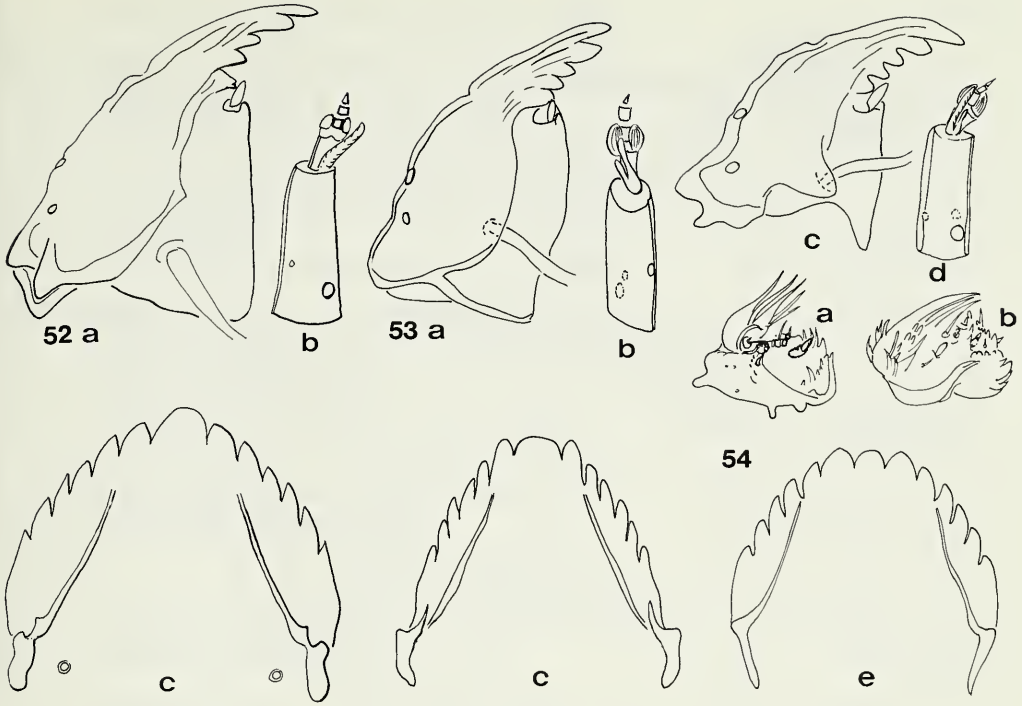


Fig. 51 *Orthocladius (Euorthocladius) rivulorum* Kieffer, larva. a. epipharynx b. antenna c. mandible d. larval (left) and pupal (right) tubes, after Taylor (1903) e. mentum f. head capsule, dorsal.



Figs. 52–54. *Orthocladius (Euorthocladius),* larvae. 52. *thienemanni* Kieffer. a. mandible c. antenna c. mentum. 53. *luteipes* Goetghebuer. a. mandible b. antenna c. mentum. 54. *ashei* n.sp. a. maxilla, dorsal b. maxilla, ventral c. mandible d. antenna e. mentum.

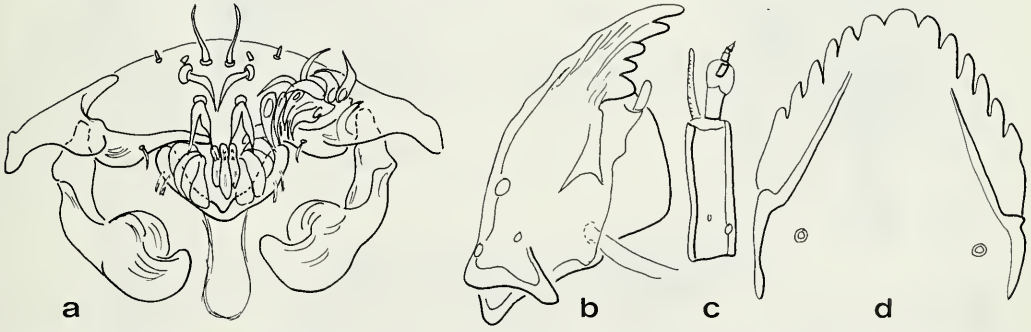


Fig. 55. *Orthocladius (Euorthocladius) rivicola* Kieffer, larva. a. epipharynx b. mandible c. antenna d. mentum.

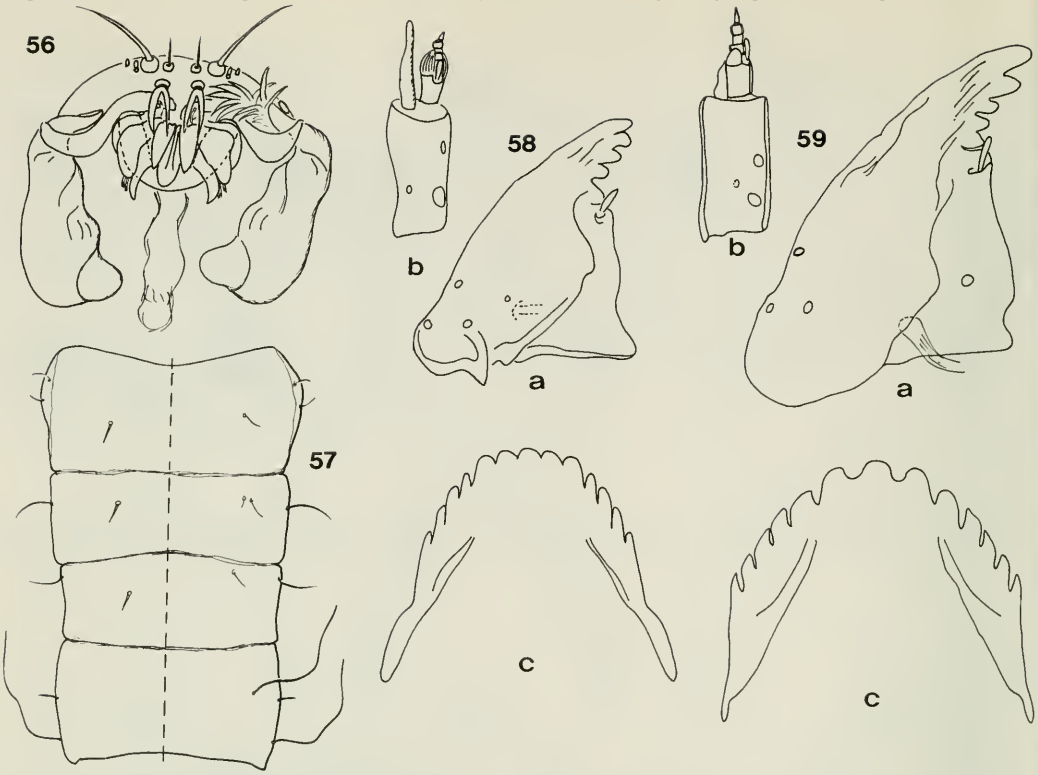


Fig. 56–59. *Orthocladius (Euorthocladius) saxosus* (Tokunaga), larva. 56. epipharynx 57. body, segments I–IV, ventral (left), dorsal (right). 58. Alberta: a. mandible b. antenna c. mentum. 59. Type series: a. mandible b. antenna c. mentum.

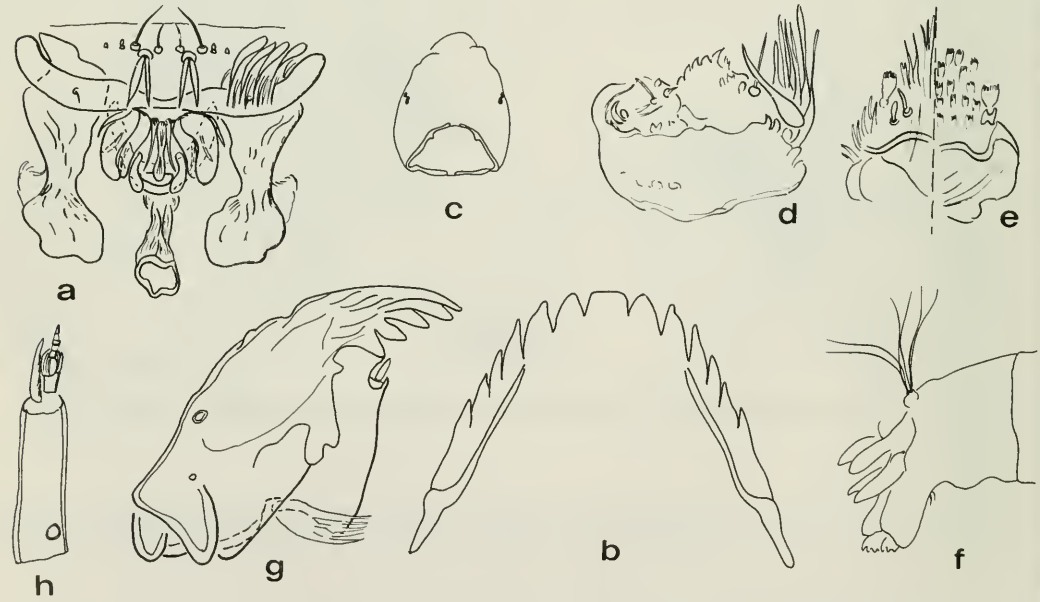


Fig. 60. *Orthocladius (Euorthocladius) abiskoensis* Thienemann & Krüger, larva. a. epipharynx b. mentum c. head capsule, dorsal d. maxilla, dorsal e. premento-hypopyaryngeal complex, dorsal (left) and ventral (right) f. posterior body, anal tubules and procercus g. mandible h. antenna.

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