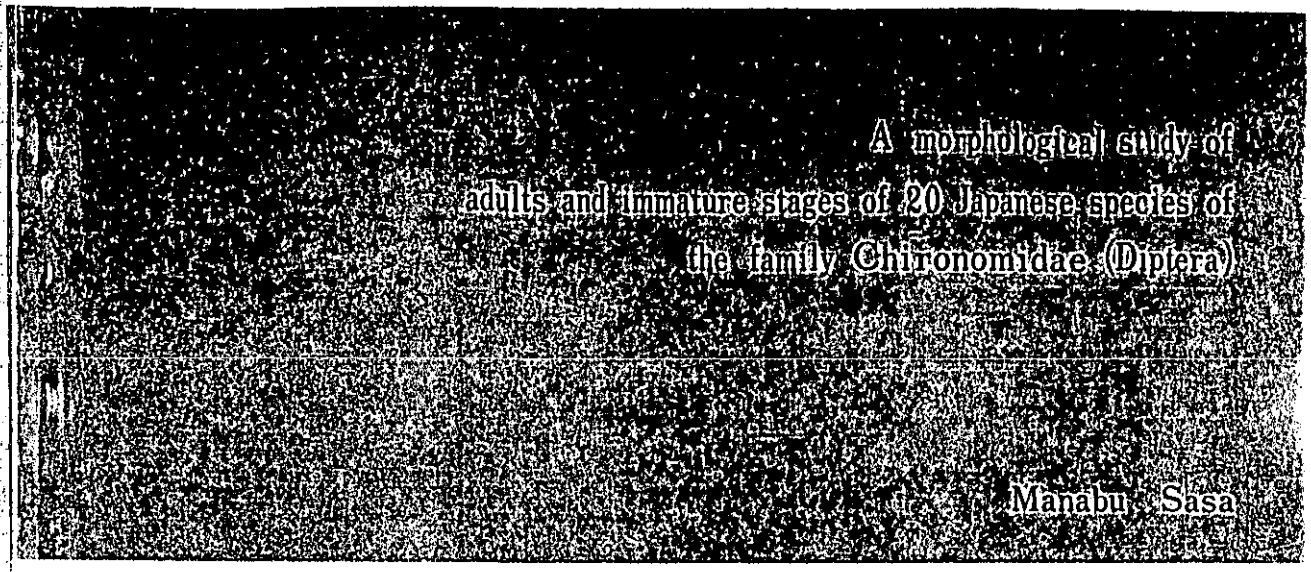
国立公害研究所研究報告　第7号
Research Report from the National Institute for Environmental Studies NO.7

R—7—'79



A morphological study of adults and immature stages of 20 Japanese species of the family Chironomidae (Diptera)

Manabu Sasa

THE NATIONAL INSTITUTE FOR ENVIRONMENTAL STUDIES

環境庁　国立公害研究所

A morphological study of adults and immature stages of 20 Japanese species of the family Chironomidae (Diptera)*

Manabu Sasa

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*Studies on Chironomidae of Japan, Part 5, from NIES.

This study was supported by Grant in Aid of Scientific Research, Ministry of Education, Culture and Science, No. 303083.

CONTENTS

INTRODUCTION

This study was undertaken as part of the Special NIES Research Program "Studies on Eutrophication of Land Water" and constitutes the fifth report on taxonomy and biology of Japanese chironomid midges compiled by the author and his colaborators. In the preceding papers by Sasa (1978a, b), accounts were given on the taxonomic status and descriptions of adults and immature stages of a very common and important species, *Tokunagayusurika akamusi* (Tokunaga), and on the comparative morphology of nine species of the genus *Chironomus* in Japan. In the present paper, description on 19 species of larvae and 20 species of pupae and adults which were frequently found in our study areas, are reported. The association between larvae and pupae as well as pupae and adults were based mostly on specimens individually reared in the laboratory. Methods for rearing, preserving and mounting the specimens were the same as reported in the preceding report (NIES R-3-78). The gum-chloral solution which was used as the mounting medium, was generally prepared by dissolving gum arabic (8 g), chloral hydrate (30 g), acetic acid (1 ml), and glycerin (3 ml) in distilled water (10 ml). The nomenclature used is almost the same as that defined in the previous papers and anatomical terms adopted were mainly from Pinder (1978), see Figs. 3, 4, 5, 16, 60 and 72.

Acknowledgement

I am much indebted to Dr. James E. Sublette and Dr. Mary F. Sublette, Eastern New Mexico University, who stayed with us in NIES during 3 weeks in the summer of 1978, and gave valuable suggestions for identification of our materials. Valuable assistance was also provided by Dr. L. Brundin, Dr. E.J. Fittkau, Dr. F. Reiss, and Dr. L.C.V. Pinder for collection of references necessary for the identification. The specimens used for this study were collected in colaboration with Dr. M. Yasuno, Mr. Y. Sugaya and other members of the Aquatic Ecology Section, NIES, Mr. H. Suzuki, Institute of Tropical Medicine, Nagasaki University, Dr. Akiko Shirasaka, Institute of Medical Science, University of Tokyo, and Dr. Y. Tabaru, Sankyo Co. Ltd. Special thanks are due to Dr. Cameron W. McLeod, visiting scientist at NIES, and Mrs. Yoshimi McLeod, who have undertaken correction, editing and typing of the English draft of this paper. All the figures were drawn by the author, and were set in order with the assistance of Miss Hiromi Kojima.

DESCRIPTION OF SPECIES

(1) *Paratanytarsus parthenogeneticus* (Freeman, 1961) Figs. 1-4.

This species was discovered in June 1976 breeding spontaneously in a number of small water containers used for breeding of algae and zooplanktons in an aquarium of NIES, soon after construction of the aquarium. Male specimen have never been found, and a colony isolated from the wild population has been maintained for more than 20 generations in 500 ml flasks and other small containers by parthenogenesis. The biology of this colony, together with susceptibility tests with various insecticides have been reported partly by Yasuno et al. (1978), and more details are to be published in a separate paper. When variations in the morphological and biological characteristics of the colonies are taken into consideration, there is no essential difference between this species and *Lundstroemia parthenogenetica* Freeman from Australia described by Freeman (1961) and Edward (1963). Because the colonies of this species are still maintained in large numbers in our laboratory, a number of specimens treated and preserved by various methods have been examined. Slide mounted specimens are in box A-06; females (No. 1-22), pupae (No. 31-40) and mature larvae (No. 51-63). Pinned specimens are in Box B-1. Alcohol preverved specimens are in Vial C-1.

Female. Small fly with body length for fresh specimens of 1.11-2.63 mm (1.83±0.45 mm in measurements of 21), and wing length of 1.42-2.16 mm (1.62±0.15 mm in measurements of 21). Body coloration mostly pale green in fresh specimens and yellowish brown in alcohol-preserved or dried specimens. Antenna dark brown, ground color of scutum pale green or yellow, scutal stripes brown, scutellum yellow, postnotum brown, halteres yellow; legs almost entirely pale brown, abdomen pale green or brown with faint pale bands along the caudal margins of the tergites.

Antenna (Fig.1 B) 6 segmented (55, 111, 67, 53, 112 microns); segment II with double rows of setae; segments III to V spindle-shaped. A pair of small conical frontal tubercles present. Palp (Fig. 1C) 4 segmented (36, 198, 96, 113 microns). Eyes bare, 195 microns high and 145 microns apart.

Pronotum reduced, and overhung by anterior projection of scutum. Wing membrane slightly brown under transmitted light, with numerous macrotrichiae over almost the whole surface. Squama bare. Anal lobe flat. Wing venation as in Table 1 a and Fig. 1 A. R 1 and R 4+5 closely set and almost parallel, R 2+3 absent, r-m short and parallel to the wing axis; fCu far beyond r-m.

Relative length of legs as in Table 2 a. LR 1.30-1.50 (1.364±0.065 in 10 specimens). Tarsus V of all legs are expanded apically. Pulvilli absent. Middle and hind leg segments bear long and stout bristles; longest bristles on middle tibia, for example, lengths about 85 microns, 3 times diameter of segment; those on hind tibia are about 110 microns, also 3 times diameter of leg segment. Front tibia lacks terminal scale in contrast to middle and hind tibiae; comb scales (Fig. 1 D) low and wide, usually confluent, occupying more than half the circumference of tibia, and bearing one or two short spurs (these comb scales may be separated in some specimens, as in Fig. 1 E). Cercus and spermathecae as in Fig. 1F and 1G.

Pupa. Body length 3.21-3.95 mm (3.43±0.28 mm, average of 10 gum-chloral mounted exuviae). Color in life, yellow-green. Thoracic respiratory organs lacking. Distribution of specialized spines and hairs on abdominal segments is as follows (Fig. 2 A-I): Segment I

without spines and spinules. Tergite II with a central spinose area, and an uniserial transverse row of large recurved spines along the caudal margin. Segment III with a central spinose or spinulous area, and a pair of spine groups each composed of some 20 long, straight and sharply pointed spines, the longest spine being 65 microns. Tergite IV with an oval and pigmented spinose area 70 microns wide and 45 microns long in the middle and near the proximal margin, and a pair of lateral and longitudinal rows of long, straight and sharply pointed spines. Tergite V with a pair of spinose zones near the proximal margin, and a pair of spinulous zones in the middle. Tergites VI and VII with a large spinulous area in the middle. Caudolateral scales on abdominal segment VIII are similar to the human hand, bearing five finger-like spines as shown in Fig. 2 I. 3 Pairs of lateral hairs on segments II to IV, 4 pairs on segments V to VII, and 5 pairs on segment VIII; those on V to VIII are long and flat swimming hairs. Anal lobes with a fringe of numerous swimming hairs, and a pair of long swimming hairs originating from the middle.

Larva. Color in life, pink. Body length of mature larvae in gum-chloral-mounted specimens 4.68-5.53 mm (5.24±0.489 mm, 10 specimens). Antenna (Fig 4 F) 5 segmented (108, 29, 12, 9, 5 microns), LAR (larval antennal ratio) 1.97. Ring organ near base of segment I; antennal hair about 30 microns long, arising from about middle of segment I. Antennal blade 43 microns long and 0.78 times as long as the combined length of antennal segments II to V. Lauterborn's organ well developed, without petiole and about as long as antennal segment III. Labial plate (Fig. 4 C) about 100 microns wide, with 11 teeth; the central tooth is simple, highest and widest. Paralabial plates narrow and striated, 110 microns wide and 25 microns long, closely set in the middle and separated by a distance of only about 5 microns. Mandible, maxilla, labrum and premandible as in Fig. 4 D, E, G. Structure of caudal segments as in Fig. 4 J.

Discussion. This species is unique in that no male has ever been found, and eggs deposited by virgin females hatch in water and develop to pupae and females in about two weeks. The period required for completion of development from the first instar larva to pupa as well as the body size of the emerged adult varies greatly according to the larval density, the temperature and the amount of the food supply. Forsyth (1971) described a new species, *Lundstroemia agameta*, for a parthenogenetic colony found in New Zealand, based on differences in body size, leg ratio, and body coloration compared with *L. parthenogenetica* from Australia described by Freeman (1961). However, the variations observed in our populations reared under various conditions apparently covered the range of variations of the above two populations, and it is considered that the present species is the same as that of Freeman's, and that Forsyth's species is probably a synonym of *L. parthenogenetica*. The genus *Lundstroemia* Kieffer, 1921, has been considered a synonym of *Paratanytarsus* Bause by Reiss (1974).

(2) *Tanytarsus oyamai*, sp. nov. Figs. 5-7.

This species has been found breeding very abundantly in concrete pools and ground ditches of NIES, soon after these were constructed in 1976. A population was also found breeding spontaneously at the bottom of insect cages containing water and soil. Immature stages were collected from the bottom sediments of these cages, pools and ditches, and large numbers of adults were collected while swarming in the air or resting on grass near the breeding places. Males of apparently the same species were collected in April 1978 while swarming on the beach of Lake Kasumigaura, Ibaraki Prefecture, and also n

August 1978 on rice paddies in Hara-mura, Nagano Prefecture.

Materials examined. Halotype (No. A 13-51), a male, reared from larvae collected from a ground ditch in NIES, 22 August 1978; paratypes, 11 males and 5 females, reared from the same lot in August 1978, all mounted in gum-chloral, Box A 13. Large numbers of dry preserved adult specimens (Box B 1), alcohol-preserved larvae and pupae and those mounted in gum-chloral were also available for this study.

Male. Small fly with body length of 2.37-3.24 mm (2.75 mm, average of 10), and wing length of 1.45-1.74 mm (1.57 mm, average of 10). Body coloration largely black; antennal hairs dark brown, ground color of scutum brown, scutal stripes shining black, scutellum brown, postnotum black, halteres yellow, legs entirely black and without pale bands, abdominal tergites almost entirely black though posterior one third being slightly darker than anterior two thirds.

Antenna 14 segmented, AR 0.86-1.12 (1.01, average of 8). Palp 4 segmented (43, 92, 87, 111 microns). Eyes bare. Frontal tubercles (Fig. 6 F) cylindrical, 29 microns long and 12 microns in diameter.

Pronotum reduced and separated in middle, overhung by anterior projection of scutum, without lateral hairs. Scutum (Fig. 4 B) with median stripes touching in the middle, with about 6 acrostichals arising from 3 pairs of holes closely set on the anterior and median line, with 7-9 dorsocentral setae on each side, and with one or two supra-alar setae on each side. Scutellum (Fig 6 B) with 5 or 6 setae on a transverse line.

Wing membrane slightly purple under transmitted light, without clouds and spots, but with macrotrichiae in cell R 5 and cell M. Squama bare. Anal lobe highly reduced. Wing venation as in Fig. 6 A and Table 1 b; r-m short and almost parallel to the wing axis; fCu beyond r-m.

Legs without white rings. Relative length of leg segments as in Table 2 b. LR relatively high, 1.60-1.79 (1.72, average of 8). Bristles on front tarsus I about 55 microns long, 2.9 times the diameter of the leg segment; those on middle and hind tibiae as well as on tarsi are nearly 150 microns long. Front tibia with a sharply pointed terminal scale (Fig. 6 H). Middle and hing tibiae with two terminal combs (Fig. 6 I), which are separated from each other and both bear a long spur. Pulvilli absent.

Hypopygium (Fig. 5 C) with a short and stout anal point bearing a pair of ridges on both sides and 4 or 5 spines in a single row. Bands on 9th tergite separated medially, and reach near to base of anal point. Appendage 1 as in Fig. 5 E, devoid of microtrichiae and bear about 5 setae on the inner margin, 2 or 3 setae on the dorsal surface, and 3 recurved setae on the lateral margin. Appendage 1a small, not extending beyond the inner margin of appendage 1. Appendage 2 with 12-15 recurved bristles. Appendage 2a (Fig. 5 F) with about 10 very narrow and sharply pointed branches.

Female. Body length 2.37-3.24 mm (2.75 mm, average of 6). Wing length 1.45-1.79 mm (1.60, average of 6). Coloration as in the male, almost uniformly black or dark brown.

Head as in Fig. 5 B. Antenna 5 segmented (46, 80, 55, 60, 125 microns), with a subapical bristle 48 microns long. Palp 4 segmented (34, 63, 67, 113 microns). Frontal tubercles conical in shape, 50 microns wide at the base and 27 microns high (in the male, frontal tubercles are roughtly cylindrical, as stated before). Wing as in Fig. 6 A and Table 1 b. LR 1.58-1.81 (1.65, average of 5). Front tibia lacking sharply pointed terminal scale seen in the male. Middle and hind tibiae with two separated and rather narrow comb scales, both bearing a long spur, same as in the males. Pulvilli absent. Hypopygium as in Fig. 5 G. Cerci (Fig. 6 G) are relatively narrow and long (70 microns long and 75 microns

wide).

Pupa. Thoracic respiratory organ (Fig. 6 J) simple, tube-like, about 280 microns long and 25 microns in diameter, apical half annulated and tapering towards the apex, with about 10 needle-like hairs arising from middle one third of the shaft.

Distribution of spines and spinules on abdominal segments: (Fig. 6 K-T): segment I with a median and a pair of lateral spinulous zones. Tergite II with a proximal spinose area, a subapical spinose area, and a caudal band of recurved spines about 15 microns long and arranged in about two transverse rows. Tergite III with a pair of long and sharply pointed spine groups. Tergites IV, V and VI each with a pair of pineapple-shaped spine groups. Segment VII devoid of spines and spinules. Both tergite and sternite VIII bear a pair of spinulous zones. Caudolateral scales on segment VIII (Fig. 6 T) are roughly triangular, about 48 microns wide and 40 microns long, bearing about 20 sharply pointed spines. 3 Pairs of lateral hairs on segments II to VI, 4 pairs on segment VII, all short and simple, while there are 5 pairs on segment VIII which are flat swimming hairs. Anal lobes on the terminal segment bear numerous long swimming hairs along the lateral margins.

Larva. Body length 5.00-6.88 mm (6.01 mm, average of 10). Color in life, pink.

Antenna (Fig 7 G) 5 segmented (94, 31, 17, 7, 3 microns), arising from a high tubercle 53 microns long and 43 microns in diameter; LAR about 1.6; antennal hair arise from about the middle of segment I; antennal blade shorter than segment II; Lauterborn's organ on petioles 41 and 36 microns long, which are longer than the combined length of antennal segments III to V. Labial plate (Fig. 7 A) 77 microns wide, with 11 teeth; the central tooth is widest and slightly notched on both sides, paler in color than rest of teeth. Paralabial plates narrow and elongated, 113 microns wide and only 14 microns long, and closely approach the mid line. Mandible (Fig 7 E) 106 microns long and 46 microns wide. Labrum and premandible as in Fig. 7 B. Preanal hair tuft (Fig. 7 I) composed of 7 long hairs and two short hairs arising from semiglobular tubercle. Posterior pseudopods with 16 claws (Fig. 7 J).

Discussion. This is a typical *Tanytarsus* species from consideration of all the morphological aspects of the adult, pupa and larva. Especially noteworthy as a member of this genus are the presence of macrotrichiae on the wing membrane, the bare squama, the short and straight r-m, and the presence of appendages 1a and 2a of the male hypopygium. However, of a total of 9 species of this genus recorded from Japan by Tokunaga (1933, 1938, 1940), none of these has the combination of morphological characters described here. Of species recorded from the Oriental Region, the present species resembles *uraiensis* obtained from a hot spring in Taiwan and described by Tokunaga (1938) from the point of view of the structure of the male hypopygium, but the both are undoubtedly different species in view of the coloration (*uraiensis* is pale yellow), the shape of the anal point and the appendage 1 of the male adult, the structure of the thoracic respiratory organ and the caudolateral combs of 8th abdominal segment of the pupa, and the shape of the central tooth of the larval labial plate. According to the key to adult males of European *Tanytarsus* species prepared by Reiss and Fittkau (1971), the present species may be regarded as a member of the *holochlorus* group based on the structure of the male hypopygium; of species in this group, it seems to be most allied to *horni* (Goetghebuer) in the structure of the anal point and appendage 1, but branches of appendage 2a of *horni* are broad and leaf-like. Of the British *Tanytarsus* species described and illustrated by Pinder (1978), the present species resembles to *gregarius* Kieffer or *inaequalis* Goetghebuer, but differs from either of them in the absence of microtrichiae on the anal point, in the numbers of bristles on the anal tergite, and in the structure of

appendage 1 or 2a.

Note: A population of males collected while swarming on the rice paddies at Haramura, on the slope of Mount Yatsugatake, Nagano Prefecture, has a longer lamella on the tip of the anal point, slightly higher AR (1.00-1.33, 1.14 in average of 6), higher LR (1.78-1.93, 1.85 in average of 6), but is regarded tentatively as the same species because other morphological characters are almost the same.

This species is named in honor of the late Professor Yoshitoshi Oyama, the formar director of *NIES*.

(3) *Chironomus tainanus* (Kieffer, 1912) Figs. 8-11.

This species was originally described by Kieffer (1912) by the name of *Tendipes tainanus*, with male and female being collected at Tainan, Taiwan; it was pointed out by Kieffer (1916) in the key for genus *Tendipes* of Taiwan that the species was characterised by the long and peculiarly shaped appendage 2. Hashimoto (1977a) reported that this species was commonly found in Japan west of the Tokai District. Inoue and Hashimoto (1978) found *Chironomus tainanus* to be a common chironomid emerging from eel ponds in Shizuoka and Mie Prefectures.

Materials studied. Larvae of this species were collected by the author and Mr. Y. Tabaru from the bottom sediment of eel ponds at Yaizu, Shizuoka Prefecture, on 22 November, 1978; pupae and adults were reared in the laboratory of NIES. Both male and female adults were collected also on the same date inside the vinyl house covering the eel ponds at Yaizu. The specimens examined were 3 males and 2 females mounted in gum-chloral together with associated pupal and larval exuviae, one pupa and 5 larvae mounted in gum-chloral (slide box No. A 31), and 10 males and 6 females preserved dry (specimen box No. B 14).

Male. Body length 5.00-5.73 mm (average 5.38 mm, 5 specimens) for dry preservation, and 5.9 mm for gum-chloral mounted specimen; wing length 3.18-3.44 mm (3.28 mm, average of 5).

Coloration: antennal hairs pale yellow, shaft yellow; ground color of scutum pale yellow, scutal stripes brownish yellow; scutellum and basal one third of postnotum pale yellow, distal two thirds of postnotum brown; abdominal tergites almost uniformly brown; hypopygium yellowish brown; leg segments largely yellow, except for the distal end of front femur and tarsi V of all legs being dark brown.

Antenna 12 segmented, AR 3.68 in a specimen and 3.76 in another. Palp 4 segmented (55, 92, 149, 183 microns). Eyes bare, each with a long dorsomedian projection. Frontal tubercles absent.

Pronotum rather reduced towards the middle, notched medially but not completely divided. Scutum projects forward over pronotum. Wing membrane without macrotrichiae, but with faint milky clouds on the distal part of cell R-M, in cell Cu, and behind vein Cu. Wing venation as in Fig. 8 A and Table 1 c; R 2+3 is closely set to R 1; fCu slightly beyond r-m. Squama completely fringed.

Relative length of leg segments as in Table 2 c. LR of front leg relatively small, about 1.2, and front tarsus V is about 0.27 times as long as front tibia. Front tibia with a rounded terminal scale (Fig. 8 B), and about 8 long subterminal bristles, each measuring about 170 microns. Middle and hind tibiae with two flat and wide comb scales (Fig. 8 C), each bearing a short spur. Hairs on front tarsus I are all comparatively short and only 2.9

times as long as the diameter of the segment, but front tarsi II, III and IV bear long beards, which are about 6 times the diameter of the segments. Pulvilli highly developed and longer than the claws.

Hypopygium (Fig. 9 A) with a prominent anal point (Fig. 9 D), which is bare and medially expanded. Dorsal appendage (Fig. 9 D) curved and horn-like, basal one-third expanded and setigerous, while distal two thirds bare, and bear 8 long bristles along the inner margin. Ventral appendages (Fig. 9 E) extremely long and apically expanded like a bulb, almost reach tip of gonostylus, and bear more than 40 bristles on its expanded apical portion, which are almost straight and not 'recurved' as in most other *Chironomus* species. Gonostylus (Fig. 9 C) stout and bears more than 10 subapical bristles.

Female. Body length 6.6 mm in a gum-chloral specimen, or 4.06-4.38 mm (4.19 mm in average of 5) in dry mounted specimens. Wing length 3.02-3.23 mm (3.11 mm in average of 5). Coloration as in male, but generally darker. Antenna (Fig. 8 E) 6 segmented (96, 164, 91, 104, 118, 190 microns); with one subterminal seta about 120 microns long. Frontal tubercles absent. Pronotum rather reduced, but not completely divided in the middle, overhung by scutum. Wing (Fig. 8 A) with faint clouds as in male; R 2+3 close to R 1. LR about 1.2. Pulvilli well developed. Cerci as in Fig. 8 D.

Pupa. Body length 7.6-7.9 mm in alcohol preserved specimens. Thoracic respiratory organs divided into numerous white filaments, as in other *Chironomus*. Distribution of spines and spinules on abdominal segments (Fig. 10 A) is also as in other chironomid species studied by us. Segment I without spines and spinules. Tergite II with proximal transverse band of small spines (about 25 microns long), large spinulous area in the middle occupying roughly two thirds of tergite, caudal band of larger spines (about 35 microns long) in roughly 3 rows, and uniserial band of large recurved spines (about 32 microns long) along caudal margin (Fig. 10 B, C). Tergite III without proximal band of spines and caudal band of recurved large spines, with pair of butterfly wing shaped spinulous areas in middle, and pair of centrally divided band of spines arranged in 3-5 rows along caudal margin (Fig. 10 D). Tergites IV, V and VI with large spinose-spinulous zone in middle, and transverse band of spines along caudal margin (Fig. 10 E, F). Tergite VII and VIII with pair of large spinulous zones (Fig. 10 H) in middle but without spines. Segment VIII with pair of caudolateral scales (Fig. 10 J) about 70 microns wide and 125 microns long, bearing 10-14 sharply pointed spines. 1 pair of lateral hairs on abdominal segment I, 3 pairs on II to VI, 4 pairs on VII, and 5 pairs on VIII; those on segments I to IV being short and simple, while those on V to VIII as well as on the anal lobes modified into long and flat swimming hairs (Fig. 10 I). Anal lobes bear fringe of numerous long swimming hairs about 0.7 mm long, and about 20 bristles (190 microns long) arising from inner margin.

Larva. Body length 8.6-10.9 mm in mature larvae fixed in alcohol. Color red, (though somewhat paler than coexisting *Polypedilum nubifer* larva). Antenna (Fig. 11 C) slender, 5 segmented (82, 36, 22, 24, 7 microns), LAR 1.09, antennal blade 65 microns long and only 0.73 times combined length of antennal segments II to V; Lauterborn's organ poorly developed. Labial plate (Fig. 11 A) with 13 teeth; central tooth being widest (33 microns) and with one pair of notches; first pair being wider than the other pairs, and being more anterior than the central tooth. Premandibles (Fig. 8 G) with 5 distal blades, among which outermost one being sharply pointed and less pigmented. Other head organs as illustrated. Caudal part as in Fig. 11 F, G, H; 7th abdominal segment without caudolateral processes; 8th abdominal segment with one pair of long blood gills from near the caudal margin, and being narrower and longer than those of occasionally coexisting

Glyprotendipes larva.

Discussion. This species is unusual as a member of the genus *Chironomus* in the strict sense in that the adult lacks in the frontal tubercles, wings with cloudy spots, appendage 2 of the male hypopygium is extremely long, apically expanded and bears numerous non-recurved hairs, appendage 1 is somewhat between that of the *Chironomus* and the *Einfeldia* type, the caudolateral scales of the abdominal segment VIII of the pupa are of a *Polypedilum* type, and the labial plate of the larva has a wide median tooth with a pair of notches. Hashimoto (1977a) has stated that he could not place this species in any of the known subgenus of *Chironomus*.

(4) ***Glyptotendipes tokunagai*, sp. nov.**. Figs. 12-15.

A species of *Glyptotendipes* has been collected from oxidation ponds of NIES, from a number of areas around lake Kasumigaura and in Tsukuba Science City, and from eel ponds in Shizuoka and Nagasaki Prefectures. This species is apparently identical in morphological characteristics of the adults and pupae to *Glyptotendipes glaucus* Meigen of Tokunaga (1938). Inoue and Hashimoto (1978) also reported *G. glaucus* as commonly breeding in eel ponds in Shikoku and Kyushu. By careful examination of adults, pupae and larvae, the present author has noted this Japanese species as being distinctive from the European *glaucus* and from any other previously known chironomids.

Materials studied. Holotype, a male, collected from an oxidation pond of NIES and reared from pupa on 27 June 1977, mounted on card, accompanied by hypopygium and pupal exuviae mounted on a slide (No. A 15-81) in gum-chloral. Paratypes, 7 males and 8 females, mounted on cards (Box B 6); 7 males and 5 females, mounted on slides in gum-chloral; all collected in Tsukuba area in April to June, 1977; 12 pupal exuviae and 7 larvae, collected from oxidation ponds in NIES (Box A 15). Specimens of adults, pupae and larvae were collected also from eel ponds in Yaizu and Yoshida (Shizuoka Prefecture) and Isahaya (Nagasaki Prefecture).

Male. Body length 7.55-8.47 mm (7.94 mm in average of 6). Wing length 3.78-4.54 mm (4.23 mm in average of 6). Body coloration dusky black or dark brown.

Antenna 12 segmented, highly plumose, AR 3.33-3.68 (3.52 in average of 6). Palp 4 segmented (99, 243, 236, 308 microns). Eyes bare, with a long dorsomedial projection. With a pair of small frontal tubercles (Fig. 13 E), which are about 17 microns high and 12 microns in diameter, and 24 microns distant from each other.

Pronotum reduced, divided in middle and not seen from above (an important characteristic of this genus). Ground color of scutum whitish grey, heavily pruinose; median and lateral stripes dark brown, also heavily pruinose. Scutellum whitish grey. Postnotum dark brown. Halteres yellow.

Wing membrane bare, milky white and semitransparent, slightly brown by transmitted light, area around r-m not pigmented. Squama completely fringed. Anal lobe conspicuously pronounced. Wing venation as in Fig. 12 A and Table 1 d; R 2+3 closer to R 1 than to R 4+5; fCu only slightly beyond r-m; r-m not darkened.

Legs almost uniformly dark brown, except the front femora, which are yellowish brown with tip darker. Relative length of leg segments as in Table 2 d. Leg ratio 1.32-1.41 (1.37 in average of 6). Front tibia with a rounded terminal scale. Front tarsus I without beards, longest hair being only 1.7 times the diameter of the segment. Comb scales on middle and hind tibiae low but very wide, each with a short spur. Front tarsus II about

1.2 times longer than front tarsus III. Pulvilli highly developed, almost as long as claws.

Abdominal tergites almost uniformly dark brown, except 9th tergite being yellowish brown. Tergites II to VI each with a racket-shaped impression near base, which corresponds to palmate scales of pupa. Hypopygium (Fig. 13 A) with a long anal point apically expanded. Dorsal appendage (Fig. 13 C) composed of highly setigerous basal portion and horn-like nude distal portion, an *Einfeldia*-type. Ventral appendage (Fig. 13 B) long and stout, slightly expanded apically, and bears some 30 stout and recurved setae. Gonostylus stout, slightly constricted near apex.

Female. Coloration as in male, generally dark brown, scutum heavily pruinose. Body length 7.76-8.98 mm (8.39 mm in average of 5). Wing length 4.03-5.31 mm (4.77 mm in average of 5).

Antenna (Fig. 12 B) 7 segmented (111, 118, 121, 128, 140, 152, 275 microns), segments II to VI flask shaped, the terminal segment with one subapical seta 140 microns long. Palp (Fig. 12 C) 4 segmented (97, 282, 233, 316 microns). Frontal tubercles very small, only about 7 microns wide and 5 microns high, and 50 microns distant from each other.

Pronotum reduced towards the middle and not visible from above. Scutum not produced forward, ground color whitish grey and heavily pruinose, scutal stripes dark brown and also heavily pruinose. Scutellum brown. Postnotum dark brown.

Wing membrane slightly tinted with brown, cross vein slightly darker. Wing venation as in Fig. 12 A and Table 1 d; fCu slightly beyond r-m. Cercus 240 microns long and 210 microns wide, as in Fig. 12 E. Spermathecae (Fig. 12 D) semiglobular, about 145 microns in diameter.

Pupa. Body length 8.5-9.4 mm (8.96 mm in average of 5) in male pupa and 9.5-10.6 mm (9.97 mm in average of 5) in female pupa. Thoracic respiratory organs divided into numerous white filaments. Distributions of scales, spines and spinules on abdominal tergites as shown in Fig. 14 A. Tergites II to VI each with a palmate (or racket-shaped) scale (Fig. 14 D-H) with finger-like spines along posterior margin and some smaller spines on surface. Length and width in microns of these scales in one of the specimens being 223 and 138 on tergite II, 272 and 147 on tergite III, 285 and 155 on tergite IV, 340 and 189 on tergite V, and 388 and 189 on tergite VI. Scale on tergite VI is about 0.36 times the length of the segment. Tergite II with central spinose and spinulous area, and uniserial caudal band of large recurved spines (Fig. 14 B). Spines or spinulus on tergites III to VIII being much smaller, such as seen in Fig. 14 C (tergite III). 3 pairs of lateral hairs on abdominal segments II to VI, 4 pairs on VII, and usually 5 pairs (6 on one side in a specimen) on VIII; lateral hairs on segments II, III and IV minute, while those on V to VIII are long, flat swimming hairs (Fig. 14 A, I). Caudolateral scales (Fig. 14 J) on segment VIII narrow and small, composed of small spines of varying numbers (2 to 7 on one side, according to specimens). Anal lobes with fringe of numerous long swimming hairs, but devoid of bristles on inner margin seen in *tainanus* pupa.

Larva. Body length 10.0-13.5 mm (12.2 mm in average of 8 mature larvae fixed in alcohol). Color in life red. Presence of only one pair of relatively short blood gills on abdominal segment VIII (Fig. 15 F, G) is key characteristic of this species. Antenna (Fig. 15 B) 5 segmented (133, 46, 31, 24, 9 microns), first segment 1.25 times combined length of segments II to VI; ring organ about 1/3 from base of segment I; antennal blade 80 microns long and 0.75 times length of segments II to V. Labial plate (Fig. 15 A) with 13 teeth; the central tooth being widest (41 microns) and with rounded margin; first lateral pair of teeth also with rounded margin and wider (24 microns) than second and

subsequent pairs. Paralabial plates well developed, fan-shaped and striated, 72 microns wide and 23 microns long. 8th abdominal segment bears pair of stout and short blood gills on ventral side near caudolateral margins. Anal gills, posterior pseudopods and pre-anal hair tufts as in Fig. 15 F, G.

Discussion. This species is presumably the same as that recorded by Tokunaga (1938, p. 324) from Tomioka (Kyushu) by the name of *Glyptotendipes glaucus* (Meigen), since all the morphological characteristics of the male, female and pupa described by him are also applicable to the present species. However, according to Edwards (1929, p. 392), *G. glaucus* is devoid of frontal tubercles but has moderate to rather long beards on the front tarsus I, and is obviously different from the present species, although the body coloration and the structure of the male genitalia are quite similar. Edwards (1929) gave a key to 8 British *Glyptotendipes* species, but this Japanese species does not fit any of them since the impressions on the abdominal tergites II to VI are very distinctive, the front tarsus II is longer than the front tarsus III, and frontal tubercles are present. Furthermore, *G. glaucus* was regarded as a subspecies of *G. pallens* (Meigen) by Goetghebuer (1937, p. 15), differing from the type subspecies in the absence of frontal tubercles. The present species is again similar to *G. pallens* in body coloration, in the ratios A.R. and L.R., and in the structure of the male hypopygium, but differs from it by the absence of tarsal beards. Pinder (1968) regarded *G. glaucus* as a synonym of *G. pallens* in his key to adult males of British Chironomidae.

The pupa and larva of the present species falls into the *gripekoveni*-group of the subgenus *Phytotendipes* defined by Lenz (1954, p. 170), as the pupa has a palmate scale on each of the abdominal segments II to VI, which increases in size for increasing segment order, and the larva has a pair of short tubes on the pre-anal segment. Among the species described in the text, the present species is most closely related to *G. barbipes* (Staeg.) as the tubes are nearly as long as the anal gills, while those of *G. pallens* are much shorter. The relative proportion and size of the palmate scales on the abdominal segments II to VI of this species are different from those of the pupae of the previously known species.

The number of species of the genus *Glyptotendipes* which has been reported is 6 from the Oriental region (2 from Taiwan, 2 from India, 1 from Java and Sumatra, and 1 from the Philippines, according to Sublette and Sublette, 1973), but the present species is apparently distinct from all these species.

(5) *Pentapedilum shirokanensis*, **sp. nov.** Figs. 16-19.

This species was collected from October 1977 to May 1978 and later from a plastic rainwater container of 1 meter in diameter and 1 meter depth which was placed under a tree behind a building of the Institute of Medical Science, Shirokane, Minatoku, Tokyo. Larvae were found attached to the green algae, *Spirogyra* sp. Pupae and adults were reared in plastic tubs in the laboratory.

Materials studied. Holotype, a male, mounted on slide in gum-chloral, collected on 27 October, 1977 (No. A 18-51). Paratypes, 2 males and 6 females, associated with pupal and larval exuviae, mounted in gum-chloral (Box A 18); 2 males and 8 females, stuck on card (Box B 2), all collected during October and November, 1977.

Male. Small fly with body length of 2.66-2.82 mm (2.76 mm in average of 3) and wing length of 1.68-1.95 mm (1.80 mm in average of 4). Body coloration mainly light brown.

Antenna 14 segmented, AR 1.43-1.57 (1.48 in average of 3); last segment tapering towards end, tip sharply pointed, and with 3 long subterminal setae (each about 75 microns long). Palp 4 segmented (53, 113, 116, 188 microns). Eyes bare, each with long dorsomedian projection. Vertex with 8 pairs of long setae arranged in single row. Frontal tubercles absent.

Thorax as in Fig. 16 B. Pronotum reduced, overhung by conically produced mesoscutum and not visible from above; lateral prothoracic setae absent. Ground color of scutum yellow, median and lateral scutal stripes brown and conspicuous. Scutum with 8-10 acrostichal setae, about 14 dorsocentral setae, and 5 prealar setae on each side, all well developed. Scutellum yellow, with 8 setae in a single transverse row. Postnotum dark brown. Halteres largely yellow and apically dark brown.

Wing membrane with numerous macrotrichiae especially on its apical and caudal portions. Squama with 6-8 fringe setae. Anal lobe flat. Wing venation as in Fig. 17 F and Table 1 e. R 1 and R 4+5 closely set and almost parallel, cell R is thus very narrow, and R 2+3 is almost invisible; r-m oblique and conspicuous; fCu slightly beyond r-m.

Legs almost uniformly brown, with exception of distal portions of femora and tibiae which are slightly darker. Relative length of leg segments as in Table 2 e. LR of front leg 1.77-1.81 (1.80 in average of 3). Longest bristles on front tarsus I about 150 microns and 3.0 times diameter of segment. Tibia, tarsus I and II of middle and hind legs with very long setae, longest one being about 270 microns and more than 10 times diameter of segment. Front tibia with a short and rounded terminal scale (Fig. 16 D) but without comb scales. Middle and hind tibiae with two completely separated comb scales, of which inner one is unarmed and only the outer one bears a long spur (Fig. 16 E). Empodium almost as long as claws. Pulvilli present, of moderate size.

Abdomen, including hypopygium (Fig. 17 A), almost uniformly dark brown. Ninth tergite semiglobular, anterior margin rounded, and with about 8 long bristles. Anal point (Fig. 17 D) 58 microns long and 10 microns wide, narrow, slender and with almost parallel sides, highly chitinized and without microtrichiae on dorsal surface. Dorsal appendage (Fig. 17 E) composed of a broad, setigerous basal portion bearing several long bristles, and a horn-like dorsal process bearing one long bristle. Ventral appendage (Fig. 17 B) about 120 microns long and 20 microns wide, only slightly expanded apically, with one very long apical bristle (75 microns) directed caudally, and some 10 recurved bristles on dorsal half. Gonostylus (Fig. 17 D) narrow and slender, with long apical spur (22 microns).

Female. Body length 1.58-2.32 mm (1.93 mm in average of 6 mounted in gum-chloral). Wing length 1.68-2.11 mm (1.91 mm in average of 9).

Head as in Fig. 16 A. Antenna (Fig. 16 C) 5 segmented (67, 137, 92, 96, 161 microns); shape of segments II, III, IV and V characteristic of this species; last segment with two long subapical bristles (207 and 169 microns). Palp 4 segmented (55, 123, 133, 227 microns). Frontal tubercles absent. Eyes with long dorsomedian projection.

Coloration as in the male, ground color of scutum yellow, scutal stripes brown; scutellum yellow; postnotum dark brown; halteres yellow basally, apical knob brown. Scutellum with about 10 bristles in single transverse row. Pronotum reduced, without lateral bristles.

Wing venation as in Fig. 17 F and Table 1 e. Wing membrane with numerous macrotrichiae over almost whole surface. R 1 and R 4+5 closely set and almost parallel, R 2+3 absent. Squama with only about 3 fringe setae. Relative length of leg segments as in Table 2 e. LR of front leg 1.75-1.93 (1.85 in average of 4).

Abdominal terga dark brown, with paler band along caudal margin. Spermathecae and cerci as in Fig. 16 F, G.

Pupa. Body length 3.5-3.9 mm (3.68 mm in average of 5, exuviae mounted in gum-chloral). Thoracic respiratory organ composed of 7 tube-like branches, as in Fig. 17 G. Distribution of spines and spinules on abdominal segments as follows (Fig. 18 B, C). Segment I without spines and spinules. Segment II with proximal transverse rows of spines (II a), sparce spinulous area in middle (II b), and transverse row of large specialized spines (II c) along caudal margin. Segments III and IV with proximal rows of spines (III, IV a), spinulous areas in the middle (III, IV b), and transverse spinose zone (III, IV c) along caudal margin (spines are much smaller than those along caudal margin of segment II). In addition, segment IV with pair of whirl-like spinulous areas caudolaterally on ventral side. Segments V and VI with proximal transverse rows of spines (V, VI a), spinulous area in middle (V, VI b), pair of spinulous areas on distal one third (V, VI c), and pair of lateral spinulous areas on ventral side. Segment VII with pair of proximal spinulous areas. Segment VIII without spines and spinulues, but with pair of caudolateral scales (Fig. 18 D) with several apical processes. Lateral hairs on abdominal segments are absent on I, a pair on II, 2 pairs on III and IV, 3 pairs on V and VI, 4 pairs on VII and VIII; those on segments II, III and IV with short and fine bristles, while those on V to VIII being long, flat swimming hairs. Anal lobes fringed with about 40 long swimming hairs.

Larva. Body length 5.11-5.47 mm (5.23 mm in average of 6, mounted in gum-chloral). Antenna (Fig. 19 C) 5 segmented (60, 19, 15, 14, 6 microns), first segment 1.1 times as long as combined length of segments II to V; ring organ situated near base of first segment; antennal blade 51 microns long and only slightly shorter than combined length of segments II to V; Lauterborn's organ vestigial. Labial plate (Fig. 19 A) with 8 pairs of teeth, central (First) pair and third pair are widest and longest, while second pair being much shorter and narrower than first and third pairs. Paralabial plate 95 microns wide and 40 microns long, roughly fan-shaped and with radiate striation. Labrum and pre-mandible as in Fig. 19 B, mandible as in Fig. 19 D.

Base of preanal hair tuft (Fig. 19 G) semiglobular, only slightly pigmented, bears 8 very long hairs (about 500 microns long) and two short hairs. Two pairs of anal gills (Fig. 19 H) are both well developed, constricted in the middle, 165 (dorsal pair) and 120 (ventral pair) microns long.

Discussion. This species clearly belongs to the genus *Pentapedilum*, as it has many macrotrichiae on the wing, the squama is fringed, the r-m is distinct and oblique. Also tibial combs are separated, and one of them has a long spur and the other is unarmed. In the male, the antenna is 14 segmented, the dorsal appendages are horn-shaped and bear long bristles and the ventral appendage has a long terminal bristle. Among the known species of this genus, the present species is most closely related to *P. nodosum* of Johannsen 1932, originally collected from lakes in Sumatra, because the wing veins R 1 and R 4+5 are almost parallel and closely approach each other, the wing membrane is almost entirely covered with macrotrichiae, the anal point is slender and of parallel sides, and the ventral appendage is only slightly expanded apically. However, this species differs from *P. nodosum* in the relative length of tarsus III and IV of the front leg (III shorter than IV in *nodosum*), in the value of AR (about 1.5 in this species and less than 1 in *nodosum*), and in the body size (*nodosum* is much smaller, with wing length of about 1 mm, according to Tokunaga, 1964).

(6) *Pentapedilum kasumiensis* sp. nov. Figs. 20-22.

Large numbers of larvae and pupae of a *Pentapedilum* species were collected from a ground pool near the shore of Lake Kasumigaura, in May and June, 1977. Adults were reared in the laboratory, and were also collected by sweeping the nearby bushes and grasses. The morphological characteristics of the males and females are closely related to those first described by Johannsen (1932) as *Pentapedilum convexum* from Sumatra, and to those from Micronesia, described in more detail under the same scientific name by Tokunaga (1964); the present species is, however, a distinctly different one.

Materials studied. Holotype, male, reared in the laboratory, 8 June 1977, Specimen No. A 14-01; paratypes, 4 males, 6 females, mounted in gum-chloral on slide (Box A 14), 4 males and 4 females pinned on card (Box B 2). Ten pupal exuviae and 8 larvae mounted in gum-chloral as well as those preserved in alcohol were used also for preparing the following descriptions.

Male. Small fly with body length of 2.02-2.60 mm (2.37 mm in average of 4), and wing length of 1.76-1.92 mm (1.86 mm in average of 5). Coloration largely yellowish brown.

Antenna 14 segmented, AR 1.13-1.33 (1.22 in average of 5), tip of terminal segment (Fig. 20 J) tapering and apically pointed, with 3 subterminal setae (72, 51, 46 microns). Palp 4 segmented (48, 106, 121, 210 microns). Eyes bare, with conspicuous dorsomedian projection. Frontal tubercles absent.

Pronotum highly reduced, not visible from above, lateral setae absent. Ground color of scutum yellow, scutal stripes reddish brown; acrostichal and dorsocentral setae of scutum well developed; with 4 or 5 prealar setae. Scutellum yellow, with 8 long setae in a transverse row. Postnotum reddish brown. Halteres dark brown.

Wing membrane slightly brown, almost completely covered with numerous macrotrichiae with exception of certain areas near the veins. Squama with about 4 hairs. Anal lobe flat. R 1 and R 4+5 closely set, almost parallel. R 2+3 reduced and almost confluent with R 1. Costa not produced beyond end of R 4+5; fCu slightly beyond r-m. Wing venation as in Fig. 21 E and Table 1 f.

Legs almost uniformly brown, though knee joint zones (distal part of femur and promixal part of tibia) are slightly darker. Relative length of leg segments as in Table 2 f. Tarsus IV shorter than tarsus III in all legs. LR of front leg 1.82-1.92 (1.88 in average of 5). Front tibia with triangular and sharply pointed terminal scale, and with 3 or 4 unusually long subterminal hairs (214, 184, 136 microns, Fig. 20 H, I). Middle and hind tibia with two separated comb scales, one of which bears a long spur while other is unarmed. Empodium and pulvilli moderately developed.

Abdominal tergites yellowish brown, slightly darker along the caudal margins. Hypopygium brown, Fig. 20 A. Anal point (Fig. 20 F, G) short and broad, with rounded apex, median furrow distinct. Dorsal appendages (Fig. 20 D, E) composed of a setigerous basal portion bearing 3-6 hairs, and a slender, bare apical process bearing a long seta (58 microns long) from near the base. Ventral appendage (Fig. 20 C) setigerous, only slightly expanded apically, bears one long apical seta and 4-6 recurved setae. Gonostylus narrow and tapering, with a short apical spur (22 microns), two subapical spurs, and some 8 setae on mesal side arranged as in Fig. 20 B.

Female. Body length 1.84-2.10 mm (1.99 mm in average of 4). Wing length 1.55-1.71 mm (1.67 mm in average of 4). Coloration as in male, generally yellowish brown.

Antenna 5 segmented (60, 108, 75, 82, 178 microns), segments II to V with peculiar

basal swellings, as in Fig. 21 A; terminal segment with two long subapical setae (each 145 microns long). Palp 4 segmented (48, 101, 106, 164 microns), Fig. 21 B.

Ground color of scutum yellow, scutal stripes brown. Scutellum yellow, with 8 setae in transverse row. Wing membrane with numerous macrotrichiae on almost entire surface. Wing vein as in male, Fig. 21 E. Relative length of leg segments as in Table 2 f. LR of front leg 1.82-1.98 (1.86 in average of 4). Front tibia with triangular, sharply pointed terminal scale and 3 subterminal long setae (174, 171, 137 microns).

Abdominal tergites yellowish brown, each segment slightly paler along caudal margin. Cerci 82 microns wide and 52 microns long, Fig. 21 D. With two spermathecae, Fig. 21 C.

Pupa. Body length 3.42-3.52 mm (3.48 mm in average of 10 pupal exuviae mounted in gum-chloral). Thoracic respiratory organs branched into 7 tube-like processes, Fig. 21 F. Abdominal segment I without spines and spinules. Tergite II with proximal spinose band, middle spinulous area, and row of large recurved spines along caudal margin; sternite II with large spinulous zone. Tergite III with proximal spinose band, middle spinose area, and caudal band of several rows of small spines; sternite III also with large spinulous zone. Distribution of spines and spinules on tergite IV, V and VI almost the same as in tergite III. Sternite IV with pair of whirl-like spinulous areas near caudal margin. Sternites V and VI with spinulous zone, which is not whirl-like. Spines and spinules are absent on tergites and sternites VII and VIII, (in the former species, proximal spinose areas are present on segment VII). 3 pairs of lateral swimming hairs on abdominal segment V and VI, and 4 pairs on VII and VIII, the same as in former species. Caudolateral scales of 8th segment are closely set to the 4th swimming hair, apically forked into 3 or 4 sharply pointed spurs, Fig. 21 G.

Larva. Body length 3.83-4.85 mm (4.25 mm in average of 8), color orange-red.

Antenna (Fig. 22 E) 5 segmented (63, 20, 15, 10, 10 microns), LAR 1.13; antennal blade 0.85 times as long as the combined length of segments II to V. Labial plate (Fig. 22 D) 145 microns wide, with 8 pairs of teeth, first and third pairs longer and wider than other teeth, and second pair much shorter and narrower than third. Paralabial plates 113 microns wide and 67 microns long, fan-shaped, with radial striations. Labrum, premandible and maxilla as in Fig. 22 A, B, and C.

Claws on anterior pseudopods without teeth, the longest one about 95 microns, Fig. 22 F. Preanal hair tuft composed of 2 short and 7 long hairs; their bases about 36 microns in diameter and 25 microns high, rather flat and not pigmented. Posterior pseudopods with 16 simple claws (Fig. 22 G), terminal part being surrounded by a spinulous collar. Anal gills nearly as long as posterior pseudopods, both pair constricted in middle, Fig. 22 H, I.

Discussion. Among the known species of *Pentapedilum*, the present species closely resembles *P. convexum* Johannsen, which was originally collected from ditches and sulphur springs in Sumatra and both males and females were described by Johannsen (1932). Tokunaga (1964) reported males and females of the same species collected in the Palau and Ponape Islands. This species is similar to *convexum* in that the wing is densely hairy, R 1 and R 4+5 are closely set and almost parallel, the front tibial scale is triangular and sharply pointed, the anal point is broad and apically rounded, and the dorsal appendage is short, slender, curved inwards and tapering and bears a long seta. However, the LR of *P. convexum* is greater than 2 according to Johannsen (1932), and Tokunaga (1964) gave values of 2.43-2.55 for males and 2.54 for the female; these figures are much larger than the values for males (1.82-1.92) and of females (1.82-1.98) for our specimens.

There are also differences in the shape of the dorsal appendage, the body size (this species is larger), and the body color (this species is darker), relative to the descriptions reported by the above authors. Based on the evidence, the author considers that the present population collected from a ground pool near the shore of Lake Kasumigaura would be better described as a new species rather than treating it as a form of *P. convexum*.

(7) *Polypedilum octoguttatum* **(Tokunaga, 1936)** Figs. 23-26.

This species was found to be breeding abundantly in concrete pools constructed for biological studies in NIES. Larvae were found in high densities all through the year in the bottom sediment, such as several hundreds per 20 cm square. Many males were collected while they were swarming in the air at around sunset, and adults of both sexes were collected while resting on the walls of the concrete pools and in nearby bushes. Colonies of apparently the same species were found commonly breeding in eel ponds in Shizuoka, Nagasaki and Ehime.

Materials studied. 16 males and 15 females reared from larvae collected from concrete pools in NIES, and mounted in gum-chloral, together with associated larval and/or pupal exuviae (Slide Box A 16); 15 males and 10 females pinned on card (Box B 2); larvae, pupae and their exuviae, mounted in gum-chloral or preserved in alcohol; all collected during June - August, 1978.

Male. Medium sized fly with body length of 4.74-5.52 mm (4.94 mm in average of 10) and wing length of 2.52-3.53 mm (2.92 mm in average of 10). Body coloration, thorax and abdomen largely dark brown (nearly black), halteres yellow, femora dark brown, tibiae and tarsi yellow, wing with about 8 faint clouds.

Antenna 14 segmented, AR 2.35-2.75 (2.55 in average of 10); three subterminal setae all very short, about 35 microns long. Palp 4 segmented (51, 137, 135, 231 microns). Small frontal tubercles present, 12 microns high and 7 microns wide, with a few subapical hairs (Fig. 23 A). Eyes bare, with conspicuous dorsomedian projection.

Pronotum highly reduced, divided in middle and not visible from above, without lateral setae. Ground color of scutum dark brown, scutal stripes black; dorsocentral setae about 30 on each side, arranged in 2 or 3 rows; prealar setae 6-8 on each side. Scutellum dark brown, with about 25 setae arranged irregularly. Postnotum black. Halteres yellow.

Wing membrane milky white, with faint clouds as shown in Fig. 24 H; 3 clouds between R 4+5 and M, 3 between M and Cu, 1 in cell Cu, and 2 posterior to Cu. Squama fringed with more than 10 hairs. Anal lobe moderate. Wing venation as in Fig. 24 H and Table 1 g; R 1 and R 4+5 approximate and almost parallel; R 2+3 ending closer to R 1 than to R 4+5; fCu slightly beyond r-m; r-m distinct and oblique.

Leg coloration; all femora dark brown; front tibia brown, front tarsus I yellow, tarsi II to V brown; tibiae and tarsi of middle and hind legs all yellow. Relative length of leg segments as in Table 2 g. LR of front leg 1.41-1.58 (1.48 in average of 10). Front tibia with apically rounded scale, and two long subterminal setae, 195 and 170 microns long. Longest hairs on front tarsus about 120 microns and 3.3 times diameter of segment. Middle and hind tibiae with two separated terminal comb scales, of which one has spur while other is unarmed. Pulvilli well developed, pad-like, and almost as long as claws.

Abdominal segments almost uniformly dark brown, except for narrow pale bands along caudal margin of tergites. Hypopygium (Fig. 23 B) with anal point (Fig. 23 D) 67 microns long, slender and parallel-sided, bare. Dorsal appendage (Fig. 23 E) bare except

for very short and flat basal portion, horn-like and apically hooked inward. Ventral appendage (Fig. 23 F) slightly expanded in middle one third, with long caudally directed apical seta (110 long microns and almost as long as gonostylus) and 25-30 stout and recurved setae. Gonostylus (Fig. 23 C) rather broad and short, about 140 microns long and 77 microns in diameter, apically pointed and with long apical seta (60 microns long) and several subapical setae.

Female. Body length 3.13-4.36 mm (3.74 mm in average of 10), wing length 2.05-3.05 mm (2.59 mm in average of 13). Coloration as in male, body almost entirely dark brown, with exception of tibiae and tarsi, being paler in color than rest of body.

Antenna (Fig. 24 B) 6 segmented (84, 133, 85, 87, 86, 154 microns); segment II with double rows of setae, constricted in middle; segments III, IV and V flask-shaped, composed of basal globular portion and distal neck; segment VI with three subterminal setae (77, 72, 43 microns). Palp (Fig. 24 A) 4 segmented (36, 130, 149, 248 microns). Small frontal tubercles present, Fig. 24 C). Wing membrane with 8 clouds, as in male; wing venation as in Fig. 25 H and Table 1 g. LR 1.43-1.52 (1.48 in average of 10). Pulvilli highly developed, nearly as long as empodium. Cercus and spermathecae as in Figs. 24 F and G.

Pupa. Body length 5.76-6.80 mm (6.17 mm in average of 10 pupal exuviae mounted in gum-chloral). Thoracic respiratory organ (Fig. 25 E) divided into 4 main branches and further numerous filamentous branches. Distribution of spines and spinules on abdominal segments as in Fig. 25 A and B; tergite I devoid of both spines and spinules; sternite I with numerous minute spinules. Tergite II with proximal band of small spines (Fig. 25 C, II a), large median spinulous area (II b), and row of large recurved spines (II c) along the caudal margin; sternite II with numerous minute spinules. Tergite III, IV, V and VI with proximal band of small spines, large median spinulous area, and caudal band of small spines, as in Fig. 25 D; sternite III with numerous small spinules; sternite IV with proximal and caudal spinulous area, and pair of lateral whirl of spinules; sternite V with sparse spinules along lateral margins; sternite VI with spinulous area on laterocaudal area. Tergites VII and VIII with proximal spinulous area, but devoid of spines; sternites VII and VIII devoid of spinules and spines. 3 pairs of lateral swimming hairs on abdominal segments V and VI, 4 pairs on segments VII and VIII, and numerous along lateral margin of the anal lobes. Caudolateral scales on abdominal segment VIII highly pigmented, and with several large and small spines along distal margin, (Fig. 24 I).

Larva. Body length 7.29-9.79 mm (8.08 mm in average of 10 mature larvae fixed in 5% formalin). Color in life red.

Antenna (Fig. 26 A) 5 segmented (77, 17, 22, 19, 5 microns), segment I 1.2 times combined length of segments II to V; ring organ about one third from base of segment I; antennal blade about 48 microns long, and 0.75 times combined length of antennal segments II to V; Lauterborn's organ attached to base of segments II and III, both branch into several hairs when viewed by SEM. Labial plate (Fig. 26 C, D) 140 microns wide, with 16 (8 pairs) teeth, central and third pairs being larger than others, while second pair being much shorter and narrower than central one. Paralabial plate fan-shaped and striated, 152 microns wide and 60 microns long. Mandible, labrum and epipharynx as in Figs. 26 B, G. Eyes separated. Claws on anterior pseudopods (Fig. 26 E) only slightly serate. Preanal hair tuft (Fig. 26 H) composed of 7 long and 2 short hairs, their base semi-globular, 27 microns in diameter and 24 microns high, not chitinized nor pigmented. Abdominal segment VII without blood gills (Fig. 26 I). Anal gills short, about 150 microns long. Posterior pseudopods also short, with 16 simple claws (Fig. 26 F).

Discussion. This species was described by Tokunaga (1936) for both male and female collected in a coastal village of Seto, Wakayama Prefecture. Inoue and Hashimoto (1978) reported *P. octoguttatum* as being a common species breeding from eel ponds in Shizuoka and Kyushu. The present author found the larvae in the bottom sediments of the concrete pools at NIES throughout the year. Adults have been collected frequently while swarming at dusk near the concrete pools, or resting on the walls of concrete pools during the daytime. Large numbers of adults and larvae were collected also by the present author from eel ponds in Shizuoka and Nagasaki; the adults are said to be a serious nuisance to people living in eel growing areas during the summer season.

Note. Synonymy, distribution and morphological studies by scanning electron microscopy for this species will be reported separately by Sasa and Sublette (in preparation), who have recognized *P. octoguttatum* and several other names described from the African and Oriental regions as synonyms of *Polypedilum nubifer* (Skuse, 1889).

(8) *Microtendipes tsukubaensis*, sp. nov. Figs. 27, 28.

Adults of this newly reported species were reared from larvae collected by Dr. M. Yasuno and co-workers of NIES from streams on the northern slopes of Mount Tsukuba during February and March, 1978, together with those of *Orthocladius kanii*, *O. makabensis* and *Eukiefferiella yasunoi*. In rearing the adult chironomids, the larvae were collected together with stones in the river bed, transferred to several plastic jars and were deposited in rooms regulated at different temperature levels (10 C, 15 C, 20 C and 25 C). Adults of this species were recovered only from the containers kept at 20 C and 25 C, while those of the other species developed to adults only in those preserved at 10 C or 15 C.

Materials studied. Holotype, male, emerged in laboratory at NIES on 16 March 1978 from larvae collected in stream on northern slopes of Mount Tsukuba, 12 March 1978; mounted in gum-chloral, specimen No. A 8-01. Paratypes, 5 males and 2 females, same data, mounted in gum-chloral, No. 8-2 to 8-8; 2 males and 8 females, pinned on card in Box No. B 12; 7 pupal exuviae, mounted in gum-chloral or preserved in alcohol.

Male. Coloration almost uniformly pale yellow except eyes and tibial combs, which are dark brown, and antennal shafts which are brown. Body length 3.03-3.38 mm (3.17 mm in average of 5), wing length 1.95-2.03 mm (1.98 mm in average of 5).

Antenna 14 segmented, AR 1.66-1.84 (1.76 in average of 4). Palp 4 segmented (24, 249, 135, 202 microns). Frontal tubercles absent. Eyes with long dorsomedian arm, each 270 microns high, and 77 microns apart.

Pronotum highly reduced, overhung by scutum and not visible from above. Scutum yellow; scutal stripes yellow and almost indistinguishable. Scutellum and postnotum yellow. Halteres yellow.

Wing almost colorless and transparent, without macrotrichiae, spots and clouds. Squama fringed, with some 9 hairs. Anal lobe flat. Venation as in Fig. 27 A and Table 1 h; R 2+3 parallel to R 1 and both terminate close to each other; fCu much beyond r-m.

Legs almost uniformly pale yellow, except for tibial combs, which are dark brown. Relative length of leg segments as in Table 2 h. Leg ratio 1.84-1.90 (1.87 in average of 5). Tip of front tibia with rounded scale (Fig. 27 G). Longest hairs on front tarsus I being 94 microns long and 3.6 times diameter of segment. Tip of middle and hind tibiae with two separated comb scales, of which one has a long spur while other is unarmed (Fig. 27 H).

Pulvilli moderately developed.

Color almost uniformly pale yellow. Hypopygium (Fig. 27 B) with anal point (Fig. 27 C) about 40 microns long, slender and parallel-sided, bare except for base. Dorsal appendage (Fig. 27 F) 145 microns long, curved and slightly expanded apically, with one lateral bristle and two (rarely three) inner bristles. Ventral appendage (Fig. 27 D) about 200 microns long and 31 microns in diameter, apically narrowed to a rather sharply pointed tip, with long apical bristle (some 95 microns long and reach far beyond tip of gonostylus) and about 10 stout recurved bristles. Gonostylus (Fig. 27 E) long and slender, about 200 microns long and much longer than coxite, apically narrowed, with one apical seta and six long setae along the inner margin.

Female. Body length 2.62-3.10 mm (2.84 mm in average of 3), wing length 1.97-2.31 mm (2.10 mm in average of 7). Coloration as in male, almost entirely pale yellow, except for eyes (dark brown), antenna (brown) and tibial combs (dark brown).

Antenna (Fig. 28 A) 6 segmented (65, 145, 101, 104, 67, 142 microns); segment II compound; segments III and IV flask-shaped; segment V fusiform and without neck; segment VI more than twice as long as segment V, slender, with several sensory setae and only one subterminal hair, being about 200 microns long. Palp (Fig. 28 B) 4 segmented (or may be 5 segmented if its basal process is regarded as a segment; 48, 46, 171, 159, 284 microns). Frontal tubercles absent. Wing venation as in Fig. 27 A and Table 1 h; R 2+3 almost fused to R 1. Relative length of leg segments as in Table 2 h; Leg ratio 1.87-2.00 (1.93 in average of 5). Cercus and spermathecae as in Figs. 28 D, E.

Pupa. Body length 3.95-4.95 mm (4.32 mm in average of 5 pupal exuviae mounted in gum-chloral). Thoracic respiratory organ (Fig. 28 I) small, divided into 4 simple tube-like branches (*convictum*-group of Lenz, 1954). Distribution of spines and spinules on abdominal tergites as follows (Fig. 28 F): segment I without spines and spinules; II with proximal band of spines in about 3 rows (II a), large spinulous area (II b), spinose area (II c), and caudal band of large recurved spines arranged in single row (II d); III and IV with proximal band of spines (in about 3 rows), middle spinulous area occupying about ¾ of tergite, and caudal row of small spines arranged in 3 or 4 rows; in addition, sternite IV has pair of whirl-like spinulous area (pedes spurii) near the caudolateral corners; V and VI with proximal band of spines (in about 3 rows), middle spinulous area, but devoid of caudal row of spines, and with pair of caudolateral spinulous areas; VII and VIII without spines, and with pair of proximolateral spinulous areas. Caudolateral scales of segment VIII (Fig. 28 H) highly pigmented and sharply pointed apically, with about 4 extremely small spines along lateral margin and 2 small spines along inner margin, otherwise almost smooth. 3 pairs of lateral swimming hairs on segments V and VI, 4 pairs on segments VII and VIII, and about 30 along lateral margin of anal lobes.

Discussion. This species is identified as a member of genus *Microtendipes* Kieffer, because the wing vein R 2+3 is almost parallel to R 1 and both terminate close to each other, the wing membrane is unmarked, and the pulvilli are only moderately developed, though most other morphological characteristics are of the *Polypedilum* types. Among the known species of this group, the present species is apparently most closely related to *Chironomus* (*Polypedilum*) *flavescens* Johannsen, 1932, which was collected from the highlands of Sumatra and Java. According to the descriptions of males and females as well as a figure of the male hypopygium presented by Johannsen (1932), both species are similar in body coloration, in the values of LR and AR, and in the basic structure of the male hypopygium. However, the present species apparently differs from *flavescens* in the relative length of the apical bristles on the ventral appendages, in the relative length of the

lateral and the inner bristles of dorsal appendages (all longer in the present species), in the number of inner bristles on the dorsal appendages (one in *flavescens*, 2 or 3 in this species), in the shape of the ventral appendages (apically expanded in *flavescens*, apically narrowed to a sharp point in this species), and in the shape of the apical scale on the front tibia (pointed in *flavescens*, rounded in this species).

(9) *Microtendipes ureshinoensis*, **sp. nov.** Figs. 29-31.

Materials studied. Larvae were collected by Mr. H. Suzuki from bottom sediment of a sewage ditch in the hot spring town of Ureshino, Saga Prefecture, together with large numbers of larvae of *Cricotopus bicinctus* (Meigen). A male (holotype, No. A 32-01), a female (paratype, No. A 32-02) and their associated pupal exuviae, and two larvae were examined first as fresh material, and were then mounted in gum-chloral for detailed microscopical study. One male (paratype) was preserved dry on card (Box B 16).

Male. Body length 3.44 mm, wing length 2.05 mm. Body coloration mostly pale yellow; scutum pale yellow; scutal stripes reddish yellow; scutellum pale yellow; postnotum brown; abdominal tergites I to VI pale green, tergites VII, VIII and hypopygium brown; legs almost uniformly yellow, with the exception of front tarsi I to V, which are brown.

Antenna 14 segmented, AR 1.86, highly plumose. Palp 4 segmented (60, 106, 125, 195 microns). Eyes with long dorsomesal projection. Frontal tubercles absent.

Pronotum reduced, overhung by scutum and not visible from above. Wing membrane unmarked and slighly tinted brown by transmitted light, devoid of macrotrichiae. Squama fringed with some 8 hairs. Anal lobe rather flat. Wing venation as in Fig. 29 A and Table 1 i; R 2+3 almost fused with R 1; r-m oblique and conspicuous; fCu well beyond r-m. Relative length of leg segments as in Table 2 i. Front tibia with a terminal scale sharply pointed (Fig. 29 F). LR 1.80. Longest hair on front tarsus I being 2.5 times diameter of segment. Middle and hind tibiae with two completely separated comb scales, wider one unarmed and narrower one with long spur. Pulvilli moderately developed.

Hypopygium (Fig. 29 H) with anal point (Fig. 29 I) 34 microns long, widest at base and otherwise almost parallel-sided, apically rounded and bare except for base. Dorsal appendage (Fig. 29 J) composed of conical, setigerous basal portion, and an inwardly directed, naked and curved apical portion (a key character of this species). Ventral appendage (Fig. 29 K) reaching well beyond tip of gonocoxite, apically expanded, and bears one long terminal seta (77 microns long) and 13 recurved setae. Gonostylus (Fig. 29 L) long and slender (175 microns long and 38 microns wide), apically tapering, and bears one terminal seta, two subterminal setae, and some 10 long setae along inner margin.

Female. Coloration as in male, though somewhat paler. Body length 2.38 mm, wing length 2.00 mm.

Antenna (Fig. 29 C) 5 segmented (60, 137, 94, 101, 239 microns); segment II with double rows of bristles, segments III and IV flask-shaped, segment V incompletely divided between basal bulb and elongated distal portion; with one long subapical hair (166 microns long). Palp (Fig. 29 D) 5 segmented (48, 55, 121, 135, 246 microns; first segment is incompletely divided from base). Frontal tubercles absent. Pronotum reduced. Scutum yellow, scutal stripes brownish yellow and less conspicuous than in the male. LR 1.79. Terminal scale of front tibia rounded apically, as in Fig. 29 B. Abdomen and legs

yellow. Cercus as in Fig. 29 E.

Pupa. Thoracic respiratory organ (Fig. 30 A) branched into 6 tubes. Distribution of spines, spinules and hairs on abdominal tergites as in Fig. 30 B; tergite I without spines and spinules; tergite II (Fig. 30 C) with basal transverse band of spines (II a) arranged roughly in 4 rows, proximal spinulous area (II b), distal spinulous area (II c), and caudal uniserial band of relatively small recurved spines (II d); tergite III (Fig. 30 D) and tergite IV with spinose and spinulous areas similar to tergite II, but recurved spines along caudal margines are larger than those on tergite II (this relation is reversed in most other species); tergite V (Fig. 30 E) and tergite VI with basal band of large spines, proximal spinulous area, and pair of distal spinulous areas, but devoid of caudal band of recurved spines seen on tergites II, III and IV; tergite VII and VIII with only pair of small spinulous area near base of segment; segments II, III and IV with 3 pairs of fine and short lateral hairs, while there are 3 pairs of long and flat swimming hairs on lateral margins of segments V and VI, 4 pairs on segments VII and VIII, and about 30 on lateral margin of anal lobes; caudolateral scales on segment VIII (Fig. 30 F) have sharply pointed apical spur.

Larva. Color in life pink. Body length 6.2 mm (in mature larva mounted in gum-chloral). Both blood gills on abdominal segment VIII and caudolateral processes on abdominal segment VII absent. Labial plate (Fig. 31 A) with 16 teeth (8 pairs); first and third pairs longest and widest, while second pair is much shorter and slightly narrower. Paralabial plates (Fig. 31 A) fan-shaped, striated, 90 microns wide and 43 microns long. Antenna (Fig. 31 C) 5 segmented (63, 19, 8, 7, 5 microns), first segment 1.56 times combined length of segments II to V; ring organ about ¼ from base of segment I; antennal blade 48 microns long, and 1.2 times combined length of antennal segments II to V; Lauterborn's organ rudimentary. Mandible (Fig. 31 B) with 4 cutting teeth, second tooth being largest. Labrum and premandible as in Fig. 31 D, maxilla Fig. 31 E. Anal segments as in Fig. 31 H. Preanal hair tuft arising from rather flat base (41 microns wide and 14 microns long), composed of 8 long hairs, and 2 short hairs on each side. Two pairs of anal gills are subequal in length, about 190 microns long and 75 microns wide at base, constricted about 2/3 from base. Posterior pseudopods about 260 microns long, each having 15 claws.

Discussion. This species is also a typical member of the *Polypedilum* group, but is different from *Polypedilum* in the strict sense and identified as *Microtendipes* because the wing vein R 2+3 is almost fused with R 1, the wing membrane is unmarked, and the pulvilli are only moderately developed. According to a key to British species of this genus compiled by Pinder (1978), the present species seems to be most closely related to *Microtendipes nitides* (Meigen) in view of the structure of the anal point, gonostylus and ventral appendage, but the former differs from this and all the other previously known species of this genus in the shape and structure of the dorsal appendage, which is characteristic of the present species.

(10) *Orthocladius (Orthocladius) makabensis,* **sp. nov.** Figs. 32-36.

Large numbers of larvae and pupae of this species were collected from streams on the slopes of Mount Tsukuba, Ibaraki, during February and March 1978, particularly from stations previously treated with a larvicide, Abate. The adults were reared in laboratories regulated at 10 C or 15 C.

Materials studied. Holotype, male, mounted in gum-chloral on a slide together with

associated pupal skin, No. A 21-01; emerged on 24 March 1978. Paratypes: 10 males mounted in gum-chloral on slides, together with pupal or larval exuviae; 6 females mounted in gum-chloral, together with pupal or larval exuviae; 8 males and 6 females, stuck on card; all from the same locality, collected during February and March, 1978, and reared in the laboratory; 7 males and 6 females, mounted in balsam, collected March, 1978. Large numbers of specimens of adults, larvae and pupae preserved dry or in alcohol were also available for this study.

Male. Body length 3.85-4.06 mm (4.02 mm in average of 5 specimens mounted in gum-chloral). Wing length 2.29-2.92 mm (2.63 mm in average of 8 specimens stuck on card). Coloration almost unifomly black.

Antenna 14 segmented; AR 1.46-1.71 (1.62 in average of 5 specimens); last segment not expanded apically (Fig. 33 B). Palp 4 segmented (60, 120, 101, 157 microns). Eyes widely separated, bare. Vertex with 6 bristles, each about 65 microns long.

Pronotum, scutum, scutellum and postnotum entirely black and slightly pruinose. Pronotum with 5 pairs of lateral setae. Scutal stripes hardly distinguishable from ground color. Acrostichal setae short (about 20 microns) and decumbent, arranged along midline of scutum to near its anterior margin. Dorsocentral setae 8 or 9 in number, about 45 microns long, arising from large pale holes. Scutellum with about 14 setae in a uniserial transverse row (Figs. 32 C, D).

Wing membrane slightly brown by transmitted light, smooth and devoid of macrotrichiae and microtrichiae recognisable under low power illumination. Squama completely fringed. Anal lobe conspicuous. Wing venation as in Fig. 32 A and Table 1 j; R 2+3 ending about midway between R 1 and R 4+5; Costa not produced beyond end of R 4+5; fCu on nearly same level as r-m; Cu 2 almost straight; An reaching far beyond fCu.

Leg segments almost uniformly black. Length of each segment as in Table 2 j. LR 0.80 for front leg, 0.57 in middle, and 0.60 in hind leg. Longest hairs on front tarsus I about 2.9 times diameter of segment. Front tarsus IV about 1.5 times length of front tarsus One terminal spur on front tibia (48 microns long), two on middle tibia (17 and 12 microns), two on middle tarsus I (29 and 27 microns), two on middle tarsus II (27 and 22 microns), two on hind tibia (63 and 27 microns), two on hind tarsus I (29 and 24 microns), and two on hind tarsus II (24 and 22 microns). Hind tibia with comb composed of some 13 spines. Pair of claws on tip of each leg are subequal in length, tip being divided into several forks, and with two basal hairs. Pulvilli absent. Empodium very short.

Abdominal tergites are almost uniformly black, and bear numerous long bristles (Fig. 32 B). Hypopygium as in Fig. 33 E; anal point (Fig. 33 C) conical and sharply pointed apically, basal two thirds thickly covered with microtrichiae and bear some 20 bristles along lateral margins, while distal one third is bare. Gonocoxite (Figs. 33 F, G) with double inner lobes, dorsal one broad and rounded, but ventral one being roughly conical. Gonostyle concave medially and truncate apically, bears one strong apical spur and two small accessory spurs.

Female. Body length 3.06-4.06 mm (3.70 mm in average of 5). Wing length 2.66-3.44 mm (2.95 in average of 6). Coloration almost entirely black, as in male (darker in general than female of *O. yugashimaensis*, and even halteres are entirely black).

Antenna (Fig. 34 A) 6 segmented (36, 101, 46, 51, 58, 149 microns). Palp (Fig. 34 B) 4 segmented (53, 113, 116, 200 microns). Eyes widely separated, bare.

Thorax almost entirely black. Scutum black and slightly shining, scutal stripes hardly distinguishable from other scutal regions. Scutellum and postnotum black. Wing membrane slightly brown by transmitted light. Wing venation as in Table 1 j and Fig.

32 A. Legs also almost uniformly black. Relative length of leg segments as in Table 2 j. Claws simple, apically pointed (Fig. 34 E; not apically spatulate and forked as in the male).

Abdominal tergites are also almost uniformly black. With two spermathecae (Fig. 34 C), both almost globular, about 80 microns in diameter. Cerci long and earlike, as in Fig. 34 D.

Pupa. Body 4.2-5.3 mm long. Thoracic respiratory organ (Fig. 34 F) tubelike, apically pointed, and with sparse spinules on apical two thirds (spinules much fewer than in *O. yugashimaensis*); length of thoracic respiratory organ variable, from 0.18 to 0.38 mm, as in following table.

Table 3.

Frequency distribution of the number of pupae of *Orthocladius makabensis* according to the length of the thoracic respiratory organ (23 specimens measured).

Length (mm)	0.18	0.22	0.26	0.27	0.30	0.31	0.32	0.33	0.34	0.35	0.36	0.37	0.38
Frequency	1	1	2	2	1	1	2	1	3	1	4	2	2

Distribution of spinose and spinulous areas on abdominal segments (Fig. 35 A) is characteristic of this species. Segment I has neither spinose nor spinulous areas, and with 5 pairs of short setae on the tergite. Segment II with 3 pairs of tergal setae, 3 pairs of sternal setae, 2 pairs of lateral setae; tergite II with large proximal spinulous area, small spinose area in middle (Fig. 35 B), and very conspicuous spinose area (Fig. 35 C) along caudal margin, where some 75 large spines of about 25 microns in length are directed towards head and arranged into 3 or 4 irregular rows; sternite II with one large spinulous area. Segment III with 5 pairs of tergal setae, 3 pairs of sternal setae, and 3 pairs of lateral setae; tergite III with latero-proximal spinulous area and large medio-distal spinose area, contiguous with each other; sternite III with large spinulous area. Segments IV, V and VI similar to segment III in arrangements of setae and spinose areas, except that sternites bear two pairs of spinose areas along caudal margins. Sternites VII and VIII as well as tergites VII and VIII each with spinulous area but without spines in caudal zones. Terminal segment (Figs. 34 G, H) has proximal spinulous area, pair of genital sheaths (longer in male than in female), and pair of anal lobes (swimming paddles) bearing 3 strong terminal bristles of about 0.23 mm in length; bases of terminal bristles being devoid of specialized spines such as in pupa of *O. yugashimaensis*.

Larva. Color in life generally milky white. Antenna (Fig. 36 B) 5 segmented (48, 10, 9, 7, 5 microns), LAR 1.6; ring organ at about 1/5 from base of first segment; Lauterborn's organ on the third segment smaller than in *O. kanii*. Labial plate (Fig. 36 A) with 13 teeth, central tooth being widest and longest. Mandible, maxilla, premandible and labrum as in Figs. 36 C, D, E, F. Claws on anterior pseudopods (Fig. 36 G) similar in serration to *O. yugashimensis* and comb teeth are shorter in general than in *O. kanii*. Preanal hair tuft composed of 6 long hairs and two short hairs; their bases are small, semiglobular, 22 microns wide and 17 microns long, and almost colorless. Posterior pseudopods with 16 claws, which are yellow or brown and paler than those of *O. kanii*.

Discussion. In the system proposed by Edwards (1929), adults of the present species keys out to group C of the subgenus *Orthocladius*, as the wings are slightly tinged brown

by transmitted light, costa is not produced; R 4+5 ending slightly beyond tip of Cu 1; An reaching far beyond fCu; r-m and fCu almost on the same level; Cu 2 almost straight, squama with complete fringe, pulvilli absent, and empodium short especially in the male.

According to the system of classification proposed by Brundin (1956), the present species belongs to the subgenus *Orthocladius* (s. str.) of the genus *Orthocladius* (s.l.), as the acrostichal setae are not reduced and begin from near the anterior margin of mesonotum, the lateral pronotal setae are also not reduced, the last antennal segment of the male is not apically swollen, tarsus I of the front leg is devoid of tarsal beards, the setae on the scutellum are not scattered but their bases are situated on a uniserial transverse line (Fig. 32 D), and the anal point is narrowly triangular and apically sharply pointed. On the other hand, all stages of this species structurally resemble those of *O. yugashimaensis,* which is described also as a new species in the present paper. However, in the male, the antennal ratio is about 1.6 in this species and 2.5-2.9 in the latter, and the structures of the anal point, the style, and the basal processes of the coxite are characteristic for each species. The halteres are entirely black in this species, but are yellow in the distal portion of *O. yugashimaensis.* In the pupa, the thoracic respiratory organ of this species has much fewer spinules, and is devoid of the characteristic spines seen on the anal lobes near the bases of the apical bristles of *O. yugashimaensis.*

(11) *Orthocladius (Orthocladius) yugashimaensis,* **sp. nov.** Figs. 37-39.

Larvae and pupae of this species were collected, both in large numbers, from riverbeds of the Kanogawa River, Shizuoka Prefecture, February and May, 1978, and the Iimori River, Nagasaki Prefecture, April 1978. Adults were reared in laboratories regulated at 10 C or 15 C. This species seems to be a common chironomid breeding in shallow and rather polluted rivers and streams in Japan, and were found in both localities together with larvae and pupae of *Chironomus yoshimatsui*, a common species found in sewage streams in Japan.

Materials studied. Holotype: male, reared from larva collected at Yugashima, Shizuoka Prefecture, 13 February 1978, mounted in gum-chloral on slide No. A 26-01. Paratypes: 4 males and 2 females mounted in gum-chloral together with associated pupal exuviae (Box A 26); 14 males and 11 females, reared individually from larva or pupa, stuck on card (Box B 14), and their pupal or larval exuviae mounted in gum-chloral; all collected from riverbed of the Kanogawa, Yugashima, Shizuoka Prefecture. In addition, 3 males and 4 females, mounted in gum-chloral, reared from larvae or pupae collected at Iimori, Nagasaki Prefecture, 3 April, 1978 (Box A 25) and 2 males and 7 females, same data, stuck on card (Box B 14) were also studied.

Male. Body length 3.3-4.1 mm (3.79 mm in average of 4). Wing length 2.60-2.76 mm, or 2.68mm in average of 5 specimens collected at Yugashima, and 2.82 and 3.17 mm in 2 specimens collected at Iimori (these values are smaller than 4-4.2 mm long of *O. glabripennis* described by Tokunaga, 1965, from Kyoto). Coloration almost entirely black.

Antenna 14 segmented, apically not expanded (Fig. 37 C), highly pruinose, antennal hair brown; AR 2.21-2.62 (2.35 in average of 5). Palp 4 segmented (67, 135, 137, 200 microns). Eyes bare.

Lateral view of thorax as in Fig. 37 B. Pronotum well developed, with 5 pairs of lateral setae. Ground color of scutum black; scutal stripes black and slightly pruinose. Acro-

stichal setae on a single row, short and decumbent, arise from near the anterior margin of scutum. Dorsocentral setae well developed, arise from large pale punctures. Scutellum dark brown, with about 12 long setae situated on transverse line. Postnotum black. Halteres basally dark brown, apically swollen and yellow.

Wing membrane bare, slightly brown by transmitted light. Squama completely fringed. Wing venation as in Fig. 37 A and Table 1 k. R 2+3 ending about midway between R 1 and R 4+5; fCu under r-m; Cu 2 almost straight, slightly bent near tip; An extending far beyond fCu.

Legs almost uniformly dark brown. Relative length of leg segments as in Table 2 k. LR 0.77 for front leg, 0.55 for middle leg, and 0.57 for hind leg. BR (beard ratio) is 2.6 for front femur, 1.6 for front tibia, and 2.1 for front tarsus I. Terminal spurs are one on front tibia (75 microns), two on middle tibia (39 and 31 microns), two on hind tarsus I, and one on hind tarsus II (30 microns). Hind tibia bears a terminal comb composed of some 12 spurs (Fig. 38 F). All legs with pair of claws which are apically forked into several combs (Fig. 38 E), an empodium, but pulvilli are absent.

Abdominal tergites are almost uniformly black, and bear numerous long bristles (about 70 on abdominal tergite II, each measuring about 190 microns, as in Fig. 37 D). Hypopygium (Fig. 38 A) with anal point (Fig. 38 B) which is apically sharply pointed, devoid of microtrichiae except for basal portion, and bears about 8 bristles on both lateral sides. Double inner lobes on gonocoxite. Dorsal lobe being rather narrow and prominent, devoid of microtrichiae except for distal region and along inner margin, and bears 8 relatively short bristles arranged as in Fig. 38 D; ventral lobe situated almost on same level, roughly rectangular in contour and broader than dorsal lobe, pruinose especially on its ventral surface, and bears about 15 long bristles along inner margin (Fig. 38 D). Gonostylus (Fig. 38 C) is simple, apically truncated, bears apical spine and two subapical spurs, but devoid of conspicuous inner swellings as seen in some other *Orthocladius* males.

Female. Body length about 2.25 mm. Coloration almost uniformly black as in male.

Antenna (Fig. 37 E) 6 segmented (65, 87, 41, 43, 43, 183 microns), third, fourth and fifth segments roughly oval. Palpus (Fig. 37 F) 4 segmented, (65, 123, 128, 217 microns). Eyes widely separated and bare.

Ground color of scutum black and shining, scutal stripes black and pruinose, and hardly distinguishable; median stripes only narrowly separated in middle. Shoulder parts of scutum slightly yellowish. Both scutellum and postnotum black. Halteres largely yellow except for basal portion.

Wing 2.8-3.0 mm long and 0.9-1.0 mm wide. Wing membrane milky white and tinted with brown when viewed by transmitted light, devoid of macrotrichiae. Squama completely fringed, with about 15 hairs. Wing venation as in Fig. 37 A and Table 1 k. R 2+3 separated from R 4+5 and terminate on costa midway between ends of R 1 and R 4+5; r-m oblique and conspicuous; fCu under r-m; Cu 2 slightly bent near end; An extends far beyond fCu.

Legs almost uniformly dark brown. Length of leg segments as in Table 2 k. Appendages are as described for male.

Abdominal tergites almost uniformly black. There are 2 spermathecae, subequal in size and roughly oval, shaped about 0.094 mm long and 0.067 mm wide, Fig. 37 G. Cercus very wide and short, as in Fig. 37 H.

Pupa. Body about 4.6 mm long. Thoracic respiratory organ (Fig. 38 G) about 0.34 mm long and 0.06 mm wide, conical shape but elongated (tube-like but tapering towards

tip) and with pointed appex, with numerous fine spinules on entire surface. Distribution of spines and spinules on abdominal segments is similar to that of *O. makabensis*; segments II to VI each with a large spinose area occupying more than two thirds of tergite; tergite II has about 100 large and prominent spines of length 35 microns arranged in 3 or 4 rows along caudal margin; spinules on other abdominal segments being much smaller and inconspicuous (14 microns in length for longest ones). Tergites VII and VIII with only extremely small spinules, hardly discernible under low power maginification. Abdominal segment VIII bears 4 pairs of bristles along lateral margins, with one situated on caudolateral corner being relatively long and stout, about 130 microns in length, while remaining 3 pairs are subequal in length and thinner, being about 75 microns (Figs. 38 H, I). Pair of swimming paddles fairly well developed, almost oval in shape, about 0.35 mm long and 0.23 mm wide, and bearing three stout apical bristles, subequal in length about 0.28 mm. Swimming paddles bear several small, sharply pointed spines near bases of apical bristles (Fig. 38 J).

Larva. Body length about 6.6 mm in mature larvae. Body color generally milky white, head capsule yellow (paler than in *O. kanii*). Hooks on posterior pseudopods brown (also paler than in *O. kanii*).

Antenna (Fig. 39 C) 5 segmented, roughly 60, 12, 5, 5, 5 microns long; total length about 87 microns; first segment about 2.3 times combined length of remaining segments of antenna; distance between ring organ and base being 1/6 of total length of segment. Labrum, epipharynx, premandible, mandible and maxilla as in Figs. 39 B, D, E . Labial plate (Fig. 39 A) with 13 teeth, central tooth rounded, and about twice as wide as first pair of lateral teeth.

Claws on anterior pseudopods (Fig. 39 F) consist roughly of three types; small claws which are 12 to 22 microns in length, smallest one being simple, but larger ones with one to several deep, comb-like teeth; medium-size claws, which are 24-46 microns in length, and with about 10 deep, comb-like teeth; and long claws, which are 85 to 90 microns in length and with about ten short saw-like teeth along concave margin near tip.

Anal part of mature larva as in Fig. 39 I. Preanal hair tuft (Fig. 39 H) each composed of 6 long, stout and pigmented hairs, and two short hairs, arising from a semiglobular base. Posterior pseudopods with 16 simple claws (Fig. 39 G), which are yellowish brown in color. Anal gills short, subequal in length and about 1/3 the length of posterior pseudopods, posterior pair being apically more pointed and narrower than anterior pair.

Discussion. This species being described here is probably the same as that reported by Tokunaga (1965) from a river in northern Kyoto and named *Orthocladius glabripennis* (Goetghebuer, 1921). However, when the present species is compared with the description of *O. glabripennis* based on type materials by Pinder and Cranston (1976), the former differs from the latter in the absence of long beards on the front tarsi, and in the shape of the anal lobe of the wing which is poorly developed. Brundin (1956) created a new subgenus within the genus *Orthocladius* for *O. consorbinus* (Holgren) and *O. glabripennis* (Goetghebuer) on account of the presence of the beards and the well developed anal lobe. However, the present species is a typical *Orthocladius* even in the sense of Brundin (1956).

This species is closely related to *O. makabensis*, but is considered here a distinct species due to the characteristics pointed in the previous text.

(12) *Orthocladius (Euorthocladius) kanii* (Tokunaga, 1939) Figs. 40-43.

Large numbers of larvae were found, together with those of *O. makabensis*, on stones in streams at Mt. Tsukuba in February and March, 1978, after treatment of the streams with insecticide. The larvae were also found, though in less density than those of *O. yugashimaensis*, in the riverbed of the Kanogawa River, Shizuoka Prefecture, in May, 1978. The morphological characteristics of the adults, pupae and larvae of these materials agreed quite well with the description of *Spaniotoma (Orthocladius) kanii* of Tokunaga (1939, 1964) collected from Kyoto and Niigata. This species seems to be common during the winter to spring in relatively clean streams of Japan.

Materials studied. 6 males and 6 females, reared from larvae collected in March, 1978, from mountain streams of Tsukuba, and mounted in balsam; 6 males and 6 females, same data, mounted in gum-chloral; 8 males and 14 females, same data, stuck on card; pupal and larval exuviae associated with the adults, same data. Large numbers of adults, pupae and larvae preserved in alcohol were also available for this study.

Male. Body length 2.86-4.17 mm (3.67 mm in average of 6, gum-chloral mounted specimens). Wing length 2.40-2.92 mm (2.60 mm in average of 8). Coloration almost uniformly dark brown, except for halteres, being largely yellow.

Antenna 14 segmented, apically not expanded (Fig. 41 A); AR 1.41-1.47 (1.44 in average of 6). Palp 4 segmented (84, 142, 123, 183 microns). Eyes widely separated, bare.

Thorax as in Figs. 40 F, G. Pronotum well developed, with several lateral bristles. Ground color of scutum dark brown, scutal stripes shining black. Scutellum dark brown. Postnotum black. Acrostichal setae of scutum lacking. Dorsocentral setae well developed, about 8 on either side, each about 130 microns long and originate from large pale hole of diameter about 17 microns. Scutellum with about 16 bristles irregularly scattered.

Wing membrane devoid of macrotrichiae, and slightly brown by transmitted light. Squama fringed with numerous hairs. Anal lobe prominent. Wing venation as in Table 1 k and Fig. 40 A. R 2+3 distinctly separated from R 1 and R 4+5, and terminate on costa about midway between ends of the two veins. Costa slightly extends beyond end of R 4+5; r-m oblique and conspicuous; fCu almost same level as r-m; Cu 2 almost straight; An reach far beyond fCu.

Leg segments almost uniformly black. Relative length of leg segments as in Table 2 k. LR 0.75-0.78 (0.77 in average of 6). Longest bristles on tarsus I being about 2.9 times diameter of segment. One terminal spine on front tibia (67 microns, Fig. 41 B), two on middle tibia I (29 and 27 microns, Fig. 41 C), two on middle tarsus I (24 and 22 microns), two on middle tarsus II (22 and 20 microns), two on hind tibia (63 and 24 microns, Fig. 41 D), two on hind tarsus I (31 and 23 microns), and two on hind tarsus II (26 and 24 microns). Hind tibia bears, besides the two terminal spurs, terminal comb composed of about 12 simple and sharply pointed spines (Fig. 41 D). All legs with pair of claws which are apically forked and basally bear a few hairs, and an empodium, but pulvilli are absent.

Abdominal tergites almost uniformly black, and bear numerous hairs irregularly scattered as shown in Fig. 42 G. Hypopygium as in Fig. 41 G. Anal point (Fig. 41 J) about 60 microns long, apically rounded (not sharply pointed as in subgenus *Orthocladius* in strict sense), bears short bristles along lateral margins but devoid of microtrichiae except for basal portion. Gonocoxite with double inner lobes (Figs. 41 H, I). Gonostylus with prominent terminal spur, two subterminal accessory spurs, and subterminal swelling, as shown in Fig. 41 K.

Female. Body length 2.53-3.07 mm (2.88 mm in average of 5). Wing length 2.19-2.97 mm (2.47 mm in average of 10). In contrast to color of male which is almost uniformly black, female of this species is yellowish in ground color of scutum, and scutal stripes are dark brown and well defined.

Antenna (Fig. 40 B) 6 segmented (72, 80, 51, 50, 43, 48, 137 microns). Palp (Fig. 40 C) 4 segmented (70, 123, 121, 205 microns). Eyes widely separated and bare.

Ground color of scutum yellow. Scutal stripes dark brown, median stripes confluent in the middle. Scutellum yellowish brown. Postnotum dark brown. Halteres yellow.

Wing membrane slightly brown by transmitted light, devoid of macrotrichiae. Anal lobe prominet. Squama fringed. Wing venation as in Fig. 40 A and Table 1 k.

Leg segments almost entirely dark brown, though trochanters and bases of femora are paler in color. Relative length of leg segments as in Table 2 k. Claws are simple and not apically forked as in male. Pulvilli absent. Cercus and spermathecae as in Fig. 40 D and E.

Pupa. Body length 2.86-3.54 mm (3.13 mm in average of 8) in female pupae, and 3.07-3.70 mm (3.40 mm in average of 8) in male pupae, all measured with pupal exuviae mounted in gum-chloral). Thoracic respiratory organ (Fig. 42 A) roughly oval, 48-63 microns long (54.0 microns in average of 10) and 22-29 microns in diameter (24.6 microns in average of 10).

Distribution of spines and spinules on abdominal segments (Fig. 42 B) as follows: tergites I and II as well as sternite I without spines and spinules; sternites II to VII with basal spinulous area, which is largest in sternite II and gradually decrease in numeral order; tergite III with small basal spinulous area but devoid of spines; tergites IV to VIII with basal spinulous area, and caudal band of sharply pointed spines as shown in Fig. 42 C; sternite VIII and IX devoid of spines and spinules, but tergite IX has basal spinulous area; terminal segment (Figs. 42 E, F) composed of pair of short lateral lobes each bearing two small bristles, and pair of genital sheaths, which are conspicuously longer in male (350 microns) than in female (145 microns); 2 pairs of lateral hairs in segments II to V, three pairs in segments VI and VII, and two pairs in segment VIII (cf. most other species have four pairs of lateral hairs on segment VIII); all lateral hairs are simple and short.

Pupae of this species are unusual in that there is no caudal band of spines on abdominal tergites II and III, none of lateral hairs is modified into flat and long swimming hairs, and that pair of swimming paddles bearing three stout bristles seen in most other orthocladine species is absent.

Larva. Mature larvae are 4.6-4.9 mm in length (4.72 mm in average of 10). Body milky white. Head dark brown (darker than in *O. makabensis*). Hooks on posterior pseudopods dark brown (also darker than in *O. makabensis*).

Head as in Fig. 43 A. Antenna (Fig. 43 A) 5 segmented (46, 14, 7, 5, 5 microns, Fig. 43 H), first segment about 1.5 times combined length of remaining 4 segments; ring organ situated at about 1/6 from base of first segment; Lauterborn's organ, or the hyaline swelling covering third segment, is almost globular, about 4 times as wide as diameter of third antennal segment (shape of this organ is characteristic of this species). Labrum, epipharyncx, premandible and maxilla as in Fig. 43 B-E. Mandible (Fig. 43 G) with 5 cutting teeth, and with two shallow incisions on the convex margin. Labium with 13 teeth, central tooth being widest, about twice as wide as first lateral pair and with flat or slightly concave edge; second pair is wider than other pairs, and has a more rounded edge.

Anterior pseudopods bear numerous claws of various sizes and shapes, medium sized hooks being comb-like and with several very long teeth.

Bases of preanal hair tuft are semiglobular, and not pigmented (in *O. makabensis*

bases are pigmented and thickened especially along inner edge), and bear two minute setae about 10 microns in length (in *O. makabensis* these setae are about 50 microns long). Preanal hair tuft composed of 6 long setae. Anal gills subequal in length, short (dorsal pair about 0.10 mm long and ventral pair about 0.09 mm long), and nearly conical in shape. Posterior pseudopods well developed, about 0.30 mm long, and bear 16 highly pigmented claws.

Discussion. This species was reported first by Tokunaga (1939) as a new species by the scientific name of *Spaniotoma (Orthocladius) kanii*, from torrential streams in the suburbs of Kyoto. Tokunaga (1964) gave additional accounts on the morphology and biology of this species found in Nagaoka, Niigata Prefecture. The present author has collected large numbers of larvae from streams on the slopes of Mount Tsukuba together with those of *Orthocladius makabensis*, *Eukiefferiella yasunoi* and *Microtendipes tsukubaensis*. Larvae of this species were found also on stones in the riverbed of the Kanogawa River, and seem to be widely distributed in the torrential streams of Japan.

According to the classification proposed by Brundin (1956), the present species seems to belong to the subgenus *Euorthocladius*, since bristles on the scutellum are irregularly scattered and not linearly arranged, and the anal point is narrower at base, less tapered, and apically more rounded than in subgenus *Orthocladius* s. str. In the pupa, the shape of the thoracic respiratory organs and the structure of the anal segment is characteristic of this species. Larva of this species can be differentiated from those of *O. makabensis* by the size of Lauterborn's organ on the antenna (wider in *kanii*) and by the shape of the claws on the anterior pseudopods (more deeply serrate in *kanii*).

(13) *Psectrocladius aquatronus*, sp. nov. Figs. 44-47.

Large numbers of larvae and pupae of this species were found in the bottom sediments of concrete pools constructed in NIES for the study of freshwater biology, during the winter season of 1977-1978. Adults were also found on and around the pools during the winter season.

Materials studied. Holotype: a male, collected on 5 December 1977, mounted in gum-chloral (slide No. A 13-5l). Paratypes: 17 males and 5 females, mounted in gum-chloral (slide Box A 13); 11 males and 10 females, stuck on card (specimen box B 20). Pupal and larval exuviae, mounted in gum-chloral together with associated adults, were also available for this study. Other specimens of adults, pupae and larvae were preserved in alcohol; all collected during December 1977 - March 1978.

Male. Body length 3.66-5.00 mm (4.22 mm in average of 14). Wing length 2.29-3.23 mm (2.79 mm in average of 10). Ground color of thorax yellow, scutal stripes brown, abdomen dark brown.

Antenna 14 segmented; AR 1.70-2.08 (1.88 in average of 10); terminal part of last segment not expanded (Fig. 45 G). Palp 4 segmented (84, 154, 152, 200 microns). Eyes bare, dark brown, and widely separated. Vertex with about 8 pairs of bristles on a single row, the innermost pair reaching to near the midline.

Thorax as in Figs. 44 E, F. Pronotum well developed, with about 7 lateral setae on each side. Ground color of mesonotum yellow, with scutal vitteae, posterior anepisternum and sternopleurite being brown. Acrostichal scutal setae absent. Dorsocentral setae well developed, about 7 on each side, arising from large pale depressions. Prealar setae 5 on each side. Scutellum yellow, with 4 to 8 setae in a transverse row. Halteres yellow.

Postnotum dark brown.

Wing length very variable, measuring from 2.3 to 3.3 mm. Squama fringed with numerous hairs. Anal lobe well developed, caudomedially produced. Wing membrane almost uniformly semitransparent, slightly brown by transmitted light, devoid of macrotrichiae. Wing venation as in Fig. 44 A and Table 1 m; R 2+3 separated both from R 1 and R 4+5; terminates on costa slightly closer to end of R 1 than to end of R 4+5; Costa produced beyond end of R 4+5; fCu distal of r-m; Cu 2 almost straight except for the extreme tip.

Legs almost uniformly yellow or yellowish brown, without pale or dark bands. Relative length of leg segments as in Table 2 m. In the type specimen, LR is 0.77 for front leg, 0.50 for middle, and 0.61 for hind leg. One terminal spur on front tibia (87 microns in type specimen, Fig. 45 C), one on middle tibia (60 microns, Fig. 45 D ; one specimen had another vestigial spur, 13 microns long, only on one side of middle tibia), two on middle tarsus I (41 and 39 microns), two on middle tarsus II (41 and 34 microns), one (not two) on hind tibia (82 microns), two on hind tarsus I (43 and 41 microns), and two on hind tarsus II (43 and 39 microns). In addition, hind tibia bears about 50 sharply pointed spines in distal portion, and a terminal comb composed of about 20 spines (Fig. 45 E). Front tarsi without long beards, BR 2.1. Tarsus V normal, not dorso-ventrally flattened. All legs with pair of claws (apically forked into several spines and devoid of basal hairs), long empodium, and pair of large, padlike pulvilli (Fig. 45 F).

Abdominal tergites are almost uniformly dark brown and devoid of pale bands, bear numerous hairs irregularly distributed all over (Fig. 44 F). Hypopygium as in Fig. 45 H. Anal point (Fig. 45 J) narrow and apically rounded, devoid of both macro and microtrichiae except base. Gonocoxite with broad and almost rectangular inner lobe (Fig. 45 I). Gonostylus (Fig. 45 K) Chinese spoon-shaped, expanded towards the apex, bears one stout terminal spine, two accessory spines, and several bristles on ventral surface and along inner margin.

Female. Body stout and short, body length 3.66-4.95 mm (4.38 mm in average of 5, mounted in gum-chloral). Wing length 2.76-2.92 mm (2.85 mm in average of 6). Color mostly yellow, with brown marks, generally paler than in male.

Antenna 6 segmented (65, 92, 53, 51, 46, 145 microns, Fig. 44 C). Palp 4 segmented (65, 140, 164, 195 microns, Fig. 44 D). Eyes widely separated, bare.

Ground color of scutum yellow, scutal stripes reddish yellow (paler than in male). Scutellum reddish yellow. Postnotum largely dark brown, with basal yellow band. Halteres yellow.

Wing venation as in Fig. 44 A and Table 1 m.

Legs yellow to yellowish brown in color. Relative length of leg segments as in Table 2 m. Leg ratio 0.80 in front, 0.49 in middle, and 0.59 in hind leg (nearly same as in male). The distribution of terminal spurs is also same as in male, one on front tibia, one or two on middle tibia (the second one is vestigial when present), two on middle tarsus I and II, one on hind tibia, and two on hind tarsus I and II. As in male, terminal comb on hind tibia consists of multiple rows of spines, as in Fig. 44 B. All legs have pair of simple claws (not apically forked as in male), large empodium, and pair of large pad-like pulvilli characteristic of this genus.

Abdominal tergites are almost uniformly yellowish brown (paler in color than in male). Two spermathecae are oval and subequal in size, 106 microns long and 55 microns wide, Fig. 45 B. Cerci as in Fig. 45 A.

Pupa. Body length 4.0-5.1 mm (4.63 mm in average of 8). Thoracic respiratory organ

(Fig. 46 E) horn-like, apically rounded, 330-437 microns long (395 microns in average of 7) and 42-72 microns in diameter (58 microns in average of 7), dorsal side being densely covered with numerous spinules. Distribution of spines and spinules on abdominal segments (Fig. 46 A) as follows: tergite and sternite I without spines and spinules; tergite and sternite II to VI with central spinulous zone and subterminal rows of spines; in addition, tergites IV, V and VI each have pair of central spine groups, which are composed of 2 or 3 spines in tergite IV, several in tergite V, and about 10 in tergite VI; tergites VII, VIII and IX as well as sternites II, III, VII, VIII and IX each has spinulous area of varying size and shape, but devoid of spines; sternites IV, V and VI each has a spinulous area, and a subterminal row of needle-like spines 16-34 microns long; the spines on tergites are dark brown but those on sternites are all colorless. 3 pairs of lateral hairs on segments II to V, 4 pairs on segments VI and VII, and 5 pairs on segment VIII; 2nd and 4th lateral hairs of segment VI as well as all of those on segments VII and VIII are long, flat and filamentous "swimming hairs", while other lateral hairs are short and simple. Terminal segment (Fig. 46 D) is composed of pair of genital sheaths, and pair of swimming paddles about 0.46 mm long and 0.26 mm wide, each fringed with about 45 swimming hairs, and bearing 3 stout and slightly curved caudal bristles about 0.63 mm in length.

Larva. Mature larvae are 8.4-8.9 mm in body length (8.77 mm in average of 10) mostly milky white in color.

Head capsule dark brown, about 0.60 mm long and 0.53 mm wide. Antenna (Fig. 47C) about ¼ length of head capsule, 5 segmented (113, 19, 10, 7, 6 microns), first segment relatively long and 2.6 times combined length of segments II to V. Ring organ located near base of first antennal segment; distance from base, about 1/7-1/8 length of segment. Antennal blade about 0.7 times combined length of antennal segments II to V. Labrum, epipharynx, premandible and maxilla as in Fig. 47 A. Chief characteristic of this species is presence of pair of palmate hairs on anterior edge of labrum, which are split into 6 sharply pointed fingers. Labial plate (Fig. 47 D) with 12 teeth; central pair about twice as wide as second pair, slightly paler than rest parts of plate, and with slightly undulating edge; second to 6th pairs of teeth with sharply pointed apex. Mandible (Fig. 47 D) with 5 cutting teeth, first tooth conspicuously longer and wider than other teeth.

Claws on the anterior pseudopods as in Fig. 47 F; longest claws only slightly curved and almost entirely smooth; the medium sized claws slightly barbed along inner edge; short claws with rather short teeth.

Preanal hair tufts each composed of 6 long hairs. Their bases (Fig. 47 I) are roughtly conical, almost as high as wide (60 microns high and 75 microns in diameter), and with 3-5 small, highly chitinized dark spurs (Warzen, according to Potthast, 1915, p. 318). The posterior pseudopods bear 16 hooks, yellowish brown in color (Fig. 47 G). Anal gills about half as long as posterior pseudopods (Fig. 47 H).

Discussion. According to the classification of adult Orthocladiinae proposed by Edwards (1929), this species clearly belongs to subgenus *Psectrocladius* of genus *Spaniotoma*, since the eyes and wings are bare, R 2+3 is separated from R 1 and R 4+5, Cu 2 is almost straight, An reaching far beyond fCu, squama is completely fringed, and all legs have large pulvilli. Among the species described for this group by Edwards (1929), Goetghebuer (1940) and Pinder (1978), the adult male of this species seems to be most closely related to *P. sordidellus* (Zetterstedt, 1840) in body coloration, in the presence of only one terminal spur on the middle tibia, in the absence of tarsal beards, and in the high antennal ratio of nearly 2.0. However, the structure of the male hypopygium is quite

different between this species and *sordidellus*, and the shape of the anal point and the anal tergite of this species is more closely related to *P. psilopterus* Kieffer as illustrated by Pinder (1978). However, the shape of the inner lobe of gonocoxite in this species is again quite different from *psilopterus*.

The morphology of pupa and larva of this species is also characteristic of the genus *Psectrocladius* described by Potthast (1915) or Thienemann (1941). In the pupa, distribution of spines and spinules on the abdominal segments, and the presence of swimming hairs on segments VII and VIII as well as along the lateral margins of swimming paddles have characteristics similar to *P. psilopterus* Kieffer described by Potthast (1915, p. 320). However, the present new species is peculiar in that the second and the fourth lateral hairs on the abdominal segment VI are modified into long and flat swimming hairs, and also that it has long and sharply pointed spines even on the abdominal sternites IV, V and VI. The structure of the thoracic respiratory organ as well as the presence of three long and stout caudal bristles on the swimming paddles are also key characters for identification of pupa of this species. In the larva, this species is also characteristic of the genus *Psectrocladius* in the paired central teeth of labium, and in the occurrence of typical palmate hairs on the labrum. Among the forms described by Potthast (1915), the present species is most closely related to *P. psilopterus* Kieffer in the occurrence of several spines on the basal tubercles of the preanal hair tufts, in contrast to two in *extensus* Kieffer.

A species of *Psectrocladius* was described by Tokunaga (1936) under the name of *Spaniotoma* (*Psectrocladius*) *yukawana*. The description was based on males and females collected on oyster beds at the seashore of Wakayama Prefecture, Japan, but the structure of the male hypopygium is entirely different from this new species. Taxonomic accounts and descriptions on the *Psectrocladius* species were made also by Johannsen (1936), Brundin (1956), Freeman (1956), Saether (1969) and Pinder (1978), but the present species seems to differ from all the previously described forms of this group.

(14) *Eukiefferiella yasunoi*, sp. nov. Figs. 48-51.

Larvae of this species were found commonly in small streams on the slopes of Mount Tsukuba during February to April 1978, together with those of *Orthocladius kanii, O. makabensis* and *Diamesa tsukuba*. Pupae and adults were reared in laboratory rooms regulated at 10 C and 15 C, but for the same materials kept at 20 C and higher temperature levels pupae and adults were not formed.

Materials studied. Holotype: male and associated pupal skin cast, reared from larva collected at Mount Tsukuba on 6 April, 1978, and mounted on slide No. A 24-51. Paratypes: 3 males and females, mounted in gum-chloral, slide box No. A 24; 4 males and 5 females, pinned on card, specimen box No. B 12. 14 pupal exuviae and 9 larvae, mounted in gum-chloral.

Male. Small species with body length of about 1.7 mm and wing length of 1.6 mm. Coloration: legs almost uniformly yellow, head and abdomen dark brown, thorax with brown scutal stripes on yellow ground color.

Antenna highly plumose, shaft being dark brown and hairs yellow, 14 segmented, the distal segment expanded apically (Fig. 48 B); AR very small, 0.44, 0.51 and 0.52 for three specimens examined. Palp 4 segmented (0.65, 0.82, 0.63, 0.61 mm). Eyes bare, widely separated and without dorsal projection. Vertex with 2 or 3 long bristles.

Thorax as in Fig. 48 M. Pronotum well developed, with 1 or 2 lateral setae on each side. Scutum with 4-8 minute acrostichal setae (each about 12 microns long), 5-8 long and stout dorsocentral setae each arising from large pale hole, and 3 or 4 supra-alar setae. Ground color of scutum yellow, scutal stripes brown. Scutellum yellow and bearing 4 uniserial setae. Postnotum dark brown.

Wing 1.57-1.64 mm long and 0.48-0.52 mm wide; wing membrane bare (without macrotrichiae, and without microtrichiae discernible under low power magnification), and slightly brown by transmitted light. Anal lobe much reduced. Squama fringed with a few hairs. Wing venation as in Fig. 48 A and Table 1 n; R 2+3 completely fused with R 4+5, a key character of this genus; tip of R 4+5 slightly proximal to tip of Cu 1; fCu situated distal to cross vein r-m; Cu 2 almost straight.

Legs almost uniformly yellow in color. Relative length of leg segments as in Table 2 n. Front tibia with single terminal spur 46 microns long and 2.1 times diameter of segment (Fig. 48 G); middle tibia with two terminal spurs, 22 and 15 microns long (Fig. 48 H); hind tibia with two terminal spurs, 37 and 17 microns long, and with incomplete comb (row of separated spines, Figs. 48 I, J). Each leg with pair of claws and empodium, but pulvilli absent. Claws forked apically, and bearing two hairs near base (Figs. 48 K, L).

Abdominal tergites almost uniformly dark brown, except for narrow pale caudal bands on tergites V, VI and VII. Chaetotaxy of tergites I to IV as shown in Fig. 49 A. Hypopygium yellowish brown, structure as in Figs. 49 B, C. Ninth tergites without anal point. Coxite with prominent dorsal process, thumb-like, covered entirely with microtrichiae and bearing conspicuous marginal and dorsal bristles, and ventral process which is rather flat, pruinose, but devoid of macrotrichiae. Gonostylus with triangular apical process, terminal spine, subterminal spur, and several short bristles on dorsal and ventral surface.

Female. Coloration generally as in male. Eyes reniform, widely separated, bare. Antenna (Fig. 48 D) 6 segmented (0.055, 0.053, 0.041, 0.043, 0.050, 0.084 mm), AR 0.41. Palp (Fig. 48 C) 4 segmented (0.036, 0.072, 0.087, 0.132 mm). Ground color of scutum yellow, scutal stripes dark brown. Scutellum yellowish brown. Postnotum yellow on proximal one third and dark brown on distal two thirds.

Wing membrane slightly brown by transmitted light, and devoid of mactrotrichiae; shape and venation as in Fig. 48 A; anal lobe rather flat; R 2+3 completely fused with R 4+5; fCu far beyond r-m.

Legs almost uniformly brown, the last three tarsal segments being somewhat darker than proximal joints. Relative length of leg segments as in Table 2 n. LR 0.77. Front tibia with a single terminal spur 0.030 mm long and 0.95 times diameter of leg segment (significantly shorter than corresponding spine of male); middle tibia with two terminal spurs 0.020 mm and 0.014 mm long; hind tibiae with two teminal spurs 0.037 mm and 0.017 mm long, and incomplete comb scale composed of row of some 15 closely set but separated spines. All legs with pair of subequal claws, each bearing two hairs at base, and large empodium. Pulvilli absent.

Abdominal tergites are almost uniformly dark brown, except for narrow pale bands on caudal margins of tergites II to VII. Cercus of female genitalia peculiar in shape, as in Fig. 48 F. Two spermathecae similar in shape and size, about 63 microns long and 37 microns wide.

Pupa. Small size, body length 2.4-2.6 mm. Thoracic respiratory organ (Fig. 50 D) filamentous and with bulb-like base, 0.28-0.40 mm long (0.35 mm in average of 8) and about 0.04 mm wide at base.

Distributions of spines and spinules, and presence of certain specialized setae on

abdominal segments are characteristic of this species (Fig. 50 A). Abdominal segment I without spines and spinose areas. Segment II to VIII with spinose areas both on tergites and sternites. Tergites II to VIII each with 3 or 4 rows of sharp spines along caudal margin, of length 35 microns or less. In addition, there is row of 12 to 14 large specialized spines (hook-like, with recurved tip) 12-20 microns long on intersegmental membrane along caudal margins of tergites III, IV and V. There are also 3 or 4 rows of small spines along caudal margins of sternites V, VI and VII. Each abdominal segment has 5 pairs of short hairs on tergite, 4 or 5 pairs of short hairs on sternite, and 4 pairs of hairs along lateral margins, as a rule. In segment VIII, number of hairs on sternite and tergite is reduced to 1 and 2, respectively and middle two pairs of lateral hairs are modified into long and stout setae of about 0.12-0.14 mm long, whilst first and fourth pairs are very weak and only about 0.03 mm in length (Figs. 50 B, C).

Terminal segment of pupa is composed of pair of genital sheaths about 0.03 mm in length in female (Fig. 50 B) and 0.10 mm in male (Fig. 50 C) and pair of triangular swimming paddles bearing 3 long and stout terminal setae, subequal in length and about 0.25 mm in length. Bases of terminal setae are strongly chitinised, but devoid of specialized spines such as seen in *O. yugashimaensis*

Larva. Mature larvae are 2.9-3.2 mm in length in alcohol-fixed specimens; color in life largely yellowish brown, partly with purplish tint and with head dark brown. Antenna (Figs. 51 A, D) stout and short, 5 segmented (20, 12, 5.2, 5.3, 5.0 microns), first segment 0.70-0.83 times combined length of segments II to V; segment I bearing ring organ and two minute setae; length of antennal blade about 21 microns and 0.7-0.8 times combined length of segments II to V. Mandible (Fig. 51 D) with 5 cutting teeth, first tooth being very long and slender; mandibular brush divided into 5 simple branches. Labial plate (Fig. 51 B) with 11 teeth; central tooth being widest, anterior margin almost flat or slightly convex, somewhat paler than remaining teeth; first lateral pair of teeth wider and more rounded than the other 4 pairs of teeth. Labrum, epipharynx and premandibles as in Fig. 51 C.

Claws on anterior pseudopods (Fig. 51 G) colorless, all simple, devoid of comb-like teeth such as seen for *O. kanii*, with exception of some medium-sized hooks, which may bear inconspicuous saw-like teeth.

Preanal hair tufts composed of 7 long, stout but colorless hairs; height of bases slightly greater than width (about 14 microns high and 12 microns wide), bases brown in color, and bearing two small setae (both about 25 microns long). Anal gills subequal in length and roughtly conical, about 2/3 length of posterior pseudopods. Each of posterior pseudopods bearing 16 claws, all hook-like, yellowish brown and paler than in related orthocladine larvae.

Discussion. The taxonomic status of genus *Eukiefferiella* Thienemann, 1926, is very confusing, as discussed in detail by Brundin (1956, p. 82). The genus was first defined by the morphological characteristics of pupae and larvae, for the *Dactylocaldius longicalcar* group of Potthast (1915). Edwards (1929, p. 350) provided a new definition based on the adult characteristics and considered *Eukiefferiella* as a subgenus of *Spaniotoma* (=*Orthocladius*). The adults of the present species agree with the concept of *Eukiefferiella* of Edwards (1929) and Goetghebuer (1940), since R 2+3 is in close contact with R 4+5, Cu 1 is almost straight, the wing membrane is devoid of macrotrichiae, the palpi are 4 segmented, and the hind tibia bears an apical comb. In the key to the adult *Eukiefferiella* compiled by Brundin (1956), this species belongs to the *brevicalcar*-group, since fCu is remarkably distal to r-m, the eyes are bare, the squama is fringed, the anal point is absent,

and the inner lobe of the gonocoxite is roughly thumb-like. Of two species of this group recorded from Europe by Edwards (1929), Brundin (1956) and Pinder (1978), the present species is more closely related to *E. brevicalcar* (Kieffer) than to *E. hospita* (Edwards), especially in the value of AR (0.9 for the latter, about 0.7 for the former and 0.5 for the present species), and in the relative position of the tips of the costa and Cu 1 (almost on the same level in *brevicalcar* and in *yasunoi*, the tip of costa is proximal to tip of Cu 1 in *hospita*). However, *yasunoi* and *brevicalcar* again differ in the number of vertex bristles behind the eyes (2 or 3 in *yasunoi* and *hospita*, 5 in *brevicalcar*) and in the structure of the inner lobe of the gonocoxite.

The structure of pupa of the present species is also typical to that of the genus *Eukiefferiella* as defined by Thienemann (1944, p. 594); there is a row of strong recurved spines on the intersegmental membrane along the caudal margins of the abdominal tergites III, IV and V; tergites II to VIII bear a band of spines along the caudal margin; the thoracic respiratory organ is swollen at the base like a bulb, and apically filamentous; the anal lobes are short, and bear 3 strong terminal bristles but are not fringed with swimming hairs.

Among the pupae of *Eukiefferiella* described by Zavrel (1939) and Thienemann (1944), the present species also keys out to the *brevicalcar*-group due to the distribution of spines and hairs on the abdominal segments. However, this species differs from *brevicalcar* especially in the shape of the thoracic respiratory organs. In *brevicalcar*, the basal swelling is nearly as long as the distal filamentous portion, whilst that of the present species is much smaller and shorter, being about one fourth of the filamentous portion and closest in size and shape to *E. atrofasciata* (Goetghebuer), which is, however, entirely different to the present species in other structures of the pupa and adult.

The structure of the larva of the present species is also typical to *Eukiefferiella* defined by Thienemann (1944), and again closest to *E. brevicalcar* in the structure of the labial plate illustrated by Zavrel (1939, p. 20).

Two species of chironomids belonging to subgenus *Eukiefferiella* in the sense of Edwards (1929) were reported by Tokunaga (1938, 1939), *Spaniotoma (E.) bicolor* Zetterstedt from Kyoto, and *S. (E.) takahashii* Tokunaga from Taiwan, but both are essentially different from the present species in the structure of the male hypopygium and other adult characteristics. The characteristics of the male hypopygium of this species, especially the absence of the anal point and the thumb-like shape of the inner lobe of gonocoxite, are somewhat similar to that illustrated by Tokunaga (1964) for *Orthocladius* (s. str.) *yoshii* collected in Niigata. The latter is also essentially different from the present species in the wing venation and in a number of other characteristics. As pointed out by Thienemann (1944, p. 595), the structure of the adult, pupa and larva of *Spaniotoma* (*Orthocladius*) *tentoriola* Tokunaga, 1939, is also similar to the genus *Eukiefferiella*, but is also quite different from the present species in many respects.

(15) ***Paratrichocladius rufiventris*** **(Meigen, 1830)** Figs. 52-55.

Large numbers of larvae and pupae of this species were found on stones in artificial streams in a wood of NIES, together with those of *Chironomus flaviplumus, Cricotopus yatabensis*, and a black fly, *Simulium uchidai*. Many male and female adults were found resting on the wall of ditches or on nearby grass. The biology of this species will be reported separately by Yasuno and his associates.

Materials studied. 8 males and 5 females mounted in gum-chloral, together with associated pupal or larval skin, reared from larvae or pupae collected on 30 November 1978; 6 males and 10 females preserved dry on pin. Large numbers of adults, pupae and larvae preserved also in 70% alcohol; 10 pupal exuviae and 10 larvae were mounted in gum-chloral for morphological studies.

Male. Body coloration almost uniformly shining black, except halteres, being basally brown and apically yellow, legs being mostly dark brown and tibiae being largely yellow. A medium-sized midge with body length of 2.58-3.47 mm (3.00 mm in average of 8), and wing length of 2.21-2.62 mm (2.47 mm in the average of 10).

Antenna 14 segmented, AR 1.35-1.63 (1.46 in average of 7); tip of antenna as in Fig. 53 A. Palp 4 segmented (60, 111, 128, 183 microns). Eyes highly pubescent, reniform and with conspicuous dorsomedian extention; distance between eyes (0.22 mm) being 0.9 times height of eye (0.2 mm).

Thorax as in Fig. 53 B. Pronotum well developed, usually with only 2 lateral setae. Scutum entirely shining black, scutal stripes hardly distinguishable. Acrostichals rather weak, about 12. Dorsocentrals well developed, 15-18 on each side, about 60 microns long, and each arising from white hole about 30 microns in diameter (a characteristic distinct from *Cricotopus*); 3-4 supra-alars on each side. Scutellum with 12-14 uniserial bristles.

Wing membrane bare, slightly purplish by transmitted light. Squama with about 12 bristles. Anal lobe well developed. Wing venation as in Fig. 52 C and Table 1; R 2+3 about midway between R 1 and R 4+5; Costa slightly produced beyond R 4+5; fCu slightly beyond r-m; M ending almost at tip of wing, and conspicuously beyond tip of R 4+5; Cu 2 almost straight.

Relative length of leg segments as in Table 2 o. LR 0.56-0.62 (0.59 in average of 7). All tibiae longer than femora, especially in front legs. Terminal spurs, one on front leg (60 microns, Fig. 53 C), two on middle tibia (22 and 20 microns, Fig. 53 D), and two on hind tibia (58 and 21 microns, Fig. 53 E). Hind tibia with terminal comb composed of 13-15 spines 29-53 microns long. Empodium well developed, pulvilli absent.

Bristles on abdominal tergites fairly evently distributed, as in Fig. 52 D. Hypopygium (Figs. 53 G, H) without anal point. Ninth tergite with about 10 short bristles 17-22 microns. Basal lobe of gonocoxite (Fig. 53 I) roughly conical, bears about 10 hairs 9-14 microns long, but devoid of microtrichiae except for basal portion. Inner margin of gonocoxite roughly Y shaped (Fig. 53 H). Gonostylus with conspicuous terminal spur, and conical subterminal expansion.

Female. Body length 2.42-3.21 mm (2.95 mm in average of 10) in alcohol preserved specimens. Wing length 2.16-2.74 mm (2.42 mm in average of 10). Coloration as in male body, almost entirely shining black, excepting halteres, being largely yellow.

Antenna (Fig. 52 B) 7 segmented (58, 48, 41, 41, 43, 48, 111 microns) with subapical bristle 70 microns long. Palp (Fig. 52 A) 4 segmented (36, 116, 145, 207 microns). Eyes highly pubescent, reniform, slightly produced dorsocentrally, distance between eyes (0.20 mm) being 0.85 times height of eye (0.23 mm). Anal lobe of wing less produced than in male, otherwise wing venation as in male (Fig. 52 C, Table 1 o). Legs generally darker than in male. LR 0.55-0.60 (0.57 in average of 7). There are one terminal spur on front tibia (51 microns, Fig. 52 E), two on middle tibia (29 and 27 microns, Fig. 52 F) and two on hind tibia (82 and 29 microns, Fig. 52 H). Terminal comb of hind tibia composed of 12-14 spines 34-58 microns long (Fig. 52 G). Cerci and spermathecae as in Figs. 52 J,K.

Pupa. Body length 3.58-4.42 mm (4.04 mm in average of 10) in alcohol preserved

exuviae. Thoracic respiratory organ horn-like, 176-248 microns long (average 194 microns) and 24-36 microns wide (31 microns in average of 7), with 35-47 spines sparsely distributed on surface, as in Fig. 54 A. Distribution of spines and spinules on abdominal segments as follows (Fig. 54 B): Tergite I and sternite I without spines and spinules. Tergite II with narrow band of spinules at about ¼ level from caudal margin, and band of strong, recurved spines along caudal margin in double or triple rows; sternite II with spinulous area in middle. Tergites III to VI each with two completely separated spinose areas, proximal one being approximately in the middle and caudal one being along caudal margin of segment; in addition, tergite VI has proximal spinulous zone. Tergite VII with two spinulous zones. Tergite VIII with one spinulous zone along proximal margin. Spinulous zones are also on sternites II to VIII. In addition, sternites IV, V and VI each has pair of whirl-like spinose areas near caudolateral corners. 3 pairs of lateral hairs on segments II to VI, 4 pairs on segment VII, and 5 pairs on segment VIII; none are modified into flat swimming hairs, though those on segment VIII are longer and stouter than the others. Anal segment (Fig. 54 E) with three pairs of strong and curved caudal bristles of subequal length, measuring 166-178 microns (average 172 microns in 10 specimens). Male genital sheaths longer than anal segment.

Larva. Body length 5.0-5.9 mm (mean 5.43, 10 mature larvae in alcohol). Color in life creamy yellow. Antenna (Fig. 55 C) 80-84 microns long, and about 0.55 times length of mandible, 5 segmented (51, 15, 8, 6, 4 microns), segment I 1.50-1.68 times combined length of segments II to V, blade 0.86-1.00 times combined length of segments II to V. Lauterborn's organ moderately developed. Ring organ about 1/6 from base of antennal segment I. Labial plate (Fig. 55 A) with 13 teeth; central tooth widest and about 1.4 times width of first lateral pair which are slightly wider than remaining pairs and with rounded margin. Mandible (Fig. 55 D) with 4 cutting teeth, outer margin slightly crenulated. Labrum, premandible and maxilla as in Figs. 55 B, E. Pecten epipharyngis composed of three subequal spines. Claws on anterior pseudopods, and those on posterior pseudopods, are as in Figs. 55 G, H. Structure of anal segments as in Fig. 55 J. Bases of preanal hair tuft (Fig. 55 H) about 27 microns wide and 22 microns high, chitinized and pigmented along inner margin, bear 6 long hairs and two shorter hairs measuring about 60 microns and 50 microns respectively.

Discussion. This species was found breeding abundantly in small artificial streams constructed in a wood of NIES, Tsukuba. The species is tentatively diagnosed here as *Paratrichocladius rufiventris* (Meigen), a chironomid species found commonly in Europe, because the morphological characteristics of adults, pupae and larvae are not essentially different from those described by previous authors. It is evident that the present species belongs to the genus *Paratrichocladius* Santos Abreu in the present sense (Pinder, 1978), as its wing membrane is bare, the pronotum is normally developed and bare dorsally, the gonostylus is simple, the squama of the wing is fringed with hairs, the eyes are pubescent, but the dorsocentral setae are well developed and arise from distinct large holes (this characteristic is important to differentiate this genus from *Cricotopus*). Among the few species known for this genus, the present one is similar to *rufiventris* in the structure of the male genitalia, especially in the absence of the anal point and the shape of the inner lobe of the gonocoxite. In the pupa, the presence of two separated spinose areas on the abdominal tergites III to VI is a characteristic of this species. The structures of larva, including that of the labial plate, also coincide with those reported for this species by previous authors (Hirvenoja, 1973, p. 88).

(16) *Cricotopus (Cricotopus) bicinctus* (Meigen, 1818) Figs. 56-59.

This species was recorded by Tokunaga (1936) with adult male and female collected at several localities in Kyoto Prefecture. The materials studied were collected by Mr. H. Suzuki and the author as larvae from the Urakami River, Nagasaki City, and from a sewage ditch in Ureshino, Nagasaki Prefecture, on 2 November 1978; pupae and adults were reared from the larvae in the labroratory. Wild adults were collected also at the same localities by sweeping the nearby bushes. Specimens examined were 10 males, 4 females, 10 pupal exuviae, 5 larval exuviae and 10 larvae mounted in gum-chloral (Box No. A 32), and 7 males and 5 females preserved dry (Box No. B 1).

Male. Body length 3.0-3.7 mm (3.27 mm in average of 5). Wing length 1.9-2.2 mm (2.05 mm in average of 10). Body coloration characteristic of this species, i.e. abdominal segments I, IV and hypopygium as well as basal portion of femora and middle portion of tibiae of all legs yellow, while remaining body parts mostly shining black or dark brown.

Antenna 14 segmented, AR 1.3-1.5 (1.45 in average of 6), tip not expanded and with about 10 sensory setae (Fig. 57 B). Palp 4 segmented (51, 87, 108, 200 microns). Eyes highly pubescent, slightly projected dorsomedially, distance between two eyes (0.25 mm) nearly equal to height of eyes.

Thorax as in Fig. 57 A. Pronotum moderately developed, with one lateral seta on each side. Scutum almost entirely shining black; acrostichal setae about 20, well developed, 16-20 microns long; dorsocentrals also about 20 on each side, highly reduced, 12-18 microns long, their bases small and inconspicuous (not large and white as in other genera of Orthocladiinae); supra-alar setae 3 on each side. Scutellum black, with about 12 uniserial setae. Postnotum black. Halteres yellow.

Wing without macrotrichiae, slightly brown by transmitted light, venation as in Fig. 56 A and Table 1 p. Squama fringed with about 7 hairs. Anal lobe moderately produced. Costa extending slightly beyond tip of R 4+5. R 2+3 ending about midway between tips of R 1 and R 4+5; fCu slightly beyond r-m. Tip of Cu 1 slightly proximal to tip of R 4+5. Cu 2 almost straight. An reaching far beyond fCu.

Leg coloration peculiar to this species; basal 2/3 of front and middle femur, basal ¾ of hind femur, and middle 4/5 of all tibiae yellow, while knee joint and distal portion of tibiae dark brown. Front tarsi almost uniformly brown, but middle tarsi I to III as well as hind tarsi I and II paler than distal tarsal segments. Tibia is longer than femur in all legs, ratio (tibia/femur) being 1.25 in front, 1.05 in middle, and 1.23 in hind legs. Ratio of tarsus I to tibia is 0.60 in front, 0.49 in middle, and 0.55 in hind leg. One terminal spur on front tibia (58 microns, Fig. 56 B), two on middle tibia (26 microns and 22 microns, Fig. 56 C), and two on hind tibia (67 microns and 26 microns). Hind tibia has terminal comb composed of some 15 closely set spines in addition to two terminal spurs (Fig. 56 D). Empodium well developed, pulvilli absent (Fig. 56 E).

Abdominal tergites I, IV and hypopygium yellow, while tergites II, III, V-IX black. Hairs on abdominal tergites as in Fig. 57 C; tergites II, III and IV with 4-5 hairs along midline, and about 10 hairs on both sides along lateral and caudal margins.

Hypopygium as in Figs. 56 F, G, H. Anal point absent. Gonocoxite with conspicuous thumb-like inner lobe directed backwards, and carrying more than 10 setae. Inner margin of gonocoxite basally rounded or U-shaped (Fig. 56 H). Gonostylus simple, apically rounded, and bearing stout apical spur.

Female. Body length 1.95-2.28 mm (2.15 mm in average of 5). Wing length 1.67-2.05

mm (1.85 mm in average of 10). Body shorter and stouter than in male. Coloration as in male, i.e. abdominal tergites I, and genitalia IV as well as middle portion of all tibiae yellow, and other parts almost entirely dark brown. Antenna 6 segmented (51, 77, 36, 38, 41, 96 microns), with one subterminal seta 30 microns long (Fig. 57 D). Palp 4 segmented (41, 63, 87, 140 microns, Fig. 57 E). Eyes rather small, widely separated, and highly pubescent.

Wing venation as in Fig. 56 A and Table 1 p. Relative length of leg segments as in Table 2 p. All femora shorter than tibiae of same legs (ratio: tibia/femur is 1.18 in the front, 1.03 in the middle, and 1.23 in the hind leg). One terminal spur on front tibia, two on middle tibia, and two on hind tibia. Cerci and spermathecae as in Figs. 57 F, G.

Pupa. Thoracic respiratory organs (Fig. 58 F) tube-like, tapering towards sharply pointed apex, with few spinules on apical half, length varying from 65 to 137 microns (102 microns in average of 10). Distribution of spines and spinules on abdominal segments as in Fig. 58 A. Segment I without spines and spinules. Segment II with two serial rows of large dark and recurved spines (about 30 microns long, Fig. 58 B) on intersegmental membrane, tergite II without spines and spinules, sternite II with basal spinulous area (Fig. 58 C). Tergite III with middle and distal spinose areas, and double or triple rows of small spines on intersegmental membrane; sternite III with a basal spinulous area. Middle and distal spinose areas on tergites IV, V and VI partially fused. Spine rows also present on intersegmental membrane along caudal margins of tergites IV and V, but absent on more distal abdominal segments. Sternites IV, V and VI bear pair of lateral spinose areas, which form whirl-like patterns on caudolateral margins (Fig. 58 C). Sternites VII to IX as well as sternite VII have basal spinulous area. Lateral hairs on abdominal segments all simple and not long and flat swimming hairs, but proximal two pairs on segment VIII slightly expanded (Fig. 58 E).

The caudal segment (Figs. 58 D, E) is composed of pair of genital sheaths, being conspicuously longer in male than in female, and pair of anal lobes bearing 3 stout and rigid apical bristles of similar length (about 150 microns). No specialized spine, and no fringe of swimming hairs on anal lobe.

Larva. Color in life milky white to pale yellow, excepting head and claws on anterior and posterior pseudopods, which are brown. Body length 3.9-5.4 mm (4.69 mm in average of 8) in gum-chloral mounted specimens. Antenna (Fig. 59 C) 5 segmented, basal segment 1.85-2.13 times combined length of segments II to V (1.96 times in average of 8); ring organ at about 1/5 from base of segment I; antennal blade 0.8 times combined length of segments II to V; Lauterborn's organ moderately developed. Labial plate with 14 teeth (Fig. 59 A); middle 5 teeth paler in color than the more lateral 4 pairs; central tooth being widest, more than twice as wide as first pair, with rounded anterior margin. Mandible (Fig. 59 D) with 5 cutting teeth, and mandibular brush composed of 5 simple branches; outer margin of mandible crenulated at about middle, and inner margin has row of about 5 saw-like teeth (key characteristics for identification of this species). Labrum, epipharynx and premandibles as in Fig. 59 E; pecten epipharyngis consists of three similar spines (key characteristic for subgenus *Cricotopus*).

Anterior pseudopods with highly serrated claws. Abdominal segments without specialized hairs. Preanal hair tuft composed of 6 long hairs, their base being wider than length, pigmented only along inner margin, and bearing two short hairs of about 65 microns and 30 microns. Anal gills about as long as posterior pseudopods.

Discussion. Adults, pupae and larvae of this species agree well in their morphology

with the descriptions of *Cricotopus bicinctus* (Meigen) which appear in Edwards (1929, p. 321), Tokunaga (1936, p. 16), Goetghebuer (1940, p. 168), Hirvenoja (1973, p. 235) and Pinder (1978, p. 60). The adults can be differentiated from the related species by the characteristic coloration of the abdominal segments and legs, by the chaetotaxy of abdominal tergites, and by the structure of the male hypopygium, especially in the shape of the inner lobe of the gonocoxite. In the pupa, the shape of the thoracic respiratory organs, the swimming paddles and the distribution of spines and spinules on abdominal segment are characteristic of this species. The larva may be differentiated by the shape of the antenna, by the presence of serration on the inner margin and crenulation on the outer margin of the mandible, and by the strucutre of the labial plate.

This species is apparently widely distributed in the Palaearctic region and recorded also from several localities in Kyoto by Tokunaga (1936). Larvae have been collected by the present author from rather polluted rivers and ditches in Nagasaki, Shizuoka and Tokyo, and the species seems to be common also to other parts of Japan.

(17) *Cricotopus (Isocladius) sylvestris* (Fabricius, 1794) Figs. 60-63.

Large numbers of adults were collected in the spring and summer in 1976 and 1978 on the shore of Lake Kasumigaura, while swarming in the air or resting on nearby grass. Larvae and pupae were also found attached to water plants in the lake, such as *Trapa japonica, Nelumbo nucifera,* and *Egeria densa.* Remarkable differences were observed in body coloration between adults reared in cold rooms (dark form) and those reared under warmer conditions (light form). Adults caught in the fields during May and June were the light form.

Materials studied. Adults caught near the shore of Lake Kasumigaura, Ibaraki Prefecture, 18 May 1976 and 9 June 1978. Adults reared from larvae collected from the lake on 9 June 1978. Pupae, larvae and their exuviae, same data. Gum-chloral mounted specimens in Box A 5, adults pinned on card in Box B 10; in addition, large numbers of specimens of all stages preserved in alcohol.

Male. Small species with body length of 2.89-3.42 mm (3.11 mm in average of 10) and wing length of 1.79-2.13 mm (1.93 mm in average of 8). Body coloration variable according to temperature. In light form (summer form, Fig. 61 A), scutal ground color yellow and scutal stripes dark brown. Scutellum yellow. Postnotum dark brown. Halteres yellow, abdominal tergites I, IV, V and VIII entirely or largely yellow, tergites II, III, VI and VII entirely or largely dark brown. Hypopygium white. In legs, coxa, trochanter, proximal 4/5 of all femora, middle ¾ of tarsi III of middle and hind legs yellow, while remaining parts largely brown. In the dark form, body almost exclusively black or dark brown, except for halteres and hypopygium which are yellow, and basal parts of abdominal tergites I and IV as well as middle ¾ of tibiae which are slightly paler than other tergites or leg segments. These two forms were recovered from same lots of larvae collected from the lake in June, former by rearing at 25 C or higher and latter at 10 C or 15 C.

Antenna 14 segmented, AR 1.38-1.52 (1.45 in average of 10); apex (Fig. 61 F) not swollen and tapering, with about 10 sensory setae. Palp 4 segmented (46, 80, 94, 152 microns). Eyes reniform, highly pubescent, distance between eyes being almost same as height of eye (0.24 mm).

Thorax as in Fig. 60 C. Pronotum well developed, with several lateral bristles.

Acrostichal setae about 10, all short and decumbent, about 12 microns long. Dorsocentral setae also minute and decumbent, their bases being small and inconspicuous. Scutellum usually with 8 setae in single row.

Wing membrane bare, slightly brown by transmitted light. Wing venation as in Fig. 60 A and Table 1 q. Squama fringed, anal lobe moderately produced. R 2+3 ending about midway between tips of R 1 and R 4+5. Costa not produced beyond end of R 4+5. Tip of Cu 1 proximal to tip of R 4+5; fCu distal to r-m. Cu 2 almost straight.

Relative length of leg segments as in Table 2 q, coloration in light form as in Fig. 60 B. All tibiae with long white ring occupying about 4/5 of segment. Tibia longer than femur of same legs. One terminal spur on front tibia (50 microns), two on middle tibia (20 and 18 microns), two on hind tibia (53 and 20 microns); in addition, hind tibia bears terminal comb. Hairs on front tarsus I relatively short, about 50 microns and only 1.8 times diameter of segment. Pulvilli well developed on all legs (Fig. 60).

Hypopygium (Fig. 61 G) without anal point; ninth tergite with pair of crescent-shaped lobes, highly setigerous. Inner margin of gonocoxite humped at base (Fig. 61 H). Inner lobe of gonocoxite simple, short and with rather pointed apex, bearing about 10 setae. Gonostylus expanded distally, with truncate apex, terminal spine stout (Fig. 61 G).

Female. Body length 2.42-2.89 mm (2.64 mm in average of 12), wing length 1.76-2.29 mm (2.02 mm in average of 8). Abdomen much stouter and shorter than in male. Coloration similar in male, both light and dark forms developed from same lot according to temperature of the culture rooms.

Antenna 6 segmented (51, 80, 43, 36, 39, 96 microns, Fig. 61 C), second segment with double row of long brisltes. Palp 4 segmented (41, 58, 60, 104 microns, Fig. 61 B). Eyes reniform, widely separated, and highly pubescent. Chaetotaxy of thorax, legs and abdomen as in male. Length of spermathecae (Fig. 61 E) slightly greater than width. Cerci (Fig. 61 D) 123 microns wide and 72 microns long.

Pupa. Body length 3.7-4.1 mm (3.85 mm in average of 10) in male pupal exuviae, and 3.3-3.8 mm (3.54 mm in average of 10) in female pupal exuviae. Thoracic respiratory organ (Fig. 62 E) simple, tube-like and without spinules, 193-265 microns long (224 microns long in average of 10) and 19-34 microns in diameter (26.0 microns in average of 10), about 1.5 times length of same organ of *C. yatabensis*, and 2.2 times of that of *C. bicinctus*.

Distribution of spines, spinules and hairs on abdominal segments as in Fig. 63 A. Tergite I with small spinulous area (unusual characteristic). Tergites II to VI each with large spinulous-spinose area occupying nearly entire surface. In addition, intersegmental membrane of tergites II to V bears band of recurved spines, among which those on II are about 30 microns long and much larger than those on subsequent segments. Tergites VII, VIII and IX with basal spinulous area, but devoid of spines. Spinulous areas also on abdominal sternites II to VIII, among which those on sternites IV to VII are divided into proximal and distal groups and form a whirl-like distribution near the caudo-lateral corners (Fig. 62 C). Abdominal segments II to VII bear 3 pairs of simple lateral hairs, among which middle one is longer than first and third hairs. Segment VIII has 4 pairs of short lateral hairs. It should be noted that none of lateral hairs is transformed into long and flat swimming hairs as seen in most other members of Orthocladiinae.

The caudal segment is composed of pair of genital sheaths, and pair of small, triangular anal lobes, which bear 3 terminal bristles, of which innermost one is usually longer than outer two (152, 117 and 113 microns in one of the specimens).

Larva. Body length 4.5-5.2 mm (4.84 mm in average of 10 alcohol preserved

specimens). Color in life creamy white.

Antenna short (total length 82 microns), about ½ length of mandible, 5 segmented (51, 12, 9, 5, 5 microns, Fig. 63 D), first segment 1.6 times combined length of segments II to V; antennal blade 21 microns long and 0.77 times combined length of segments II to V; Lauterborn's organ of moderate size; distance between ring organ and base being 1/3 of total length of segment I. Labial plate (Fig. 63 B) with 11 teeth, all teeth almost uniformly dark brown; central tooth rather narrow and sharply pointed, the first pair broader than rest and with notch on lateral side. Mandible (Fig. 63 E) with 5 cutting teeth, outer margin conspicuously crenulated. Labrum, epipharynx and premandible as in Fig. 63 A; Pecten epipharyngis flat and triangular plate-shaped, with notch on each side (characteristic of *Isocladius*). Abdominal segments I to VI with pair of hair pencils arising from common bases located near the caudolateral corners of segment, each composed of 408 long and slender hairs. Anal segments as in Fig. 63 G. Preanal hair tuft composed of 5 or 6 long hairs and two short hairs arising from small semiglobular base (Fig. 63 H). Anal gills much shorter than posterior pseudopods.

Discussion. The present species breeding vigorously in the shallow water vegetation of Lake Kasumigaura is diagnosed here as *C. sylvestris*, since the morphological characteristics of the adults, pupae and larvae agree well with those described by previous authors for materaials collected in Europe. Tokunaga (1936) recorded 16 species of *Cricotopus* from Japan proper, Taiwan and Karahuto, but states "This is widely distributed species in the northern Hemisphere and has been recorded by J.J. Kieffer, from Formosa but I have not met the species yet." In the adult male, the characteristics are that the inner margin of the gonocoxite has a hump at the base (subgenus *Isocladius*), with a broad pale band on all tibiae, also the abdominal tergites I and IV are yellow, without tarsal beards, and with small pulvilli on all legs; the setae on the abdominal tergites II, III and IV are highly reduced in number, and the gonocoxite lobe is narrow and conical.

In the pupa, this species has a pair of relatively long thoracic respiratory organs which bear no spinules, is devoid of swimming hairs on the abdominal segments and swimming paddles, and has three short and stout terminal setae on the swimming paddle, which also agree with the pupae of *C. sylvestris* described in detail by Hirvenoja (1973).

In the larva, this species has a peculiar labial plate, with a conspicuous crenulation on the mandible, and hair pencils on intermediate abdominal segments, all of which are characteristics which differentiate *C. sylvestris* and allied species from other *Cricotopus* species.

(18) *Cricotopus (Isocladius) yatabensis*, sp. nov. Figs. 64-67.

This species was found abundantly breeding in concrete pools and shallow concrete ditches constructed in NIES, almost throughout the year except for mid-summer. Adults were found swarming near the breeding places, or resting on the concrete walls of the pools and ditches.

Materials studied. Holotype: male, reared in laboratory from larva collected on 2 December 1978, and mounted in balsam. Paratypes: 10 males and 10 females, same data, preserved dry. 12 males and 14 females pinned on card as well as 18 males, 10 females, 15 pupal exuviae and 16 larvae mounted in gum-chloral were also examined in morphological studies.

Male. Relatively small species with body length of 2.6-3.3 mm (3.02 mm in average of

10) and wing length of 1.47-1.95 mm (1.76 mm in average of 10). Body coloration almost entirely shining black, except for posterior margin of abdominal tergite I and posterior 4/5 of abdominal tergite IV, being dark brown, and hypopygium and halteres, being pale yellow.

Antenna 14 segmented, AR 0.94-1.18 (1.05 in average of 10); tip of antenna as in Fig. 64 B. Palp 4 segmented (51, 72, 94, 140 microns). Eyes pubescent (covered thickly with minute hairs).

Distribution of hairs on thorax and abdominal tergites I-IV as in Fig. 65 A. Pronotum moderately developed, with two lateral setae on each side. Scutum shining black, scutal stripes hardly discernible. Acrostichal setae about 15, all short and decumbent. Dorsocentral setae 18-30 on each side, all relatively short (about 40 microns long), arising from small holes. Scutellum also shining black, with 22-30 hairs irregularly distributed. Postnotum black. Halteres yellow.

Wing membrane slightly brown, devoid of macrotrichiae. Squama fringed. Anal lobe rather flat. Wing venation as in Fig. 64 A and Table 1 r. R 2+3 widely separated both from R 1 and R 4+5, ending on costa closer to end of R 4+5 than to that of R 1. Costa produced beyond end of R 4+5; fCu well beyond r-m. Cu 2 almost straight except for near end. An extending far beyond fCu.

Legs almost uniformly black, without pale bands such as seen in most other *Cricotopus* species. Relative length of leg segments as in Table 2 r. Front tibia unusually long, and thus LR of front leg (0.54) small and almost same as LR of hind leg (0.55). Hairs on front tarsus I only about 2.1 times diameter of segment. One terminal spur on front tibia (48 microns, Fig. 64 C), two on middle tibia (25 and 22 microns, Fig. 64 D), two on hind tibia (55 and 19 microns, Fig. 64 E), but none on tarsal segments. Hind tibia with terminal comb spines (Fig. 64 E). All legs with pair of claws, apically forked, pair of small pulvilli at base of claws, and one long empodium (Fig. 64 F).

Abdominal tergites mostly shining black, with exception of caudal part of tergite I and caudal 4/5 of tergite II, which are slightly paler. Abdominal tergites with numerous hairs scattered almost all over, and chaetotaxy not specially reduced as in most other *Cricotopus* species (Fig. 65 A). Hypopygium white (a distinguishing characteristic of this species from other black Orthocladinae-species). Anal point absent, but there is pair of crescent-shaped lobes bearing numerous stout hairs at caudal end of ninth tergite (Figs. 64 G, H). Inner margin of gonocoxite forms a hump (Fig. 64 I). Gonocoxite has inner lobe, simple and finger-like, bearing several hairs but devoid of microtrichiae (Fig. 65 H). Gonostylus simple, apically expanded and bearing stout terminal spine (Fig. 65 H).

Female. Small species with body length of 2.5-2.8 mm (2.66 mm in average of 7) and wing length of 1.26-1.79 mm (1.50 mm in average of 7). Body coloration as in male, almost entirely black, with exception of halteres (yellow) and cerci (white).

Antenna 6 segmented (51, 72, 43, 41, 43, 92 microns, Fig. 65 B). Palp 4 segmented 48, 77, 96, 157 microns, Fig. 65 C). Eyes highly pubescent.

Scutum with black stripes on dark brown ground color. Scutellum dark brown. Postnotum black. Halteres yellow. Wing membrane slightly brown by transmitted light. Venation as in Fig. 64 A and Table 1 r; fCu far beyond r-m;

Legs entirely black. Relative length of leg segments as in Table 2 r. Front leg ratio 0.51, smallest among species examined. All legs with pair of simple claws, pair of small pulvilli, and one long empodium on tip of tarsus V (Fig. 65 G). Distribution of terminal spurs as in male (one on front and hind tibia, two on middle tibia, but none on tarsi, Figs. 65 D, E, F). Hind tibia bears terminal comb spines.

Abdominal tergites largely shining black, except for tergite IV, which may be slightly paler, and hypopygium which is white. Length of spermathecae greater than width, without distinct neck, Fig. 65 H. Cerci short and broad, Fig. 65 I.

Pupa. Body length 2.4-3.3 mm (2.78 mm in average of 10 pupal exuviae). Thoracic respiratory organ (Fig. 66 D) 129-168 microns long (148 microns in average of 10), horn-like and apically tapering to sharp tip, with small and fine spinules sparsely distributed on surface.

Spines and spinules on abdominal segments as in Figs. 66 A, B, C. Tergite II with double or triple rows of large recurved spines (about 25 microns long) along caudal margin, and pair of small spinulous area near lateral margins. Tergites III to VI with middle spinose area, caudal band of seveal rows of small spines, band of several rows of small recurved spines on intersegmental membrane, and pair of lateral spinulous area. Tergites VII, VIII and IX without spines but each with middle spinulous area. Sternites III to VIII also have spinulous area, as shown in Fig. 66 A. In addition, sternites IV to VI bear numerous short and fine spines (about 8 microns long) along caudal margins, which form whirl-like pattern in caudolateral corners.

Anal segments (Figs. 66 E, F) composed of pair of genital sheaths, and pair of relatively small, triangular anal lobes bearing 3 short but stout caudal bristles of subequal length (about 130 microns long).

Larva. Body length 3.4-4.1 mm, color yellow. Antenna (Fig. 67 B) short, only about 63 microns in length and 1/2.2 length of mandible; 5 segmented (36, 11, 7, 6, 5 microns), first segment 1.2 times combined length of segments II to V; ring organ situated close to the base of first segment; antennal blade 24 microns long and slightly shorter than combined length of antennal segments II to V. Mandible 135 microns long and 123 microns wide; with 5 cutting teeth, of which most apical tooth is longer and narrower than remaining teeth; outer margin of mandible conspicuously corrugated (Fig. 67 A). Labial plate rather sharply angulated in middle, with 11 teeth almost evenly pigmented; central tooth narrow and sharply pointed; first lateral pair has notch on lateral margin (Fig. 67 C). Labrum as in Fig. 67 D. Epipharynx and premandible as in Fig. 67 E; pecten epipharyngis (pes) fused into triangular plate, representing a form of *Isocladius*.

Abdominal segments I to VII bear pair of hair pencils on caudolateral corners of either side, and composed of about 10 long hairs in the case of first two abdominal segments, or of some 20 or more similar hairs in subsequent segments. Abdominal segment VIII bears pair of preanal hair tufts composed of 6 long hairs and two short hairs arising from semi-globular base.

Anal segments as in Fig. 67 J. Anal gills leaf-shaped, upper pair being 116 microns long and lower pair about 157 microns. Posterior pseudopods bear 16 claws of normal shape (Fig. 67 I). Base of preanal hair tuft as in Fig. 67 H.

Discussion. This species was one of the most common chironomids found breeding in concrete pools and ditches constructed in NIES. It is clearly a member of the genus *Cricotopus*, as the eyes of the adults are pubescent, the dorsocentral setae of the scutum are short and the punctures from which they arise are very small. Also the squama is fringed with hairs, and the hypopygium is white. It belongs to the group C by classification of Edwards (1929), as the tibiae are of one color. In the classification proposed by Hirvenoja (1973), this species falls in the *reversus*-group of subgenus *Isocladium*, in view of the chaetotaxy of the abdominal tergites and in the shape of pes of larva. Among two species of this group known from Europe, the present one is closer to *perniger* (Zetterstedt, 1850) than to *reversus* Hirvenoja, 1973, due to the absence of ves-hairs, and

in the shape of the female spermathecae, which are not globular but elongated. However, this new species differs distinctly from *perniger*, which was described from Sweden, in the body coloration, in the structure of the hypopygium, in the length of the abdominal segments, in the antennal ratio (around 1.0 in this species), and the size of the thoracic respiratory organ (this species is longer). Among the *Cricotopus* species recorded from Japan by Tokunaga (1936), this species is closest to *yoshimurai* described for males collected in Kyushu, but this new species is larger in body size, (1.7-2 mm in *yoshimurai*), darker in body coloration, larger in AR (0.67-0.7 in *yoshimurai*), and bears fewer and longer hairs on the inner lobe of the gonocoxite.

(19) ***Thienemanniella majuscula*** **(Edwards, 1924)** Figs. 68-71.

Larvae and pupae of this species were collected from bottom sediments of an outdoor artificial stream constructed in a wood outside of our laboratory during January and February 1979, together with those of *Paratrichocladius rufiventris* and *Cricotopus yatabensis*. Adults were also found resting on walls of the ditch.

Specimens studied. 7 males and 6 females, collected from wall of the artificial ditch on 3 February 1979, and mounted in gum-chloral (Specimen No. A 34-51 to 57 and 61 to 66); 5 pupal exuviae collected in the laboratory after emergence of adults, and mounted in gum-chloral (No. 34-71 to 75); 4 larvae dissected and mounted in gum-chloral (No. 34-81 to 84); 3 males and 3 females, pinned on card (in box B 20). Additional speciemens of adults preserved either dry or in 70% alcohol, as well as those of pupae, larvae and their exuviae preserved in alcohol, were also available for this study.

Male. Very small midge with body length of 1.68-1.92 mm (1.82 mm, in average of 7, mounted in gum-chloral), and wing length of 1.26-1.47 mm (1.38 mm in average of 9). Body coloration characterized by sharply defined contrasting colors of dark brown and pale yellow; eyes and antennal shaft dark brown; ground color of scutum yellow, central and lateral scutal stripes black; scutellum and postnotum dark brown; abdominal tergites I, II and III largely yellow, IV to IX dark brown; halteres yellow; legs almost uniformly brown.

Head as in Fig. 68 A. Antenna 13 segmented (including pedicel), all segments are sharply separated (in the related species of *lutea* Edw. and *vittata* Edw., segments XI and XII are indistinctly separated). AR 0.66-0.74 (0.71+4.3 in average of 7), and last segment being about as long as combined length of segments V to XII, slightly swollen apically, and bear more than 20 short hairs in apical region (Fig. 68 B). Palp 4 segmented (24, 41, 75, 147 microns), first segment very short, last segment being 1.05 times combined length of segments I to III. Vertical setae two pairs, supraorbatal setae absent. Eyes highly pubescent, reniform, widely separated and without dorsomedian projection; distance between two eyes (0.27 mm) 1.4 times height of eye.

Thorax as in Fig. 69 E. Pronotum reduced towards the middle, with 2 or 3 very short lateral hairs on each side. Scutum without acrostichals, with 8-11 dorsocentral setae about 63 microns long, each arising from a large pale hole, and with 3-4 supra-alar setae on each side. Scutellum with only 2-4 setae, also arising from large pale holes.

Wing membrane bare; squama bare; anal lobe flat. Wing venation as in Fig. 69 D and Table 1 s. R 1 and R 4+5 entirely fused and thickened, forming clavus which ends on costa at about 2/5 length of wing. A false vein extends from r-m along anterior margin of wing to near apex. M almost straight; fCu far beyond r-m.

Relative length of leg segments as in Table 2 s. Hind tibia cylindrical and not expanded apically to form apical projection like in species of related genus *Corynoneura*. Tarsi IV of all legs cordiform, shorter than tarsi V of same legs. Hairs on legs short and sparse, those on front tarsus I only about 43 microns long and 1.5 times diameter of segment. One apical spur on front tibia (31 microns long, Fig. 68 C), two on middle tibia (14 and 12 microns long, Fig. 68 D), and two on hind tibia (31 and 22 microns long, Fig. 68 F). Hind tibia also bears terminal comb composed of about 12 spines (29-36 microns long, Fig. 68 E). Tips of tarsi V bear two apically pointed claws, small empodium, but pulvilli are absent.

Numbers of hairs on abdominal tergites highly reduced in this species, only several on each segment, as in Fig. 69 E. Hypopygium as in Figs. 68 K, L, M. Anal point lacking. Gonocoxite with broad and roughly rectangular inner lobe, bearing more than 10 bristles and many microtrichiae. Gonostylus simple, with large terminal spine.

Female. Small midge with body length of 1.8-3.0 mm (2.08 mm in average of 8), and wing length of 1.29-1.42 mm (1.33 mm in average of 10). Ground color of body yellow, antennal shaft, eyes, scutal stripes, postnotum and large parts of abdominal tergites brown.

Frontal view of head as in Fig. 69 C. Antenna 6 segmented (36, 43, 34, 36, 41, 70 microns), last segment elongated and egg-shaped, 0.45 times combined length of segments II to V (Fig. 69 A). Palp 4 segmented (21, 43, 65, 125 microns). Eyes pubescent (Fig. 69 B), reniform, without dorsomedian projection, distance between two eyes (204 microns) being 1.3 times height of eye.

Pronotum with 2 or 3 lateral setae. Scutum without acrotrichals, with 8-10 dorsocentrals each side, all arising from large, pale hole. Postnotum with only 2 setae. Wing venation as in Fig. 69 D. R 1 and R 4+5 entirely fused and thickened, and extends to about 60 % of wing length (40% longer than male). Relative length of leg segments as in Table 2 s. Tarsus IV shorter than tarsus V in all legs. Pulvilli absent.

Hairs on abdominal tergites highly reduced, only 2-4 on each segment. Spermathecae and cercus as in Figs. 69 F, G.

Pupa. Body length 2.07-2.45 mm (2.25+0.12 mm in measurements of 10 pupal exuviae). Thorax, lateral sides of abdominal segments I-VII, as well as large portion of segments VIII and IX of pupal exuviae brown in color (a characteristic of pupa of genus *Thienemanniella*). Thoracic respiratory organ absent. Distribution of spines, spinules and hairs on abdominal tergites as in Figs. 70 A, B. Segment I without spines and spinules. Tergite II with row of small spines along caudal margin. Tergite III to VI each with central spinulous area, and row of small spines along caudal margin. Tergites VII, VIII and IX with central spinulous area but without band of spines. Sternites II to VIII each with spinulous area in center, but without whirl-like lateral spinose areas seen in most other orthocladine pupae. Segment I with pair of long and flat lateral swimming hairs (unusual characteristic for chironomid pupa). Segment II with 3 pairs of lateral hairs, among which middle one is long and flat, with first and third pairs being short and simple. Segments III to VIII each with 4 pairs of lateral hairs, all modified to long and flat swimming hairs (numbers of lateral hairs in most other groups of chironomid pupae are none in segment I, 3 pairs on segments II to VI, 4 pairs in segment VII, and 5 pairs in segment VIII). Anal lobes of terminal segment well developed like swimming paddles, and each bear 3 long (about 0.35 mm) and stout hairs from about middle of lateral margin, one flat and short hair (about 0.04 mm long) from inner margin, and a fringe of about 40 swimming hairs along lateral and caudal margins (Figs. 70 C, D).

Larva. Body 2.3-3.2 mm in gum-chloral mounted specimens, color in life creamy white except head and claws on pseudopods, which are brown. Head long and narrow, about 0.33 mm long and 0.20 mm wide. Antenna very long, 154-174 microns (163+7 microns in measurements of 10) and about 2.2 times length of mandible; 5 segmented (101, 31, 24, 5, 4 microns), first segment 1.5 times combined length of segments II to V; segment II dark brown, other segments yellow (key characteristic of this genus), segment I slightly curved; distance from base to ring organ roughly 1/3 length of segment; with short seta located at about 4/5 segment length from base; antennal blade about as long as segment II; Lauterborn's organ inconspicuous. Labial plate (Fig. 71 D) almost evenly dark brown, with 6 pairs of teeth, central pair being widest. Mandible (Fig. 71 E) with 5 cutting teeth, inner and outer margins smooth. Labrum, epipharynx, premandible and maxilla as in Figs. 71 A, B, F.

Claws on anterior pseudopod as in Fig. 71 G. Preanal hair tufts composed of 4 long hairs, bases (Fig. 71 I) semiglobular, and carrying two short hairs. Posterior pseudopods very long, about 0.20 mm and roughly 2.5 times length of anal gills; have one strong spine at about 1/3 distance from base, and 16 simple terminal claws (Figs. 71 H, J).

Discussion. The adult, pupa and larva of the present species exibit characteristics typical of genus *Thienemanniella* (or *Corynoneura* in wider sense). In the adult, the fused wing vein R is a distinguishing characteristic of this group, and the shape of the tibia and tarsus II of the legs is unique to this genus. Among the previously known forms, the present species agrees in the morphology of the male and female with that of the *Thienemanniella majuscula* (Edwards) of Europe, in that the eyes are pubescent, the male antenna is composed of 13 well defined segments, the last segment being as long as the preceding 8 segments together, and the gonocoxite lobe is very broad and bears long setae. In the pupa, this species is also characteristic of *Corynoneura*-group in that the anal lobes are fringed with swimming hairs and have 3 long lateral setae and one shorter inner seta, the abdominal segments III to VIII bear 4 pairs of lateral swimming hairs, and the abdominal tergites II to VI have a row of spines along the caudal margin. In the larva, the structure and color of the antenna are typical of this genus. In Japan, *T. majuscula* (Edw.) was recorded by Tokunaga (1936) as being common in Kyoto in autumn.

(20) ***Diamesa tsukuba*, sp. nov.** Figs. 72-75.

Large numbers of larvae were collected during February to April 1978 in mountain streams on the slopes of Mount Tsukuba, after the area was treated with insecticide for black fly control experiments. Larvae were easily distinguished from coexisting chironomids by their color being almost entirely black. Pupae and adults were reared in the laboratory in small plastic containers kept in cold rooms regulated at 10 C or 15 C, but the larvae mostly died when kept in warmer temperatures at 20 C or higher.

Materials studied. Holotype: a male, emerged on 10 March 1978 from larva collected at Mount Tsukuba, in gum-chloral slide No. A 23-01. Paratypes: 3 males and 4 females, mounted in gum-chloral, 3 males and 3 females, mounted in balsam in March 1978, reared from larva collected the same locality; 7 males and 8 females, pinned on card in Box B 12, same data. Larvae, pupae and their exuviae mounted in gumchloral, and adults preserved dry were also available for this study.

Male. Body almost uniformly black. Body length 4.0-6.0 mm (4.71+0.69 mm in measurements of 7), wing length 3.06-4.23 mm (3.69+0.42 mm in measurements of 8).

Antenna 14 segmented, AR 2.43-2.90 (2.58+0.16 in average of 7), highly plumose, apex slightly expanded, with one apical seta about 35 microns long and more than 10 sensory setae in subapical region (Fig. 73 D). Palp 4 segmented (0.17, 0.20, 0.20, 0.29 mm). Eyes highly pubescent (Fig. 72 J), with conspicuous dorsomedian projection, distance between two eyes (0.35 mm) being 0.9 times height of eye. Head with about 30 vertical setae between two eyes, and about 15 postorbital setae on each side.

Thorax as in Fig. 73 A. Pronotum well developed, connected in middle, with 4-5 lateral setae on each side. Scutum almost entirely black, scutal stripes hardly distinguishable from ground color; acrostichal setae absent; dorsocentral setae uniserial, 9-11 on each side, with large pale hole at base; supra-alar setae 5 on each side. Scutellum black, with about 30 setae irregularly scattered. Postnotum black. Halteres brown, apical portion slightly paler.

Wing membrane slightly purple by transmitted light, densely covered by microtrichiae. Squama fringed with black hairs. Anal lobe well developed, right-angled. Wing venation as in Table 1 t and Fig. 72 A. Cross vein r-m long and oblique. Cross vein m-cu placed a little beyond fCu. Costa extends slightly beyond end of R 4+5. R 2+3 ending about midway between tips of R 1 and R 4+5.

Legs almost uniformly black. Relative length of leg segments as shown in Table 2 t. Leg ratio 0.74 in front leg, 0.50 in middle leg, and 0.69 in hind leg. Tarsus IV of all legs cordiform, divided apically into two lobes, and shorter than tarsus V of corresponding legs (Fig. 73 C). One terminal spur on front tibia (104 microns long, Fig. 73 E), two on front tarsus I (48, 41 microns), two on front tarsus II (37 and 35 microns), two on mid tibia (67 and 60 microns, Fig. 73 F), two on mid tarsus I (46 and 39 microns), two on mid tarsus II (43 and 34 microns), two on hind tibia (99 and 53 microns), two on hind tarsus I (46 and 46 microns), and two on hind tarsus II (43 and 41 microns). Hind tibia with incomplete comb (row of about 20 closely set but separated setae, which are 75 to 36 microns long, Fig. 73 G). All other leg segments are devoid of terminal spurs. All legs with pair of claws, apically forked into 5 teeth and with 4 basal hairs, and long and conspicuous empodium, but pulvilli absent (Fig. 73 C).

Abdominal segments, including hypopygium, almost uniformly black. Structure of hypopygium (Figs. 73 H, J) is characteristic of this species. Anal point very long and slender (217 microns long but only 12 microns wide in middle for typical specimen), almost entirely bare except for basal part which bears microtrichiae, and has secondary apical process on tip, as in Fig. 73 I. Gonocoxite has very broad dorsal lobe which bears numerous short hairs along inner margin, and semicircular ventral lobe which bears about 20 external long hairs (about 200 microns in length) arranged radially on ventral surface. Gonostylus simple, slightly expanded near apex, and bears one main and two accessory spines near tip (Fig. 73 K).

Female. Body coloration almost entirely black, except halteres which are brown or yellow. Body length 4.0-4,7 mm (4.37+0.23 mm in measurements of 7), wing length 3.11-4.08 mm (3.54+0.33 mm in measurements of 7). Frontal view of head as in Fig. 72 I; with about 25 vertical setae between two eyes, and about 18 postorbital setae on both sides. Eyes highly pubescent (Fig. 72 J). Antenna 8 segmented (63, 89, 58, 60, 55, 51, 147 microns, Fig. 72 C), last segment 0.4 times combined length of segments II to VII. Palp 4 segmented (108, 166, 183, 318 microns). Distance between two eyes (0.29 mm) being 0.75 times height of eye.

Ground color of scutum black and pruinose, scutal stripes black and inconspicuous. Scutellum dark brown. Postnotum black. Halteres largely yellow, basal one-fourth brown

(halteres black in male). Chaetotaxy of thorax as in male.

Wing membrane slightly purple by transmitted light, thickly covered by microtrichiae, but devoid of macrotrichiae. Anal lobe nearly rectangular. Squama fringed with black hairs. Wing venation as in male, Fig. 72 A and Table 1 t.

Legs almost uniformly black. Relative length of leg segments as in Table 2 t. Leg ratio 0.65 in front leg, 0.46 in middle leg, and 0.66 in hind leg. Tarsus IV of all legs cordiform, with two lobes on tip, and shorter than tarsus V of same legs (Fig. 72 H). Claws simple, with pointed apex (not spatulate and apically forked as in male claws), and bear about 6 hairs at base; empodium well developed, with numerous branches; pulvilli absent (Fig. 72 G). Spermatheca semiglobular, dark brown, Fig. 72 L. Cercus as in Fig. 72 K.

Pupa. Body length 4.9-6.7 mm (5.67 mm in average of 6, measured with mounted pupal skin). Thoracic respiratory organ filamentous, 8-10 microns in diameter and 0.39-0.53 mm long (434 microns in average of 10), apically pointed, and with smooth surface (Fig. 74 E).

Distribution of spines and spinules on abdominal segments as in Fig. 74 A. Both tergites and sternites have reticulate surface. Segment I with spinulous zone along caudal margin of tergite, but devoid of large spines. Tergite II with spinulous zone covering proximal half, row of 6-8 large triangular spines and 4-6 smaller spines on distal 2/5 level, and narrow spinulous zone along caudal margin; sternite II almost entirely spinulous, but devoid of large spines. Tergites III to VIII similar in distribution of spinules and spines to tergite II, i.e. large spinulous zone covering proximal two thirds of segment, transverse row of 12-16 large triangular spines at about 2/5 level, and narrow spinulous zone along caudal margin. Sternites III to VII also have row of 7-12 large triangular spines on about 2/5 level from caudal margin, and covered by numerous spinules almost entirely except for middle portion anterior to row of large spines. Sternite VIII devoid of large spines, and spinulous almost all over.

Caudal segment with large spinulous area on tergite, pair of genital sheaths, much longer in male than in female pupa, and pair of anal lobes bearing 3 stout terminal bristles almost equal in length of 0.29-0.33 mm (0.314 mm in average of 6).

Larva. Mature larvae of this species can be differentiated by bare eye from most other chironomid larvae coexisting in streams by color of head capsule (black), thoracic and abdominal segments (brown), and claws of posterior pseudopods (black), which are all much darker than corresponding parts of other species. Body length 6.7-9.0 mm (8.4 mm in average of 7).

Antenna 5 segmented (65, 19, 7, 5, 5 microns, Fig. 75 B), first segment about 1.7 times combined length of segments II to V; third segment annulated, apparently divided into 5 rings; antenal blade 31 microns and 0.75 times combined length of second to fifth antennal segment. Ring organ in 1/6 level from base of first antennal segment. Epipharynx, premandible, labrum and maxilla as in Figs. 75 C, D. Pecten epipharyngis composed of three triangular spines. Mandible with 5 teeth, mandibular brush very strong, composed of some 20 hairs arranged like a fan; each hair with saw-like teeth on distal half (Fig. 75 E). Labial plate (Fig. 75 A) highly chitinized and strongly pigmented, with 21 cutting teeth, central tooth widest and about twice as wide as second pair, which is again wider than remaining teeth.

Claws on anterior pseudopods slightly pigmented, medium-sized claws comb-like, with 4 deep teeth, large claws with saw-like minute teeth along convex and concave margins (Fig. 75 F).

Caudal part of larva as in Fig. 75 G. Preanal hair tuft each composed of 4 highly

pigmented hairs, 0.29 mm long; hair tuft has no basal process, and arises directly from body wall near dorsocaudal margin of 8th abdominal segment (Fig. 75 H). Anal gills subequal in length, about 0.17 mm long, and apically rounded. Posterior pseudopods well developed, nearly 0.6 mm long, with 16 terminal claws which are highly pigmented and nearly black.

Discussion. This species is without doubt a member of genus *Diamesa*, subfamily Diamesinae, since the wing has the cross vein m-Cu, which is placed a little beyond fCu, R 2+3 is separated from R 1 and not connected with R 1 by R 2, r-m is long and curved, tarsus IV of all the legs are cordiform and bilobed at the tip, and the female antenna is 8 segmented. Among the three groups within the genus *Diamesa* defined by Edwards (1929), this species belongs to Group A because the eyes are pubescent and the wings are grey or purplish. Among the three British species described in this article, the present species is most closely related to *D. waltli* (Meigen) or to *D. bohemani* (Goetghebuer) of Pinder (1978), in the shape of the anal point, but the present species differ essentially from these forms in the structure of the inner lobes of the gonocoxite. The ventral lobe of this species (Fig. 73 J) is quite unique in that it bears long, fan-shaped bristles, and can be easily differentiated from all previously recorded *Diamesa* species by this characteristic. Of 5 species of genus *Diamesa* (s. str.) recorded by Tokunaga (1936) from Japan, the present species is closest to *D. plumicornis*, since it bears bristles on the frontoclypeus, apical spines on tarsi I and II but not on tarsus III, and a long anal lobe on the male 9th tergite. However, the present species differs distinctly from this and all other *Diamesa* species described by Tokunaga (1936, 1937, 1964) in the structure of the male genitalia, especially in the shape of the inner lobes of the gonocoxite.

In the pupa, this species is similar in the structure of the anal lobes to members of the subfamily Orthocladiinae, but differs from them in bearing large conical spines on both abdominal tergites and sternites. In the larva, it is characterized by the annulated structure of the third antennal segment, in the fan-shaped mandibular brush, in the absence of basal process of the preanal hair tuft, and in the coloration of claws on the posterior pseudopods which are very dark.

SUMMARY

Adults and immature stages of twenty species of chironomid midges belonging to various genera of the subfamilies Chironominae, Orthocladiinae and Diamesinae have been described for materials collected from the study areas in Tsukuba, Shizuoka and Nagasaki. Specimens were randomly selected from our collections and mostly represented common and important species based on our biological studies of land water. Of the 20 species discussed in the present paper, 12 are treated as new species, and 3 are new to Japan (Nos. 1, 15, 17). Of the remaining 5 species recorded by previous workers from Japan, only one species (No. 2) was known from the descriptions of the adult, pupa and larva, and thus new records for larvae of 3 species (Nos. 3, 16, 19), and for pupae of 2 species (Nos. 3, 16) are given.

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Note. References with * are described only in Japanese, and the titles were translated into English by the present author.

Table 1.
Comparison of standard measurements of wing venation among chironomid species.

Species Code	Species name	Sex	WL (mm)	Percentage to wing length												
				ww	sc	R1	R2+3	R4+5	Cs	M	Cu1	Cu2	An	r-m	m-Cu	fCu
a	*Paratanytarsus parthenogeneticus*	F	1.61	25	52	79		95	95	100	89	70	49	46	-	52
b	*Tanytarsus oyamai*	M	1.92	22	68	78	85	96	96	100	90	70	53	52	-	58
		F	1.87	25	65	72	80	94	96	99	85	66	49	48	-	52
c	*Chironomus tainanus*	M	3.18	22	73	84	87	99	99	99	90	73	67	56	-	59
		F	3.09	26	68	81	82	97	97	99	88	66	60	50	-	54
d	*Glyptotendipes tokunagai*	M	3.50	21	65	83	87	99	99	97	87	68	62	52	-	55
		F	5.30	25	66	83	87	99	99	98	85	67	61	49	-	52
e	*Pentapedilum shirokanensis*	M	1.68	25	61	80	80	97	97	98	89	67	56	52	-	56
		F	2.21	26	58	80	80	98	98	99	90	68	55	50	-	55
f	*Pentapedilum kasumiensis*	M	1.79	24	59	79	82	97	97	99	91	69	47	51	-	54
		F	1.68	28	55	78	81	97	97	98	86	66	52	47	-	52
g	*Polypedilum octoguttatum*	M	2.76	25	66	79	81	96	96	98	88	69	59	51	-	53
		F	2.69	31	63	77	81	96	96	97	87	65	58	49	-	53
h	*Microtendipes tsukubaensis*	M	2.03	23	61	81	83	100	100	99	91	68	56	49	-	57
		F	2.13	27	58	77	79	99	99	95	86	64	53	46	-	52
i	*Microtendipes ureshinoensis*	M	2.09	24	66	82	83	99	99	97	89	69	61	49	-	58
		F	2.15	29	56	75	77	99	99	97	86	68	58	47	-	52
j	*Orthocladius makabensis*	M	2.68	23	54	65	73	87	87	91	84	68	57	45	-	46
		F	2.56	26	45	62	67	85	85	87	77	56	48	36	-	37
k	*Orthocladius yugashimaensis*	M	3.17	21	60	69	76	87	87	92	83	70	60	46	-	47
		F	2.83	26	42	53	63	73	73	81	74	59	48	34	-	35

Species Code	Species name	Sex	WL (mm)	Percentage to wing length												
				ww	sc	R1	R2+3	R4+5	Cs	M	Cu1	Cu2	An	r-m	m-Cu	fCu
l	*Orthocladius*	M	2.29	25	64	77	86	94	94	99	91	73	60	49	-	50
	kanii	F	2.62	24	58	71	79	94	94	99	92	76	61	48	-	49
m	*Psectrocladius*	M	4.00	26	64	73	84	95	99	99	92	74	60	47	-	53
	aquatronus	F	3.86	29	65	73	83	96	99	99	92	76	61	46	-	51
n	*Eukiefferiella*	M	1.57	31	46	59	89	90	93	100	92	71	46	42	-	53
	yasunoi	F	2.50	33	47	56	92	93	96	100	92	73	43	37	-	51
o	*Paratrichocladius*	M	2.49	22	57	69	80	91	94	99	90	73	62	49	-	52
	rufiventris	F	2.47	29	53	70	81	92	97	99	90	71	57	48	-	50
p	*Cricotopus*	M	1.85	22	63	72	83	93	96	99	89	72	64	49	-	53
	bicinctus	F	1.69	28	50	65	75	85	88	90	82	64	58	43	-	46
q	*Cricotopus*	M	2.21	25	56	69	81	94	94	98	77	71	57	47	-	53
	sylvestris	F	2.31	29	59	68	82	96	96	99	88	69	56	47	-	51
r	*Cricotopus*	M	1.82	24	54	70	83	93	96	99	87	72	59	51	-	58
	yatabensis	F	1.64	31	56	69	84	94	97	98	88	70	56	48	-	53
s	*Thienemanniella*	M	1.31	32	-	38	-	44	44	99	91	69	53	35	-	54
	majuscula	F	1.08	36	-	36	-	61	61	98	89	66	48	36	-	43
t	*Diamesa*	M	3.58	24	68	79	86	98	98	99	90	71	66	52	43	38
	tsukuba	F	3.21	31	60	68	83	97	97	99	90	71	62	47	41	38

Note. WL: wing length in mm; ww: percentage of wing width to wing length; Sc to An: percentage of the length from wing base to end-point of respective wing vein to wing length; r-m, m-Cu, fCu: relative position in percentage to wing of respective fork ; F: female; M: male (see Fig. 60 A).

Table 2.
Comparison of relative length of leg segments among chironomid species

Species Code	Species name	Sex	Leg No.	Length in 0.01 mm unit fe	ti	t 1	t 2	t 3	t 4	t 5	LR
a	*Paratanytarsus parthenogeneticus*	F	I	57	43	58	30	24	17	10	1.35
			II	61	53	25	14	11	8	7	0.47
			III	72	65	37	23	21	11	7	0.57
b	*Tanytarsus oyamai*	M	I	54	37	61	35	27	19	11	1.66
			II	58	52	27	17	14	10	8	0.52
			III	65	64	43	28	23	17	11	0.67
		F	I	58	36	57	24	18	12	10	1.59
			II	53	55	25	15	11	8	8	0.45
			III	61	67	40	23	20	12	10	0.60
c	*Chironomus tainanus*	M	I	108	103	125	77	71	60	28	1.22
			II	98	111	53	47	33	22	17	0.48
			III	131	141	84	53	51	32	22	0.60
		F	I	111	114	137	68	59	49	25	1.20
			II	113	111	53	32	25	17	15	0.48
			III	127	143	76	48	42	23	18	0.53
d	*Glyptotendipes tokunagai*	M	I	193	168	237	122	102	85	39	1.41
			II	195	198	100	73	56	39	27	0.51
			III	195	222	154	95	78	51	29	0.69
		F	I	183	188	276	129	110	95	44	1.47
			II	220	222	112	71	59	39	27	0.51
			III	222	254	163	100	83	51	29	0.64
e	*Pentapedilum shirokanensis*	M	I	75	47	85	52	39	23	15	1.81
			II	83	66	40	23	18	13	8	0.60
			III	94	79	55	30	27	18	9	0.70
		F	I	84	54	95	59	45	31	15	1.75
			II	90	80	41	25	18	13	8	0.51
			III	95	85	56	32	28	18	10	0.66
f	*Pentapedilum kasumiensis*	M	I	68	43	79	47	35	25	13	1.84
			II	75	58	36	21	16	10	7	0.62
			III	82	68	48	26	24	15	8	0.70
		F	I	69	44	84	50	36	27	13	1.91
			II	76	60	36	21	16	11	7	0.60
			III	77	64	50	27	23	15	8	0.71
g	*Polypedilum octoguttatum*	M	I	99	78	124	59	54	40	19	1.58
			II	111	93	59	33	25	18	13	0.64
			III	111	112	82	43	39	24	14	0.74
		F	I	94	70	100	49	41	33	18	1.43
			II	102	86	51	28	22	16	11	0.60
			III	101	105	76	41	36	22	14	0.72

Species Code	Species name	Sex	Leg No.	Length in 0.01 mm unit fe	ti	t 1	t 2	t 3	t 4	t 5	LR
h	*Microtendipes tsukubaensis*	M	I	101	65	118	84	55	46	18	1.82
			II	112	89	50	28	21	14	8	0.56
			III	96	87	75	41	34	20	10	0.86
		F	I	111	81	134	93	61	50	23	1.66
			II	114	100	52	32	24	16	10	0.52
			III	115	111	84	44	36	24	11	0.76
i	*Microtendipes ureshinoensis*	M	I	87	57	104	68	50	41	19	1.81
			II	94	80	48	30	23	16	10	0.60
			III	99	94	66	37	34	21	12	0.70
		F	I	96	59	106	79	57	44	20	1.79
			II	97	87	49	30	23	17	11	0.56
			III	104	98	69	41	31	21	11	0.70
j	*Orthocladius makabensis*	M	I	88	94	70	48	36	22	14	0.74
			II	85	86	49	31	23	13	12	0.57
			III	89	100	60	38	30	16	14	0.60
		F	I	89	100	67	41	31	20	13	0.67
			II	91	88	46	26	21	13	12	0.53
			III	97	104	61	36	27	16	13	0.58
k	*Orthocladius yugashimaensis*	M	I	92	104	75	49	35	23	16	0.72
			II	95	94	49	31	25	17	14	0.52
			III	106	114	66	41	33	19	14	0.58
		F	I	96	106	78	45	32	21	14	0.73
			II	96	94	50	29	21	13	13	0.54
			III	105	120	69	40	29	15	14	0.57
l	*Orthocladius kanii*	M	I	88	93	71	46	33	21	14	0.76
			II	84	84	46	30	22	13	13	0.54
			III	96	98	60	36	28	16	15	0.61
		F	I	67	67	50	31	22	14	12	0.74
			II	61	62	32	20	15	9	10	0.52
			III	67	74	41	25	18	11	10	0.55
m	*Psectrocladius aquatronus*	M	I	94	110	84	51	38	22	16	0.77
			II	101	103	51	31	25	17	15	0.50
			III	119	118	73	41	31	20	15	0.61
		F	I	86	98	79	41	35	22	13	0.80
			II	89	92	46	28	20	15	12	0.49
			III	94	109	64	39	31	19	14	0.59
n	*Eukiefferiella yasunoi*	M	I	48	53	39	24	16	11	8	0.75
			II	50	47	23	13	11	6	6	0.49
			III	54	56	30	18	14	6	6	0.53
		F	I	45	46	36	23	14	9	7	0.77
			II	46	45	20	11	9	5	5	0.45
			III	50	53	27	15	13	6	6	0.51

Species Code	Species name	Sex	Leg No.	Length in 0.01 mm unit fe	ti	t 1	t 2	t 3	t 4	t 5	LR
o	*Paratrichocladius rufiventris*	M	I	68	89	53	32	24	18	13	0.60
			II	70	72	38	21	17	12	11	0.53
			III	73	90	51	27	22	14	12	0.57
		F	I	78	94	63	33	23	17	14	0.57
			II	81	83	40	21	17	12	11	0.48
			III	80	95	52	28	22	14	13	0.54
p	*Cricotopus bicinctus*	M	I	76	96	57	36	24	17	13	0.60
			II	80	84	41	22	17	11	11	0.49
			III	78	95	52	30	22	13	12	0.55
		F	I	58	69	39	23	17	12	10	0.56
			II	59	61	29	17	12	8	8	0.48
			III	54	67	38	20	10	10	8	0.57
q	*Cricotopus sylvestris*	M	I	60	78	42	23	17	14	11	0.54
			II	62	64	29	17	13	9	9	0.45
			III	61	74	38	21	17	11	10	0.51
		F	I	54	68	34	17	13	10	10	0.50
			II	57	58	26	14	11	8	8	0.45
			III	57	65	34	17	16	9	9	0.52
r	*Cricotopus yatabensis*	M	I	63	80	43	27	20	15	11	0.54
			II	68	70	30	18	14	10	9	0.43
			III	66	76	41	23	19	11	10	0.55
		F	I	57	71	36	22	16	12	9	0.51
			II	60	61	27	15	12	7	8	0.44
			III	63	69	37	20	16	9	9	0.54
s	*Thienemanniella majuscula*	M	I	46	39	28	13	7.5	2.5	4.3	0.73
			II	44	47	30	16	7.8	2.9	4.9	0.65
			III	40	47	33	18	12	3.9	5.1	0.71
		F	I	42	38	24	10	6.4	3.2	4.8	0.63
			II	41	44	27	13	10	2.1	4.7	0.62
			III	35	44	26	15	6.5	3.1	3.9	0.60
t	*Diamesa tsukuba*	M	I	137	171	127	66	41	10	14	0.74
			II	149	151	76	40	25	11	13	0.56
			III	159	178	122	59	33	12	13	0.68
		F	I	142	159	102	56	36	14	16	0.65
			II	144	137	63	35	22	13	14	0.46
			III	156	156	102	54	32	15	16	0.66

Note. Figures are length of segments in unit of 0.01 mm; LR is obtained by dividing the length of t 1 with length of ti.
M: male; F: female; fe: femur; ti: tibia; t 1: tarsus I; t 2: tarsus II; t 3: tarsus III; t 4: tarsus IV; t 5: tarsus V. I: front leg; II: middle leg; III: hind leg.

EXPLANATION OF FIGURES

(1) *Paratanytarsus parthenogeneticus* (Freeman, 1961)

Fig. 1. Female A. wing. B. antenna. C. palp. D. comb scale of hind tibia. E. comb scale of middle tibia. F. spermathecae. G. cercus.

Fig. 2. Pupa A. abdominal segments. B-I. spines, spinules and scales on abdominal segments. B. spines and spinules on segment II. C. spine groups on segment III. D. median and lateral spine groups on segment IV. E. a spine groups on segment V. F. a part of spinulous area on segment VI. G. do, segment VII. H. swimming hairs on segment VIII. I. caudolateral scale on segment VIII.

Fig. 3. Larva A. head, dorsal aspect. B. head, ventral aspect.

Fig. 4. Larva A. labial plate and paralabial plate. B. mandible (cutting teeth on left side). C. maxilla. D. antenna. E. labrum, epipharynx and premandible. F. claws on anterior pseudopod. G. claws on posterior pseudopods. H. caudal part of larva.

(2) *Tanytarsus oyamai*, sp. nov.

Fig. 5. Adult A. frontal view of head, male. B. do, female. C. male hypopygium, dorsal view. D. anal point, lateral view. E. appendage 1 and 1a, ventral view. F. appendage 2a. G. female hypopygium, ventral view.

Fig. 6. (A-I: adult; J-T: pupa) A. wing of male (above) and female (below). B. dorsal view of scutum and scutellum, showing bases of setae. C. female palp. D. female antenna. E. frontal tubercles, female. F. frontal tubercles, male. G. cercus of female hypopygium. H. tip of front tibia, male. I. tip of hind tibia, male. J. thoracic respiratory organ, pupa. K. abdominal segments of pupa, showing distribution of spines and spinules. L. spinulous area (part) on tergite I. M, N, O. spines on tergite II. P. spines on tergite III. Q, R, S. spine group on tergite IV, V and VI. T. caudolateral scale of segment VIII.

Fig. 7. Larva A. labial plate and paralabial plates. B. labrum, epipharynx and premandible. C. premandible. D. maxilla. E. mandible, dorsal view. F. cutting teeth and subdental seta of mandible, ventral view. G. antenna. H. claws on anterior pseudopod. I. caudal part of larva. J. claws on posterior pseudopods.

(3) *Chironomus tainanus* (Kieffer, 1912)

Fig. 8. Adult and Larva A. wing, male and female. B. tip of front tibia, male. C. tip of hind tibia, male. D. female cercus. E. female antenna. F. female palp. G. labrum and premandible, larva.

Fig. 9. Male hypopygium A. dorsal view of genitalia. B. dorsal appendage, dorsal view. C. gonocoxite. D. anal point. E. ventral appendage, dorsal view.

Fig. 10. Pupa A. dorsal view of abdominal segments. B. a part of proximal spinose and spinulous area on tergite II. C. a part of apical spinose area and caudal band of recurved spines on tergite II. D. spinules and spines on tergite III. E. a part of central spinose area on tergite IV. F. a part of apical spinose area on tergite IV. G. a part of proximal spinulous and spinose area on tergite V. H. a part of spinulous area on tergite

VII. I. a swimming hair on segment VI. J. left and right caudolateral scales on segment VIII.

Fig. 11. Larva A. labial plate and paralabial plate. B. mandible. C. antenna. D. claws on anterior pseudopod. E. claws on posterior pseudopod. F. bases of preanal hair tuft. G. anal segments, ventral view. H. anal segments, lateral view.

(4) *Glyptotendipes tokunagai*, sp. nov.

Fig. 12. Adult A. wing. B. female antenna. C. female palp. D. spermathecae. E. cercus.

Fig. 13. Adult A. male hypopygium. B. ventral appendage. C. dorsal appendage. D. anal point, lateral view. E. frontal tubercles, male. F. frontal tubercles, female.

Fig. 14. Pupa A. abdominal segments, dorsal view. B. spines and hooks on tergite II. C. spines on tergite III. D. palmate scale on tergite II. E. do, tergite III. F. do, tergite IV. G. do, tergite V. H. do, tergite VI. I. a swimming hair on segment VII. J. caudolateral scales on segment VIII.

Fig. 15. Larva A. labial plate and paralabial plate. B. antenna. C. mandible. D. claws on anterior pseudopod. E. claws on posterior pseudopod. F. posterior part of larva, lateral view. G. posterior part of larva, dorsal view.

(5) *Pentapedilum shirokanensis*, sp. nov.

Fig. 16. Adult A. head, frontal view, female. B. thorax, lateral view, male. C. female antenna. D. tip of front tibia, female. E. tip of middle tibia, female. F. spermathecae. G. cercus.

Fig. 17. Adult and pupa A. male hypopygium. B. ventral appendage. C. gonostylus. D. anal point. E. dorsal appendage. F. wing. G. thoracic respiratory organ of pupa.

Fig. 18. Pupa A. thorax, ventral view. B. abdominal segments. C. enlarged view of spines or spinules. D. caudolateral scales on abdominal segment VIII.

Fig. 19. Larva A. labial plate and paralabial plate. B. labrum, epipharynx and premandibles. C. antenna. D. mandible. E. claws on anterior pseudopod. F. claws on posterior pseudopod. G. bases of preanal hair tufts. H. caudal part of larva.

(6) *Pentapedilum kasumiensis*, sp. nov.

Fig. 20. Adult male A. hypopygium. B. gonocoxite. C. ventral appendage. D, E. dorsal appendage. F. anal point, dorsal view. G. anal point, lateral view. H. tip of front tibia and base of tarsus I, lateral view. I. tip of front tibia, ventral view. J. tip of antenna.

Fig. 21. Adult and pupa A. female antenna. B. female palp. C. spermathecae. D. cercus. E. wing. F. thoracic respiratory organ, pupa. G. caudolateral scale on abdominal segment VIII, pupa.

Fig. 22. Larva A. labrum and premandibles. B. mandible. C. maxilla. D. labial plate and paralabial plate. E. antenna. F. claws on anterior pseudopod. G. claws on posterior pseudopods. H. caudal part, dorsal view, preanal hair tufts omitted. I. caudal

part, lateral view.

(7) *Polypedilum octoguttatum* (Tokunaga, 1936)

Fig. 23. Male A. frontal tubercles. B. hypopygium. C. gonocoxite. D. anal point. E. dorsal appendage. F. ventral appendage.

Fig. 24. Adult and pupa A. female palp. B. female antenna. C. female frontal tubercles. D. tip of front tibia, female. E. tip of hind tibia, female. F. spermathecae. G. cercus. H. wing, male (left) and female (right). I. caudolateral scales on 8th abdominal segment of pupa.

Fig. 25. Pupa A. abdominal segments I to V. B. abdominal segments VI to anal lobe. C. spines and spinules on abdominal tergite II. D. spines and spinules on tergite III. (a. proximal group of spines; b. central group of spinules; c. caudal group of recurved spines). E. thoracic respiratory organ.

Fig. 26. Larva A. antenna. B. mandible. C. labial plate and paralabial plate. D. labial plate. E. claws on anterior pseudopod. F. claws on posterior pseudopod. G. labrum and premandibles. H. base of preanal hair tuft. I. caudal segments.

(8) *Microtendipes tsukubaensis*, sp. nov.

Fig. 27. Adult A. wing. B. male hypopygium. C. anal point. D. ventral appendage. E. gonocoxite. F. dorsal appendage. G. tip of front tibia, male. H. tip of middle tibia, male.

Fig. 28. Adult female (A-E) and pupa (F-I) A. female antenna. B. female palp. C. tip of front tibia, female. D. spermathecae. E. cercus. F. abdominal tergites of pupa. G. spines and spinules on abdominal tergites II and III. H. caudolateral scale on 8th abdominal segment. I. thoracic respiratory organ.

(9) *Microtendipes ureshinoensis*, sp. nov.

Fig. 29. Adult A. wing. B. tip of front tibia, female. C. female antenna. D. female palp. E. cercus. F. tip of front tibia, male. G. tip of hind tibia, male. H. male hypopygium. I. anal point. J. dorsal appendage. K. ventral appendage. L. gonocoxite.

Fig. 30. Pupa A. thoracic respiratory organ. B. abdominal tergites. C. spines and spinules on tergite II (in part). D. spines and spinules on tergite III (in part). E. spines and spinules on tergite VI. F. caudolateral scale on abdominal segment VIII.

Fig. 31. Larva A. labial plate and paralabial plate. B. mandible. C. antenna. D. labrum and premandibles. E. maxilla. F. claws on anterior pseudopod. G. claws on posterior pseudopod. H. anal portion.

(10) *Orthocladius (Orthocladius) makabensis*, sp. nov.

Fig. 32. Adult A. wing. B. abdominal tergite II, male. C. thorax, male, lateral view. D. thorax, male, dorsal view (acs: acrostichal setae; dcs: dorsocentral setae; pas: prealar setae).

Fig. 33. Adult male A. front tarsus V. B. tip of antenna. C. anal point. D. gonostylus. E. male hypopygium. F. inner lobes of gonocoxite, dorsal view. G. inner lobes of gonocoxite and gonostylus ventral view.

Fig. 34. Female adult and pupa A. female antenna. B. female palp. C. spermathecae. D. cercus. E. front tarsus I. F. thoracic horn, pupa. G. anal part of male pupa. H. anal part of female pupa.

Fig. 35. Pupa A. abdominal segments, lateral view (left side-dorsal). B. distal spinulous area of abdominal tergite II. caudal spinose area of tergite II. D. lateral whirl-like spinulous area on sternite IV. E. inner spinose area on sternite IV. F. caudal spinose area on tergite VI. G. proximal spinulous area on sternite VI. H. lateral spinose area on sternite VI. I. proximal spinulous area on sternite VII. J. proximal spinulous area on tergite VIII. K. proximal spinulous area on sternite VIII. L. base of apical bristles on anal lobe.

Fig. 36. Larva A. labial plate. B. antenna. C. mandible. D. maxilla. E. premandible. F. labrum and premandibles. G. claws on anterior pseudopod. H. claws on posterior pseudopod. I. base of preanal hair tuft (all same enlargement).

(11) *Orthocladius (Orthocladius) yugashimaensis*, sp. nov.

Fig. 37. Adult A. wing of male and female. B. thorax, lateral view, male. C. tip of male antenna. D. abdominal tergite II, male. E. female antenna. F. female palp. G. spermathecae. H. cercus.

Fig. 38. Male adult and pupa A. male hypopygium. B. anal point. C. gonostylus. D. inner lobes of gonocoxite, ventral view. E. tip of front tarsus V, showing claw and empodium, male. F. tip of hind tibia, male. G. thoracic respiratory organ of pupa. H. anal part of female pupa. I. anal part of male pupa. J. base of terminal bristles of anal lobe, pupa.

Fig. 39. Larva A. labial plate. B. labrum and premandibles. C. antenna. D. maxilla. E. mandible. F. claws on anterior pseudopod. G. claws on posterior pseudopod. H. base of preanal hair tuft. I. anal part of larva.

(12) *Orthocladius (Euorthocladius) kanii* (Tokunaga, 1939)

Fig. 40. Adult A. wing. B. female antenna. C. female palp. D. spermathecae. E. cercus. F. thorax, dorsal view. G. thorax, lateral view.

Fig. 41. Adult male A. tip of antenna. B. tip of front tibia. C. tip of middle tibia. D. tip of hind tibia. E. front tarsus V. F. hind tarsus V. G. hypopygium. H. inner lobes of gonocoxite, ventral view. I. inner lobe of gonocoxite, dorsal view.

Fig. 42 (A-F: pupa; G: adult male). A. thoracic respiratory organ. B. lateral view of abdominal segments. C. spines and spinules of respective abdominal segments. D. anal part, male pupa, lateral view. E. anal part, male pupa, dorsal view. F. anal part, female pupa, dorsal view. G. abdominal tergites I to III of adult male, lateral view and left half only, showing bases of bristles (left side dorsal).

Fig. 43. Larva A. head, dorsal view. B. epipharynx and premandibles, ventral

view. C. sensory area of labrum and pecten epipharyngis. D. premandible. E. maxilla. F. labial plate. G. mandible. H. antenna. I. claws on anterior pseudopod. J. claws on posterior pseudopod. K. anal part, dorsal view. L. base of preanal hair tuft.

(13) *Psectrocladius aquatoronus*, **sp. nov.**

Fig. 44. Adult A. wing. B. tip of hind tibia, female. C. female antenna. D. female palp. E. male thorax, dorsal view. F. male thorax, lateral view.

Fig. 45. Adult A. female cercus. B. female spermathecae. C. tip of front tibia, male. D. tip of middle tibia, male. E. tip of hind tibia, male. F. front tarsus V, male. G. tip of male antenna. H. male hypopygium. I. inner lobe of gonocoxite. J. anal point. K. gonostylus.

Fig. 46. Pupa A. hairs, spines and spinules on abdominal segments, lateral view. B. spines on abdominal tergites, enlarged; II b: caudal spines on second tergite; III b: caudal spines on third tergite; IV a: proximal spines on fourth tergite; IV b: caudal spines on fourth tergite. C. spinules and spines on abdominal sternites; II c and III c: spinules on second and third sternites; IV c, V c and VI c: caudal spines and spinules on fourth, fifth and sixth sternites. D. caudal part of male pupa. E. thoracic respiratory organ.

Fig. 47. Larva A. labrum, epipharynx and premandible. B. mandible. C. antenna. D. labial plate. E. maxilla. F. claws on anterior pseudopod. G. claws on posterior pseudopod. H. anal segments. I. base of preanal hair tuft.

(14) *Eukiefferiella yasunoi*, **sp. nov.**

Fig. 48. Adult A. wing. B. tip of male antenna. C. female palp. D. female antenna. E. spermatheca. F. female cercus. G. tip of front tibia, male. H. tip of middle tibia, male. I. tip of hind tibia, showing terminal comb. J. tip of hind tibia of male, showing terminal spurs.

Fig. 49. Adult male A. hairs on abdominal tergites I - IV. B. hypopygium, dorsal view. C. hypopygium, ventral view.

Fig. 50. Pupa A. lateral view of abdominal segments II - IX, and enlarged view of spines and spinules. B. caudal segments of female pupa, dorsal view. C. caudal segments of male pupa, lateral view.

Fig. 51. Larva A. antenna. B. labial plate. C. labrum, epipharynx and premandibles. D. mandible and antenna. E. maxilla. F. claws on posterior pseudopod. G. claws on anterior pseudopod. H. caudal segments, lateral view. I. base of preanal hair tuft.

(15) *Paratrichocladius rufiventris* **(Meigen, 1830)**

Fig. 52. Adult A. female palp. B. female antenna. C. wing. D. abdominal tergites I to V, male, showing bases of hairs. E. tip of front tibia, female. F. tip of middle tibia, female. G. tip of hind tibia, showing comb, female. H. tip of hind tibia, showing terminal spines, female. I. hind tarsus V, female. J. spermathecae. K. cercus.

Fig. 53. Adult male A. tip of antenna. B. thorax, lateral view. C. tip of front tibia. D. tip of middle tibia. E. tip of hind tibia. F. front tarsus V. G. hypopygium and ninth tergite, dorsal view. H. hypopygium and ninth sternite, ventral view. I. inner lobe of gonocoxite and gonostylus, ventral view.

Fig. 54. Pupa A. thoracic respiratory organ. B. abdominal segments, lateral view. C. enlarged view of spines and spinules on abdominal tergites. D. enlarged view of spines and spinules on abdominal sternites. E. anal segment, dorsal view.

Fig. 55. Larva A. labial plate. B. labrum, epipharynx and premandible. C. antenna. D. mandible. E. maxilla. F. premandible. G. claws on anterior pseudopod. H. base of preanal hair tuft. I. claws on posterior pseudopod. J. anal segments, dorsal view.

(16) *Cricotopus bicinctus* (Meigen, 1818)

Fig. 56. Adult A. wing. B. tip of front tibia, male. C. tip of middle tibia, male. D. tip of hind tibia, male. E. hind tarsus V, male. F. gonostylus and gonocoxite, male. G. male hypopygium, dorsal view. H. male hypopygium, ventral view.

Fig. 57. Adult A. head and thorax, lateral view, male. B. tip of male antenna. C. abdominal segments, lateral view, male. D. female antenna. E. female palp. F. spermatheca, female. G. cercus, female.

Fig. 58. Pupa A. abdominal segments, lateral view. B. spines and spinules on abdominal tergites. C. spinules on abdominal sternites. D. caudal segment, female pupa. E. caudal segments, male pupa. F. thoracic respiratory organ.

Fig. 59. Larva A. labial plate. B. maxilla. C. antenna. D. mandible. E. labrum, epipharynx and premandibles. F. claws on anterior pseudopods. G. caudal segments. H. base of preanal hair tuft. I. claws on posterior pseudopod.

(17) *Cricotopus sylvestris* (Fabricius, 1794)

Fig. 60. Adult A. wing. B. legs, female. C. thorax and abdominal tergites I to IV, male, showing distribution of bristles. D. front tarsus V.

Fig. 61. Adult A. thorax and abdomen, showing body coloration, light form (left, male; right, female). B. female palp. C. female antenna. D. female cercus. E. spermathecae. F. tip of male antenna. G. male hypopygium, dorsal view. H. male hypopygium, ventral view.

Fig. 62. Pupa A. abdominal segments, lateral view. B. spines and spinules on abdominal segments, lateral view. B. spines and spinules on abdominal tergites, enlarged view. C. spinules on abdominal sternites, enlarged view. D. caudal part of male pupa. E. thoracic respiratory organ.

Fig. 63. Larva A. labrum, epipharynx and premandibles. B. labial plate. C. maxilla. D. antenna. E. mandible. F. claws on anterior pseudopod. G. caudal part. H. base of preanal hair tuft. I. claws on posterior pseudopod.

(18) *Cricotopus yatabensis*, sp. nov.

Fig. 64. Adult A. wing. B. tip of male antenna. C. tip of front tibia, male. D. tip of middle tibia, male. E. tip of hind tibia, male. F. middle tarsus V, male. G. male hypopygium, dorsal view. H. male hypopygium, left half, dorsal view. I. male hypopygium, left half, ventral view.

Fig. 65. Adult A. dorsal view of thorax and abdominal segments I-IV of male, showing distribution of hairs. B. female antenna. C. female palp. D. tip of front tibia, male. E. tip of middle tibia, male. F. tip of hind tibia, male. G. hind tarsus V, male. H. spermathecae, female. I. cercus, female.

Fig. 66. Pupa A. abdominal segments, lateral view. B. spines or spinules on abdominal tergites, enlarged view. C. spinules and small spines on abdominal sternites, enlarged view. D. thoracic respiratory organ. E. tip of anal lobe and terminal bristles. F. anal part of male pupa.

Fig. 67. Larva A. mandible. B. antenna. C. labial plate. D. labrum. E. epipharynx and premandibles. F. maxilla. G. claws on anterior pseudopod. H. base of preanal hair tuft. I. anal part.

(19) *Thienemanniella majuscula* (Edwards, 1924)

Fig. 68. Male adult A. head, frontal view. B. tip of antenna. C. tip of front tibia. D. tip of middle tibia. E. tip of hind tibia, showing comb spines. F. tip of hind tibia, showing two terminal spines. G. front tarsus V, dorsal view. H. front tarsus V, lateral view. I. middle tarsus V, ventral view. J. hind tarsus V, lateral view. K. hypopygium, dorsal view. L. inner lobe of gonocoxite and gonostylus, ventral view. M. hypopygium, ventral view.

Fig. 69. Adult A. female antenna. B. part of eye, showing pubescence. C. head, female, frontal view. D. wing. E. lateral view of thorax and abdominal segments I-VI, male. F. spermathecae. G. cercus.

Fig. 70. Pupa A. abdominal segments, dorsal view. B. spines and spinules on abdominal tergites. C. caudal part of male pupa. D. caudal part of female pupa.

Fig. 71. Larva A. labrum, epipharynx and premandible, ventral view. B. labrum, dorsal view. C. antenna. D. labial plate. E. mandible. F. maxilla. G. claws on anterior pseudopod. H. caudal part, dorsal view. I. base of preanal hair tuft. J. claws on posterior pseudopod.

(20) *Diamesa tsukuba*, sp. nov.

Fig. 72. Adult A. wing. B. female antenna. C. female palp. D. tip of front tibia, female. E. tip of middle tibia, female. F. tip of hind tibia, female. G. hind tarsus V, ventral view. H. hind tarsus IV and V, lateral view. I. female head, frontal view. K. cercus. L. spermathecae.

Fig. 73. Adult male A. thorax, lateral view. B. palp. C. hind tarsus IV and V. D. tip of antenna. E. tip of front tibia. F. tip of middle tibia. G. tip of hind tibia. H. hypopygium, dorsal view. I. tip of anal point, enlarged. J. hypopygium, ventral view. K. tip of

gonostylus, enlarged.

Fig. 74. Pupa **A.** abdominal segments, lateral view. **B.** spines on abdominal tergites (in part). **C.** spines on abdominal sternites (in part). **D.** anal part of female pupa. **E.** thoracic respiratory organ.

Fig. 75. Larva **A.** labial plate. **B.** antenna. **C.** maxilla. **D.** labrum, epipharynx and premandibles. **E.** mandible. **F.** claws on anterior psuedopod. **G.** anal segments. **H.** base of preanal hair tuft. **I.** claws on posterior pseudopod.

LIST OF ABBREVIATIONS

Acs (Fig. 16, 32): acrostichal seta, adult; *anb* (Fig. 3): antennal blade, larva; *ant* (Fig. 3, 16): antenna, adult and larva; *dcs* (Fig. 16, 32): dorsocentral seta, adult; *cx* (Fig. 60): coxa, adult; *eye* (Fig. 3, 16): eye, adult and larva; *fe* (Fig. 60): femur, adult; *lbo* (Fig. 3): Lauterborn's organ, larva; *lbr* (Fig. 3): labrum, larva; *lpb* (Fig. 3): labial plate, larva; *lps* (Fig. 60): lateral pronotal seta, adult; *lvt* (Fig. 60): lateral scutal vittea, adult; *mnb* (Fig. 3): mandibular brush, larva; *mnc* (Fig. 3): mandibular comb, larva, Chironominae only; *mnd* (Fig. 3): mandible, larva; *mvt* (Fig. 60): median scutal vittea, adult; *mxl* (Fig. 3): maxilla, larva; *plp* (Fig. 60): palp, adult; *prb* (Fig. 3): paralabial plate, larva; *prm* (Fig. 3): premandible, larva; *prt* (Fig. 60): pronotum, adult; *psm* (Fig. 60): postnotum, adult; *sas* (Fig. 16): supra-alar seta, adult; *sls* (Fig. 16): scutellar seta, adult; *slm* (Fig. 60): scutellum, adult; *ti* (Fig. 60): tibia, adult; *tr* (Fig. 60): trochanter, adult; *t I - t V* (Fig. 60): tarsus I - tarsus V, adult.

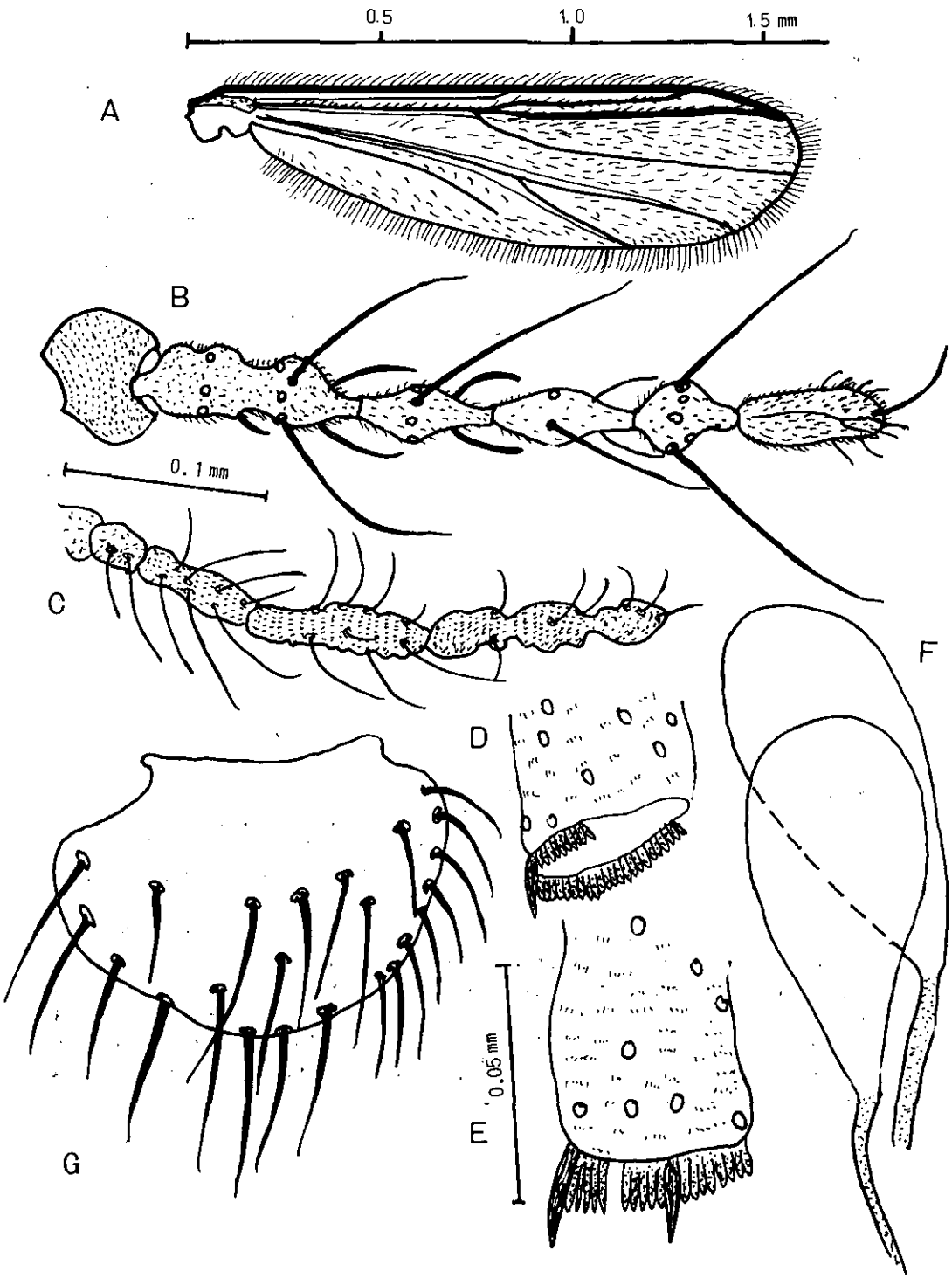

Fig. 1. *Paratanytarsus parthenogeneticus* (Freeman) Female.

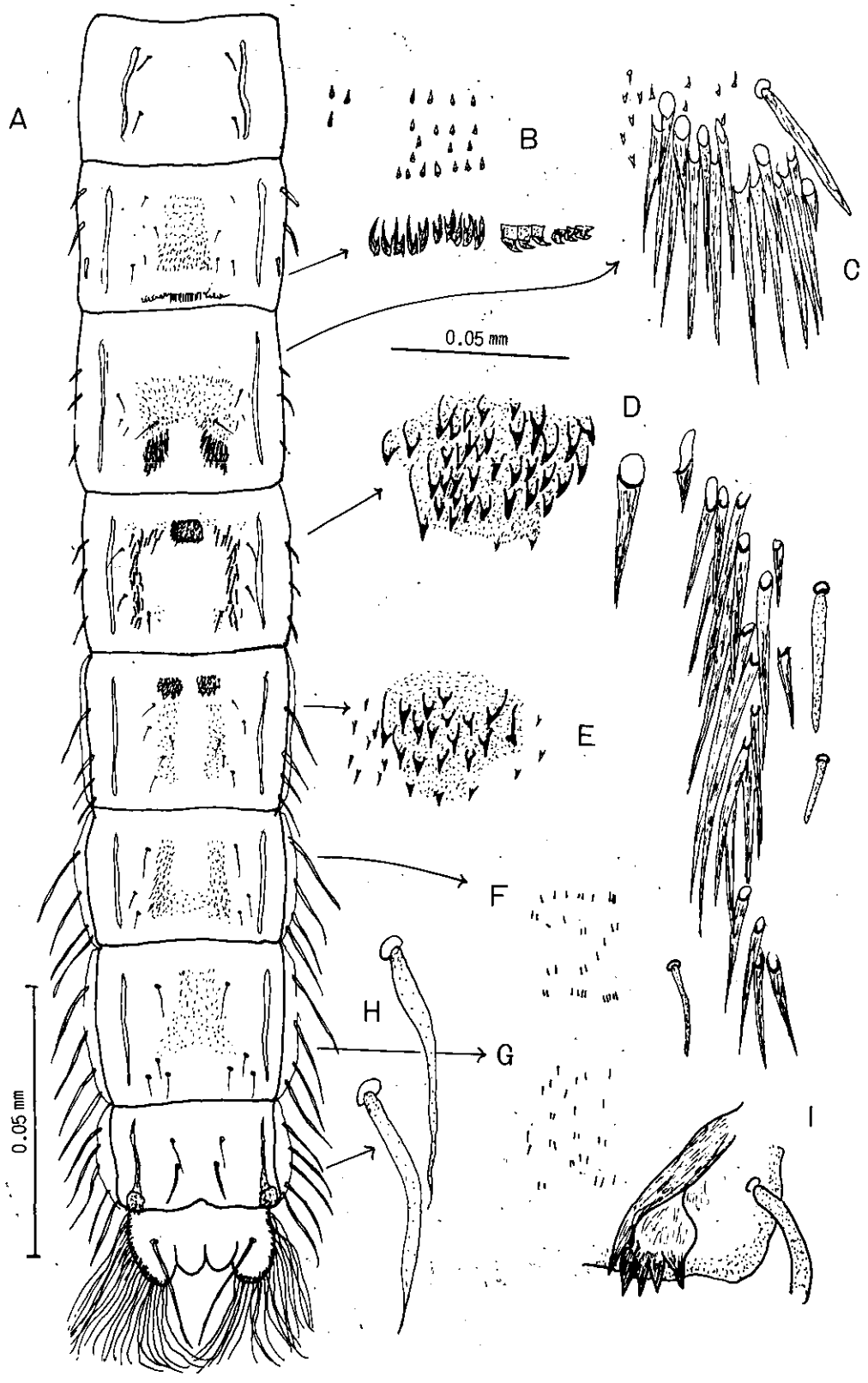

Fig. 2. *Paratanytarsus parthenogeneticus* (Freeman) Pupa.

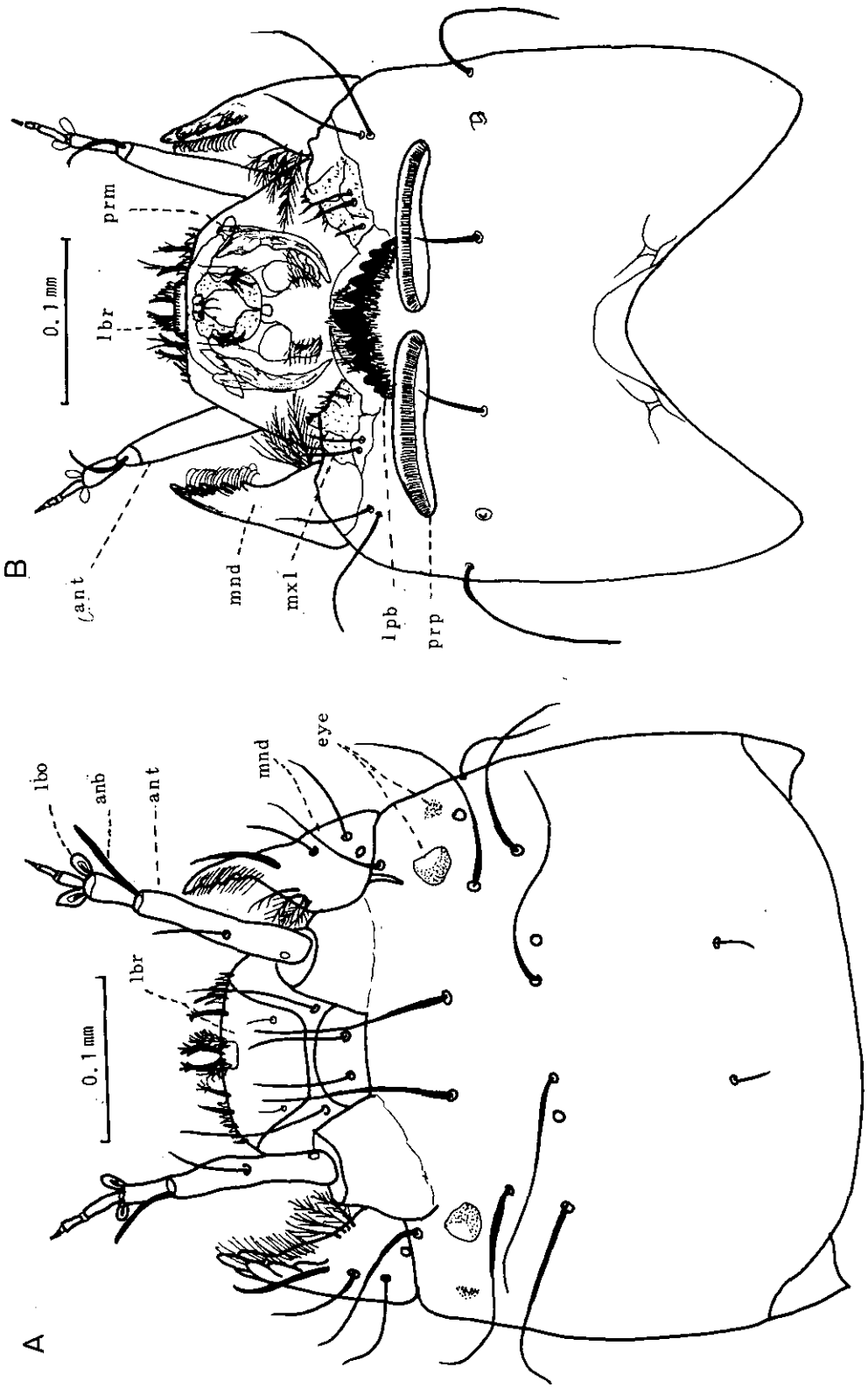

Fig. 3. *Paratanytarsus parthenogeneticus* (Freeman) Larva.

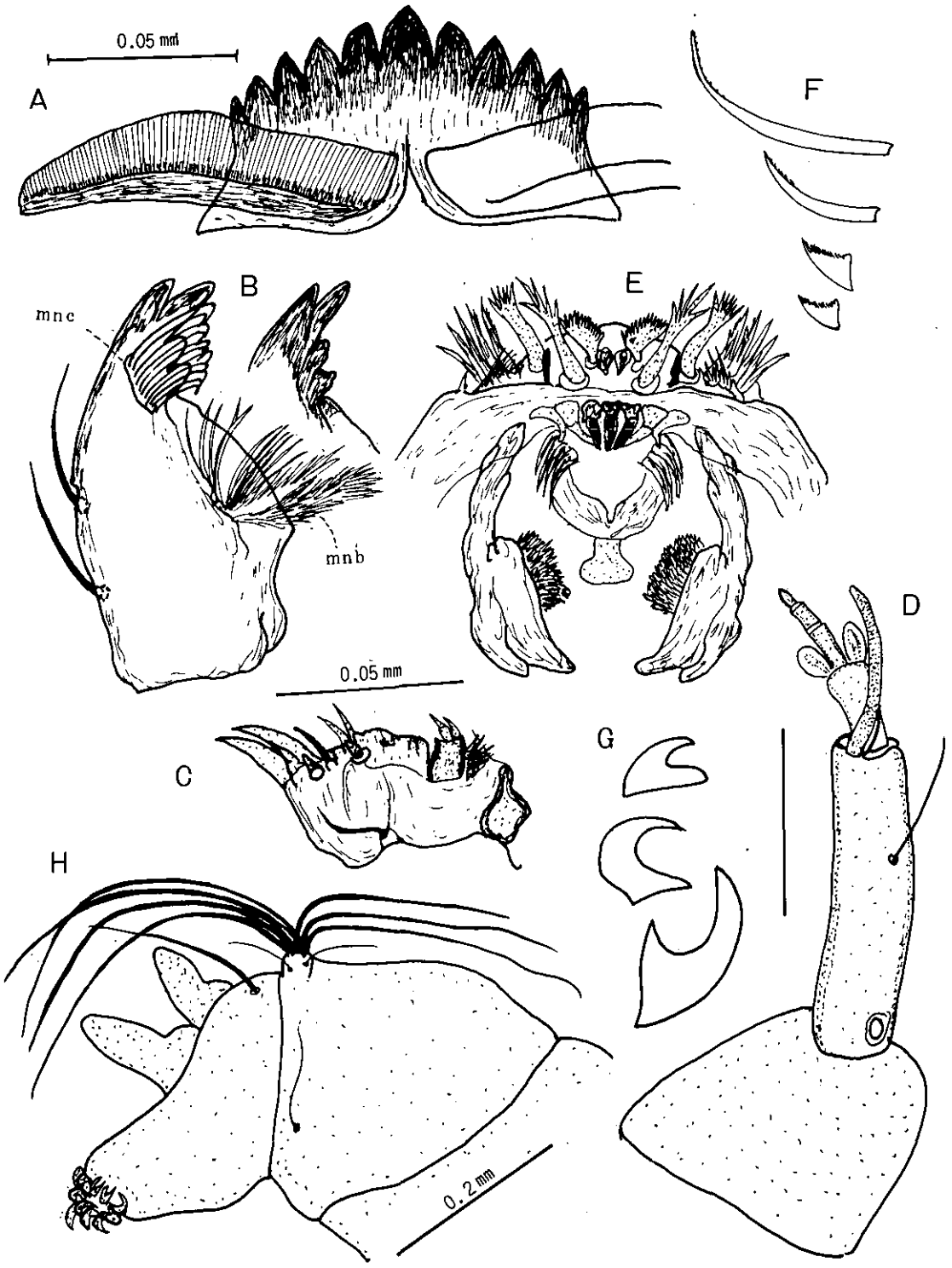

Fig. 4. *Paratanytarsus parthenogeneticus* (Freeman) Larva.

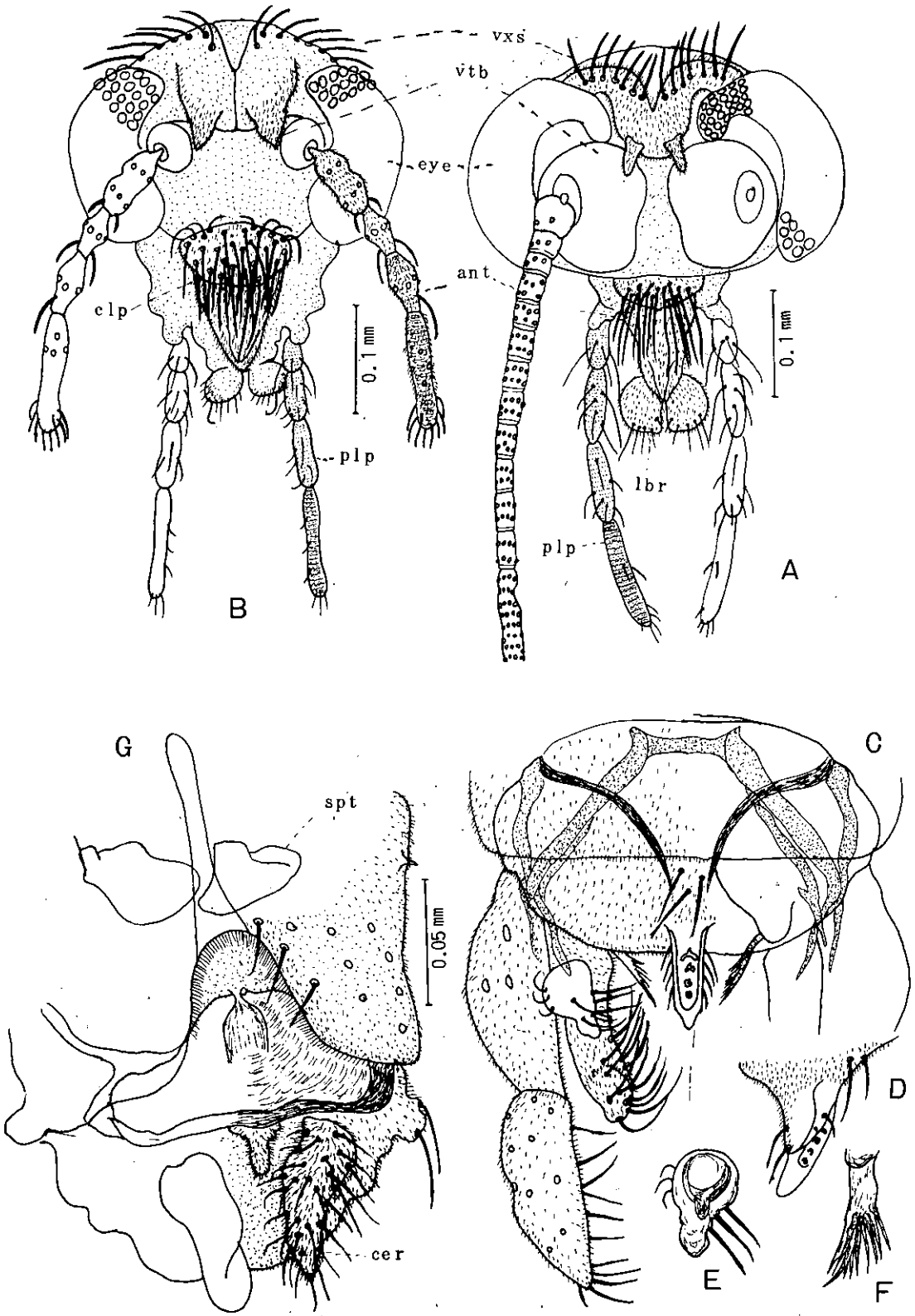

Fig. 5. *Tanytarsus oyamai*, sp. nov. Adult.

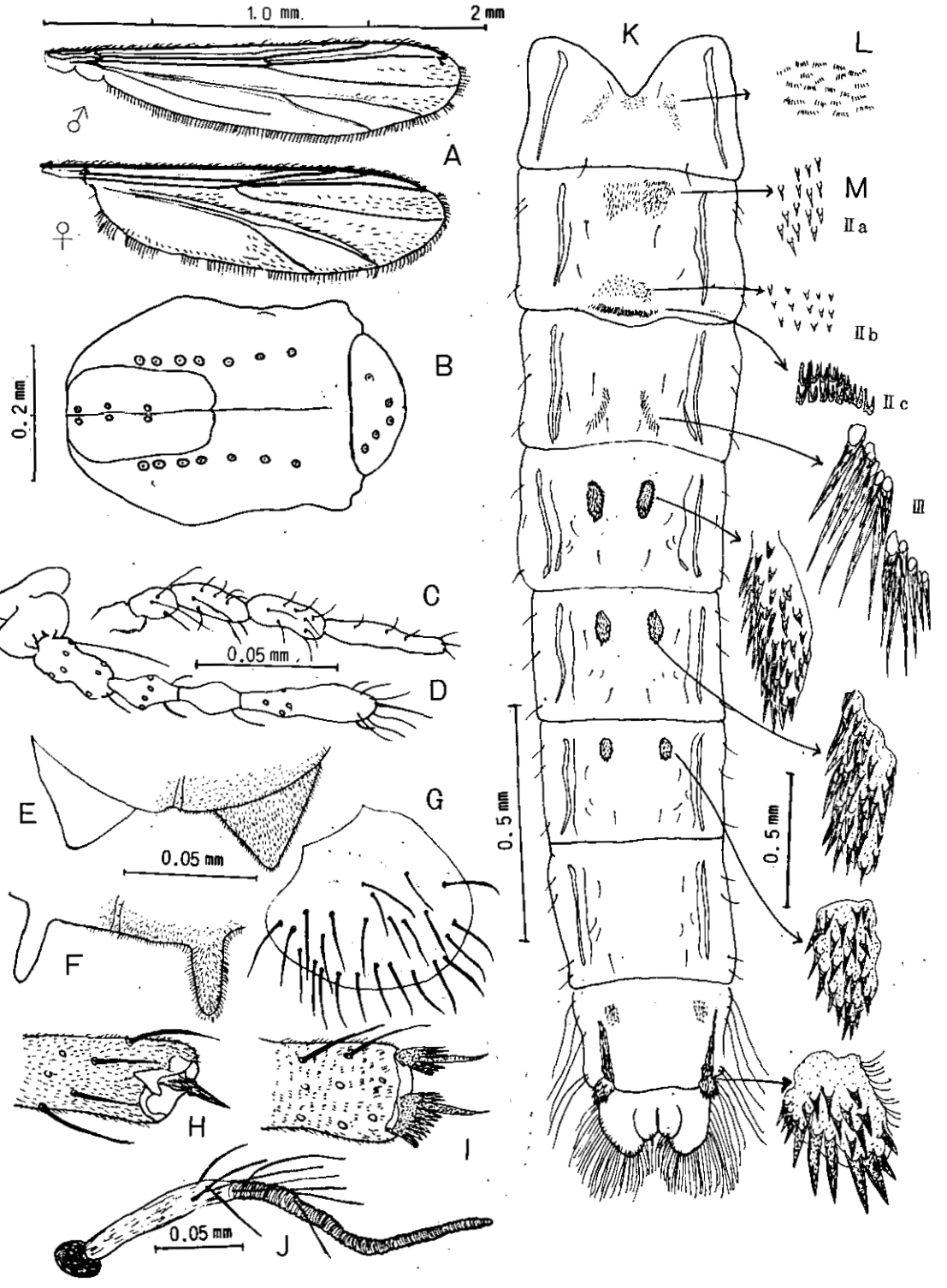

Fig. 6. *Tanytarsus oyamai*, sp. nov Adult and Pupa.

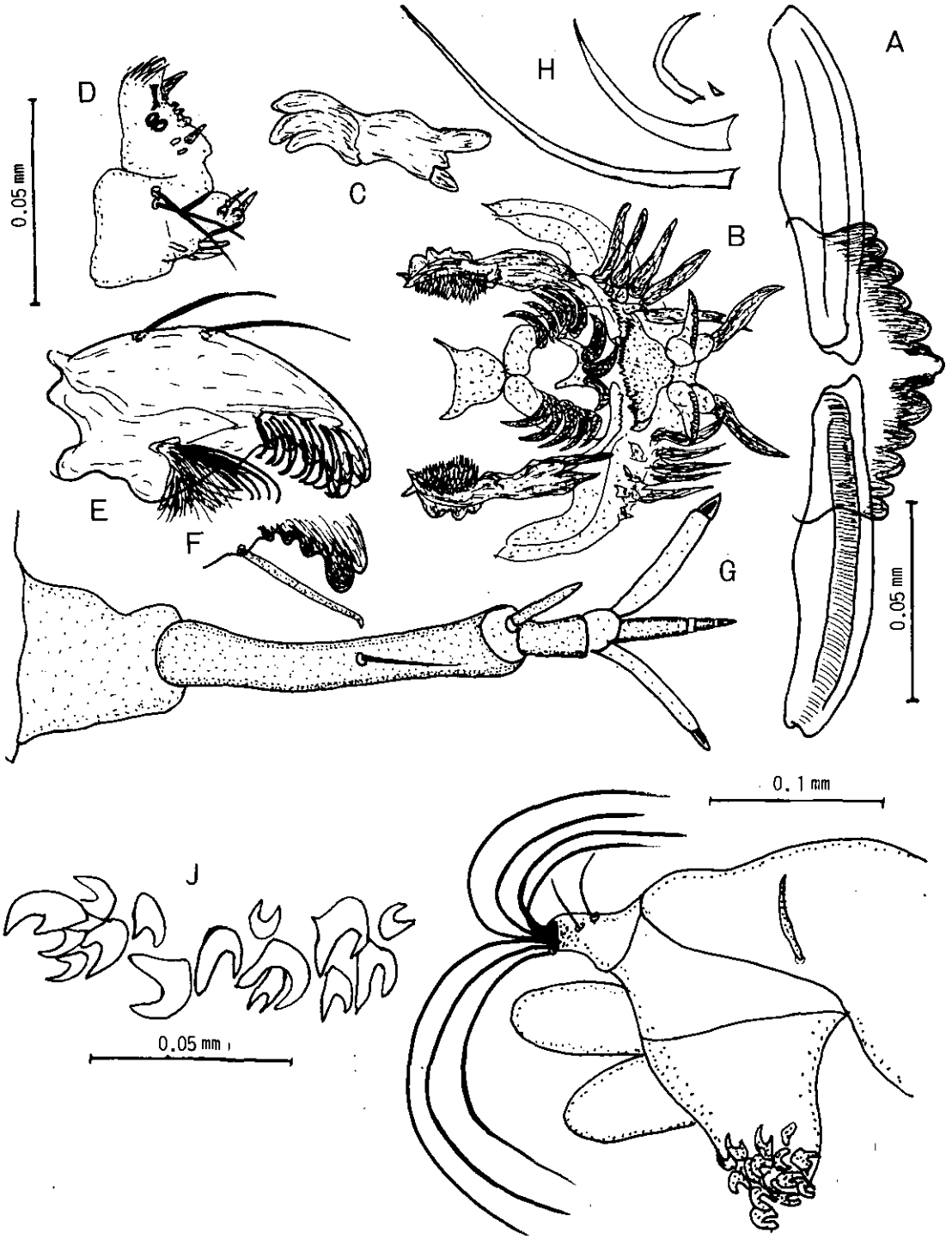

Fig. 7. *Tanytarsus oyamai*, sp. nov. Larva.

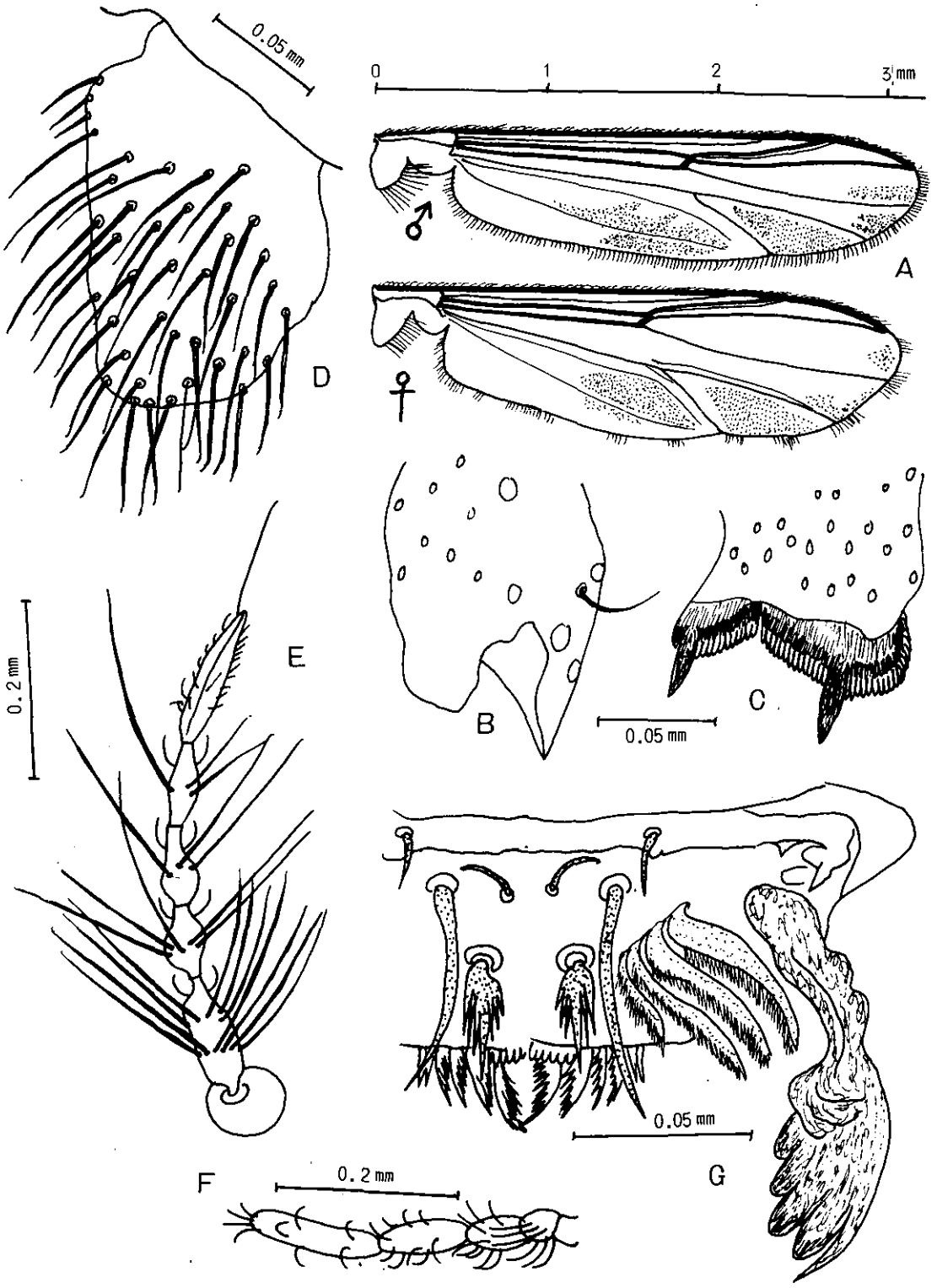

Fig. 8. *Chironomus tainanus* (Kieffer) Adult and Larva.

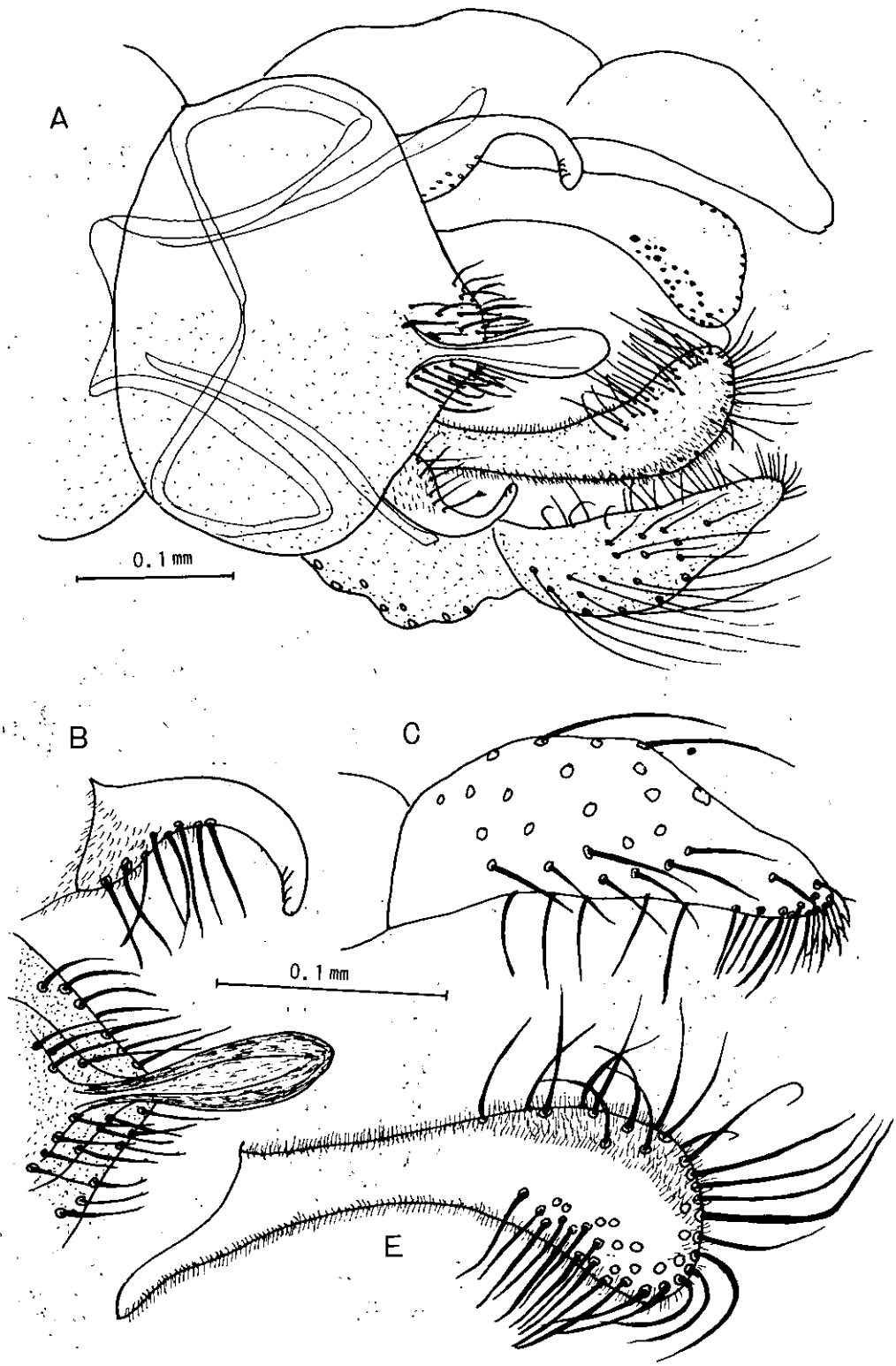

Fig. 9. *Chironomus tainanus* (Kieffer) Male hypopygium.

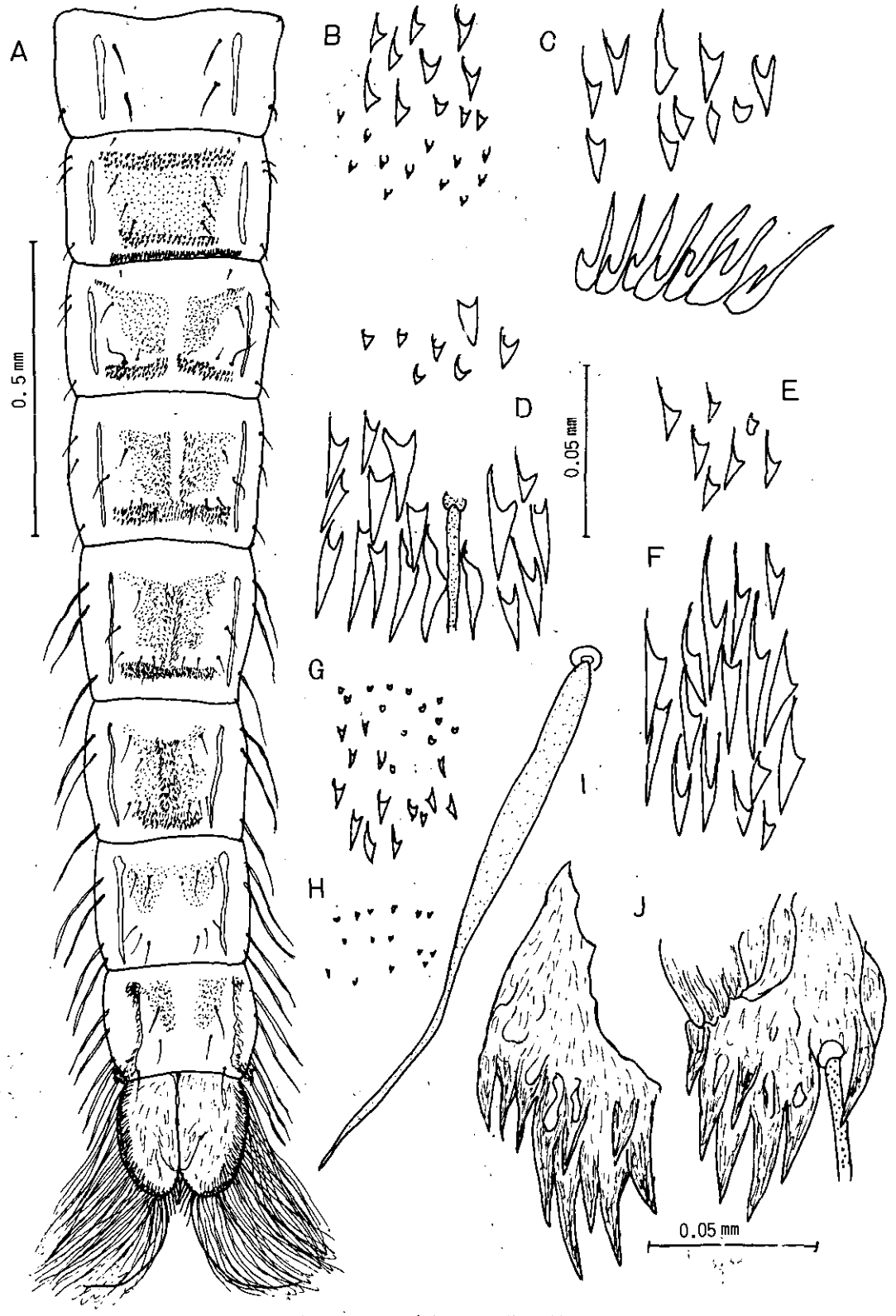

Fig. 10. *Chironomus tainanus* (Kieffer) Pupa.

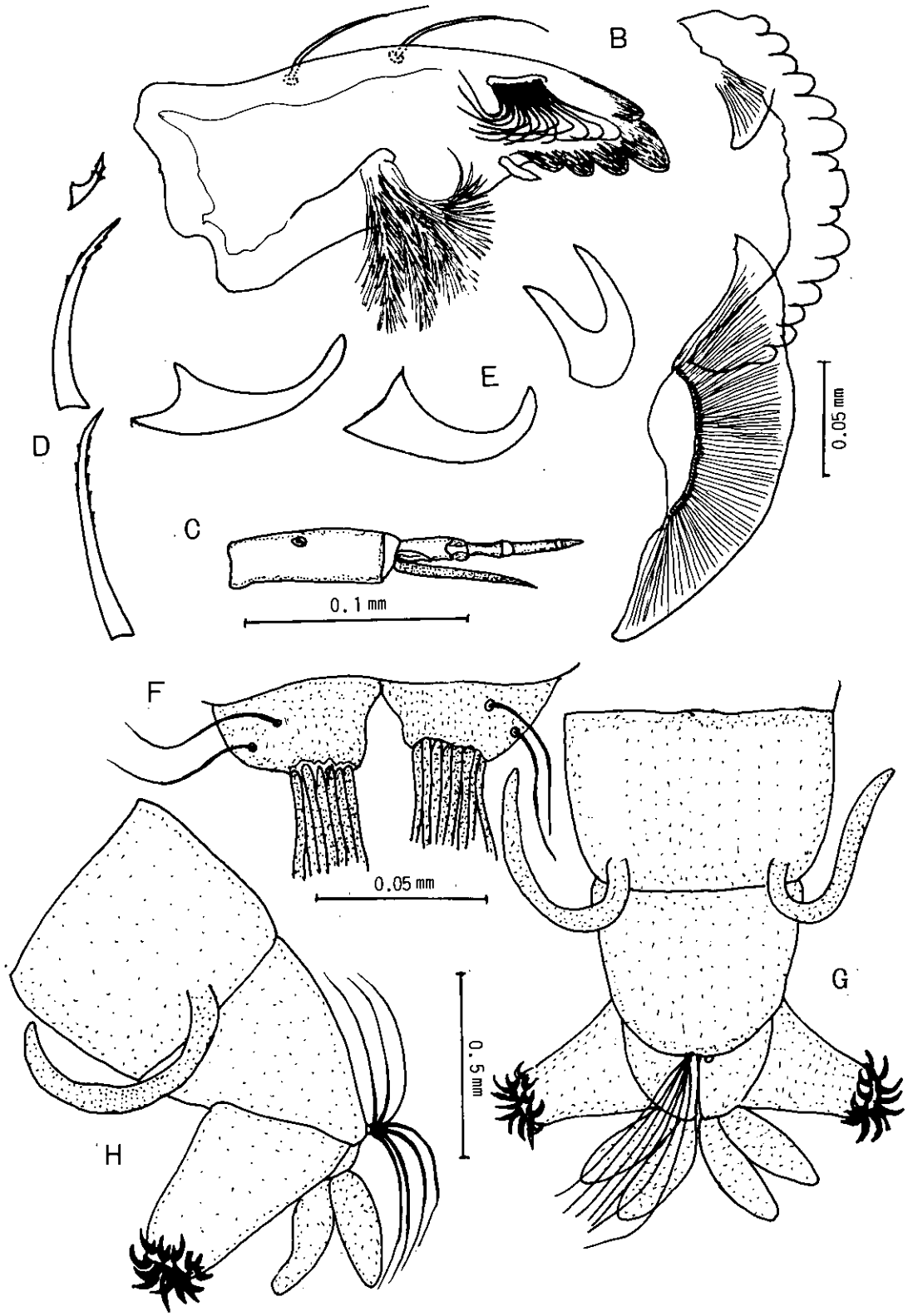

Fig. 11. *Chironomus tainanus* (Kieffer) Larva.

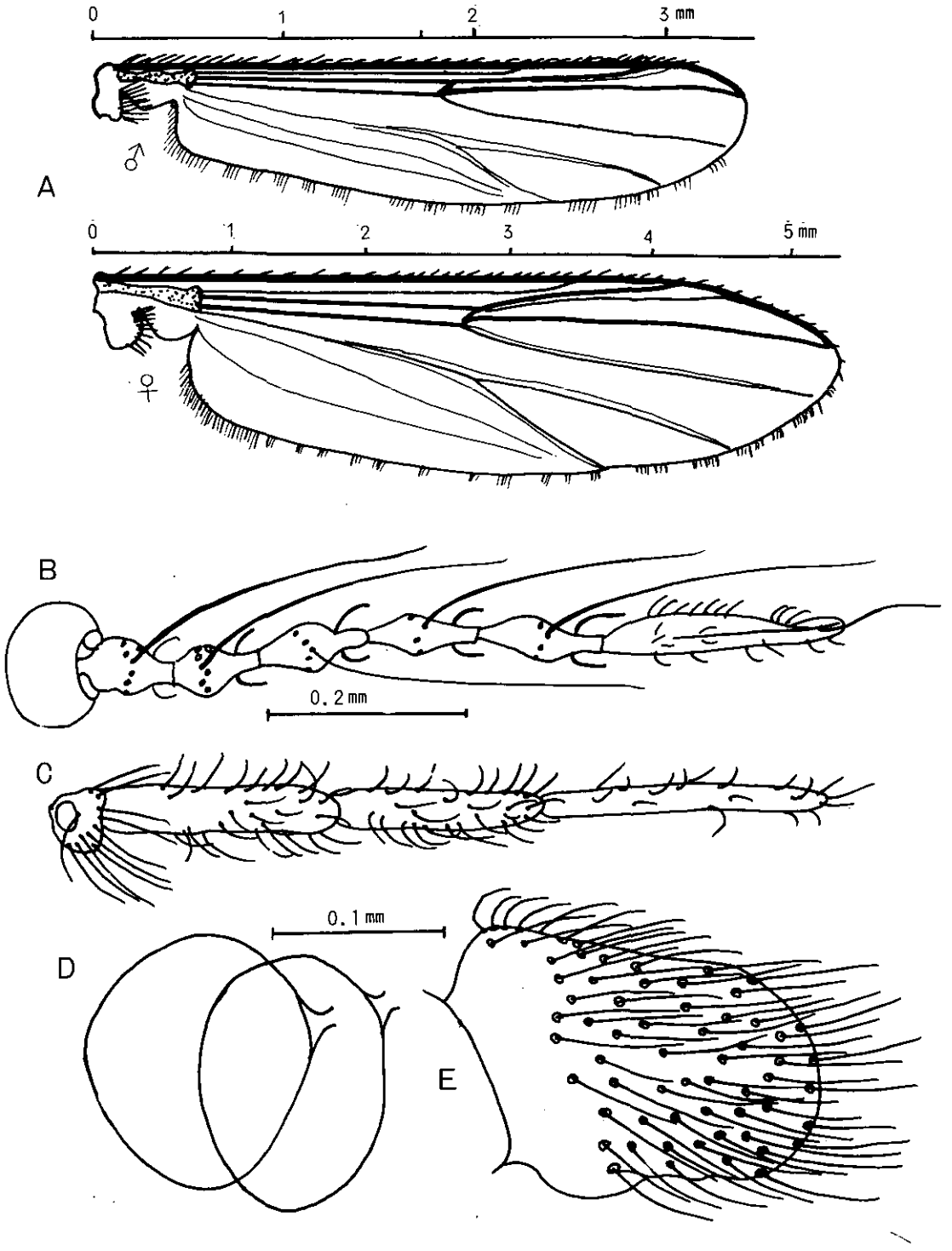

Fig. 12. *Glyptotendipes tokunagai*, sp. nov. Adult.

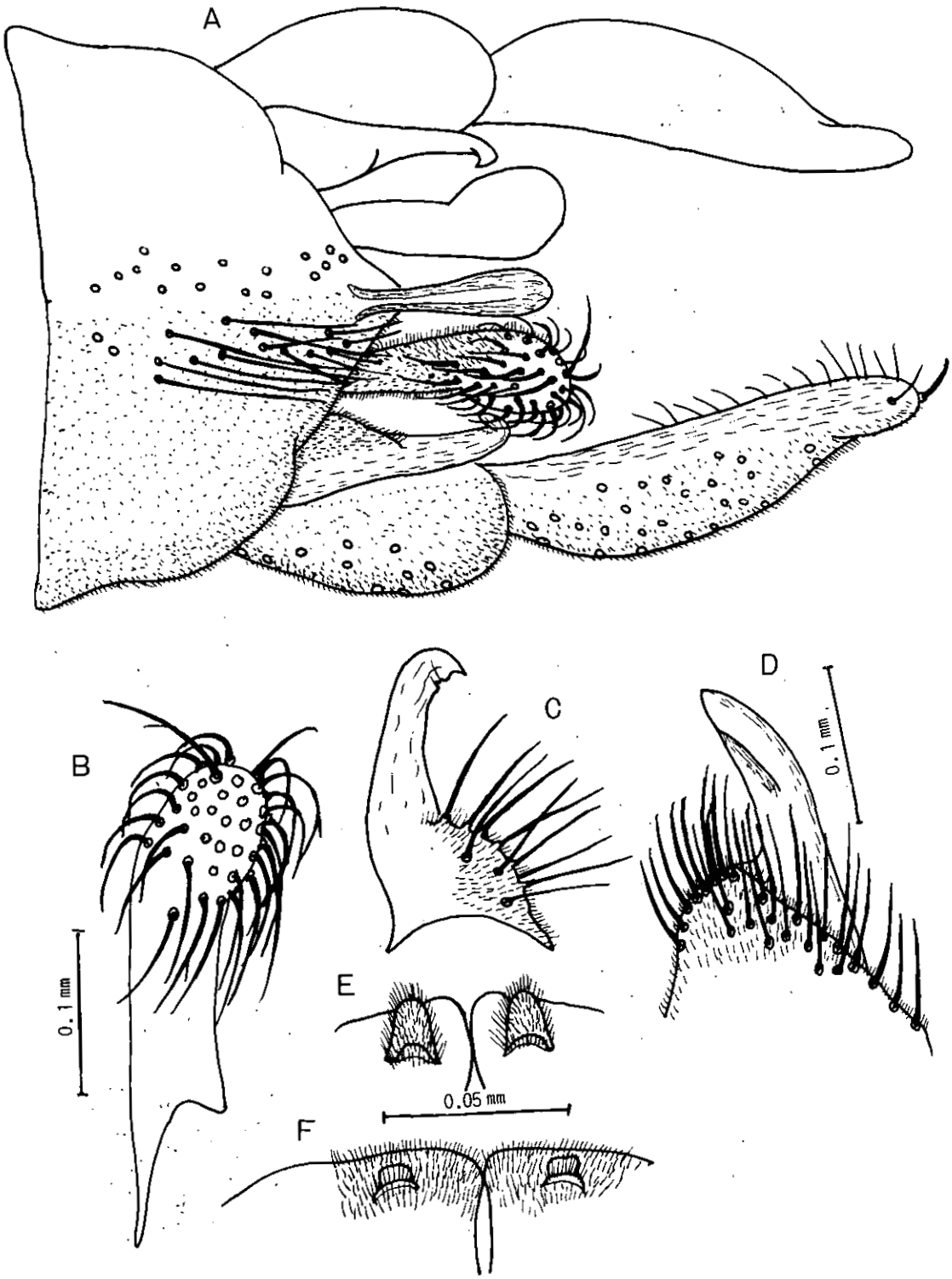

Fig. 13. *Glyptotendipes tokunagai*, sp. nov. Adult.

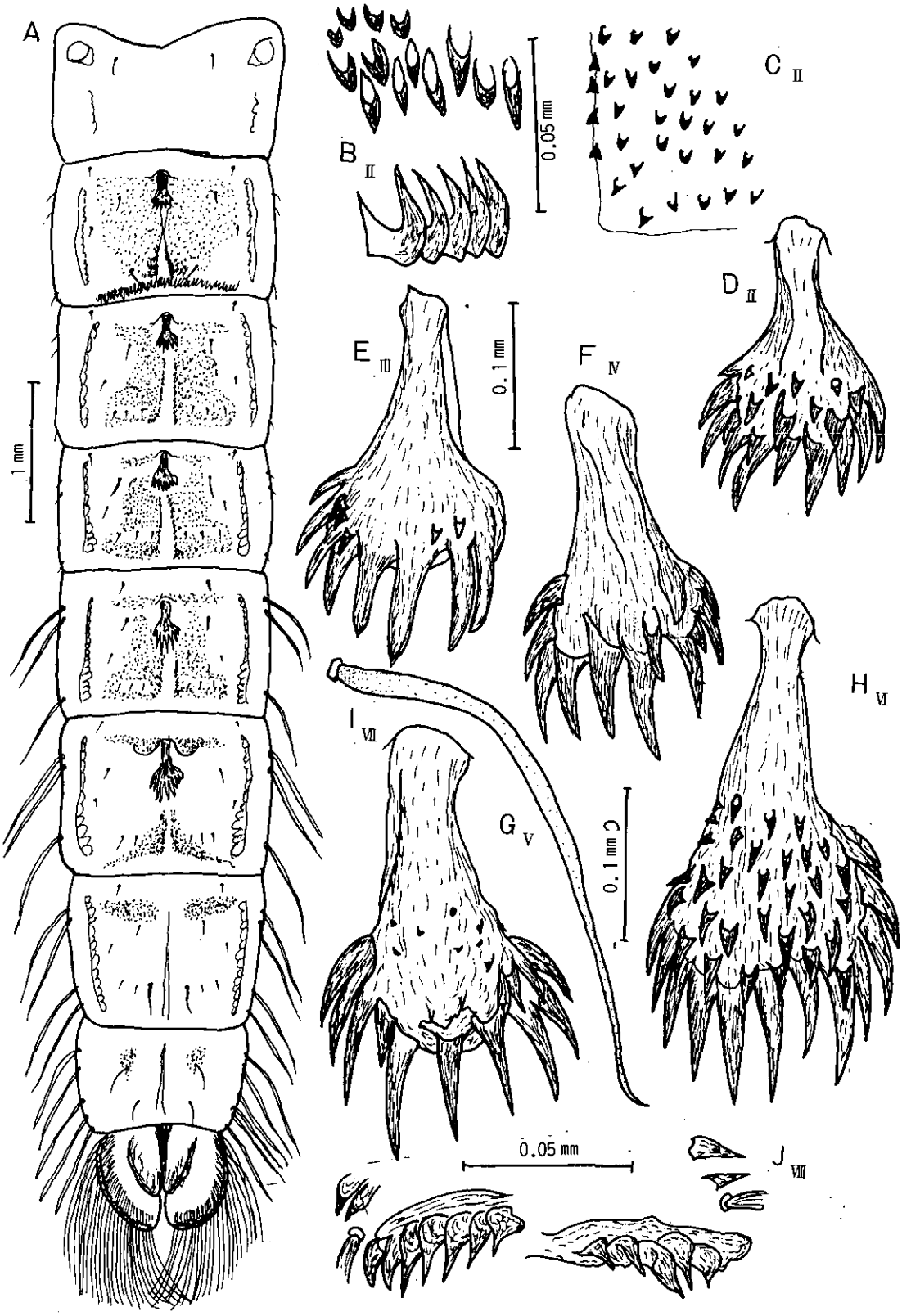

Fig. 14. *Glyptotendipes tokunagai*, sp. nov. Pupa.

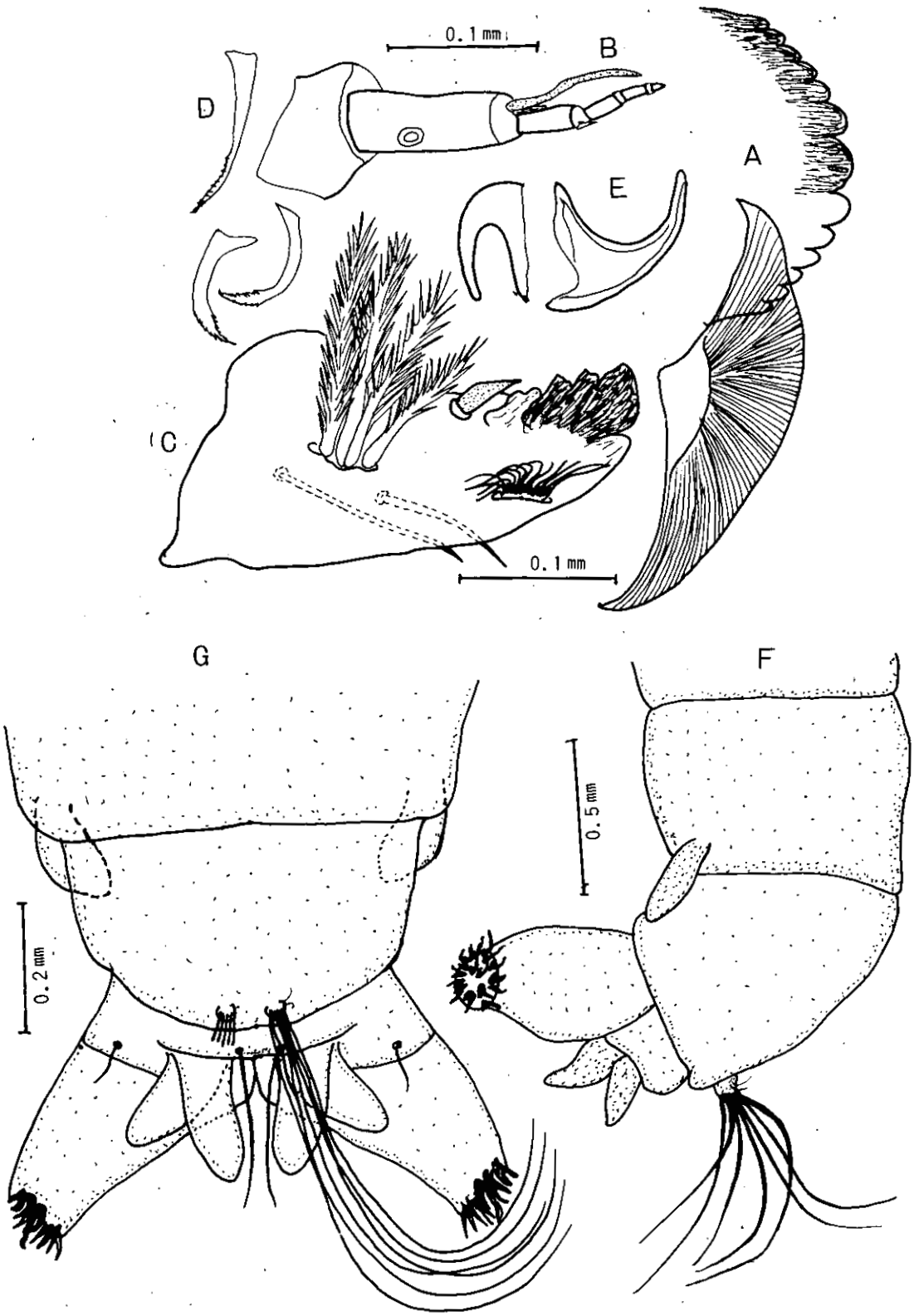

Fig. 15. *Glyptotendipes tokunagai*, sp. nov. Larva.

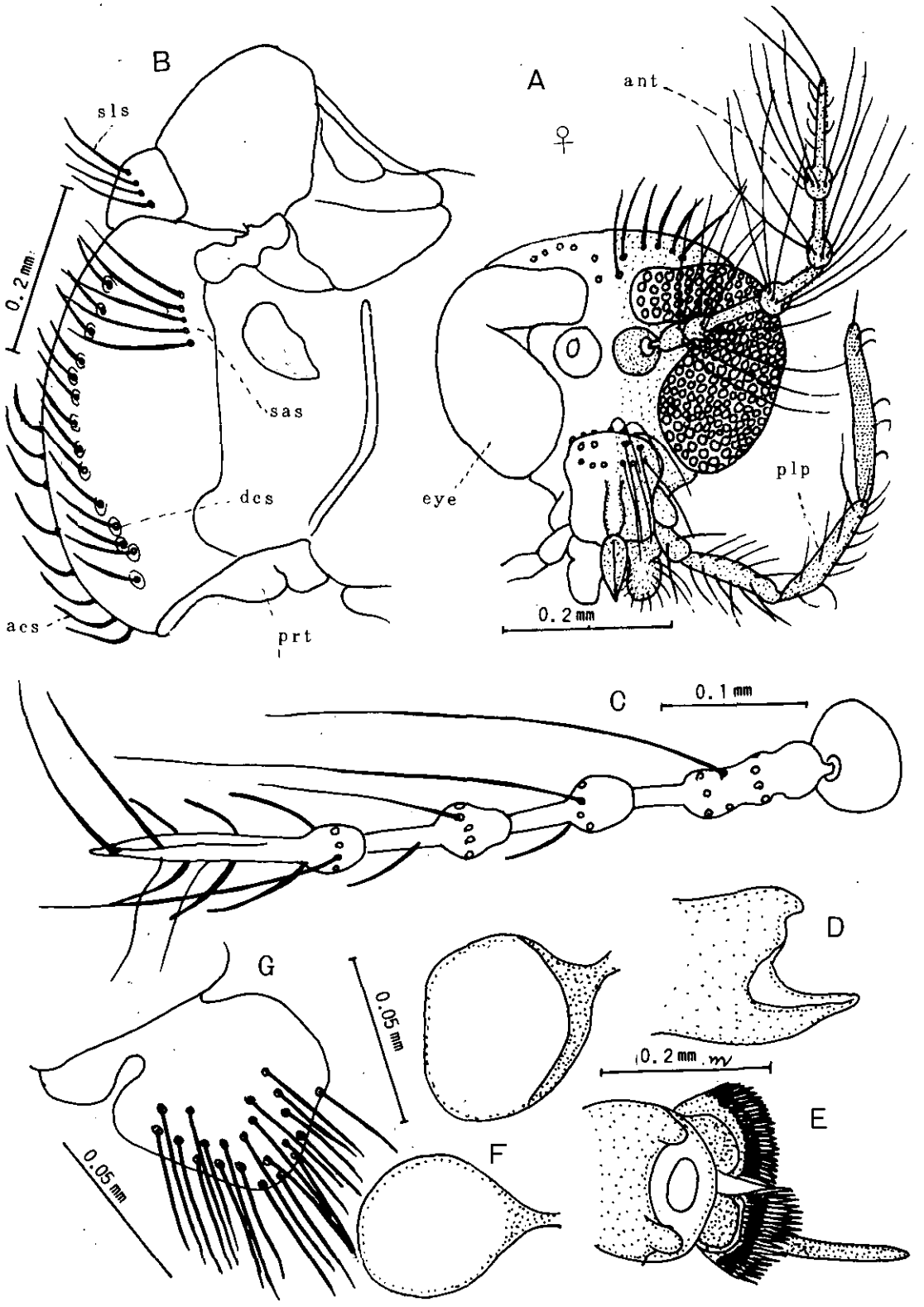

Fig. 16. *Pentapedilum shirokanensis*, sp. nov. Adult.

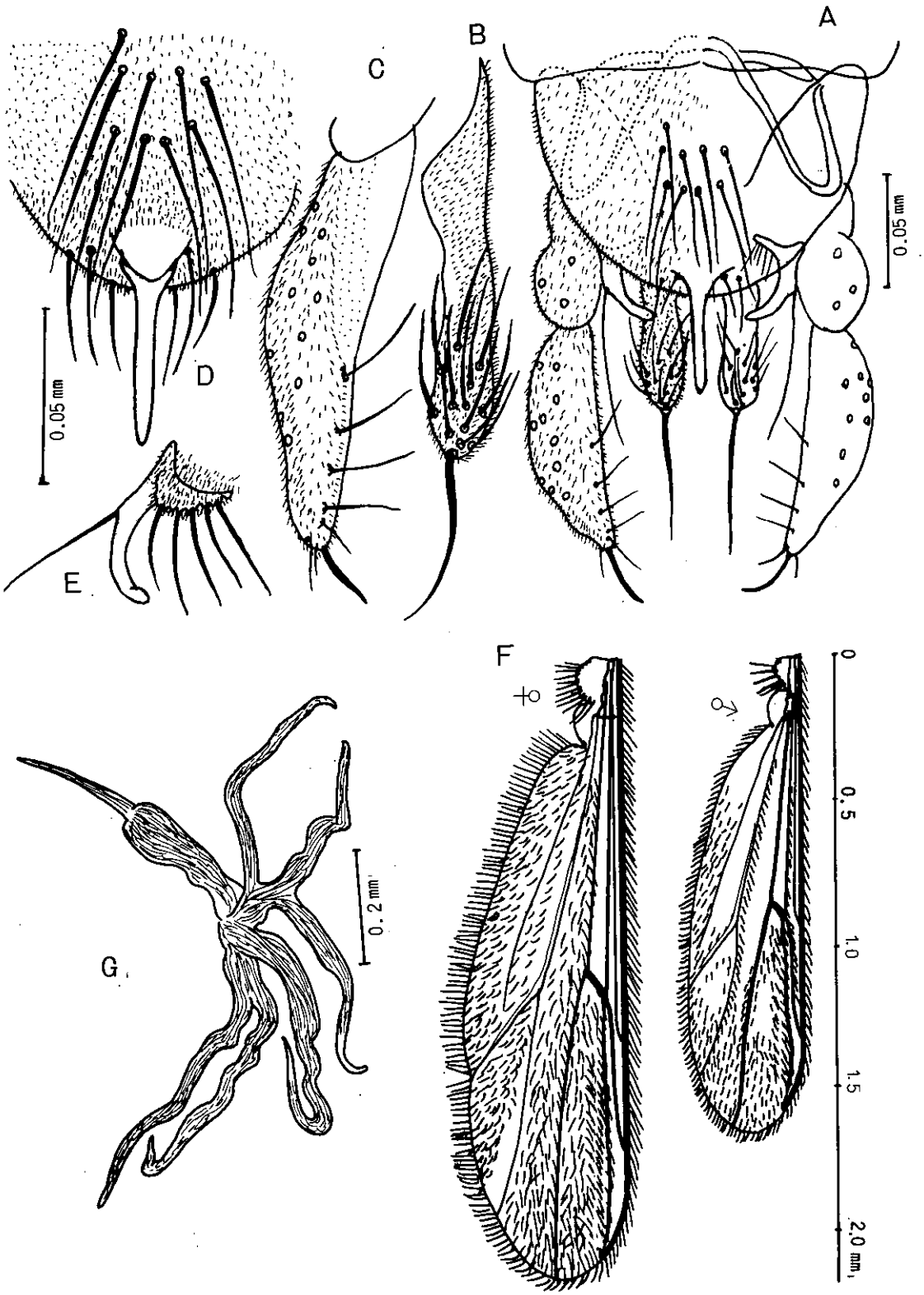

Fig. 17. *Pentapedilum shirokanensis*, sp. nov. Adult and Pupa.

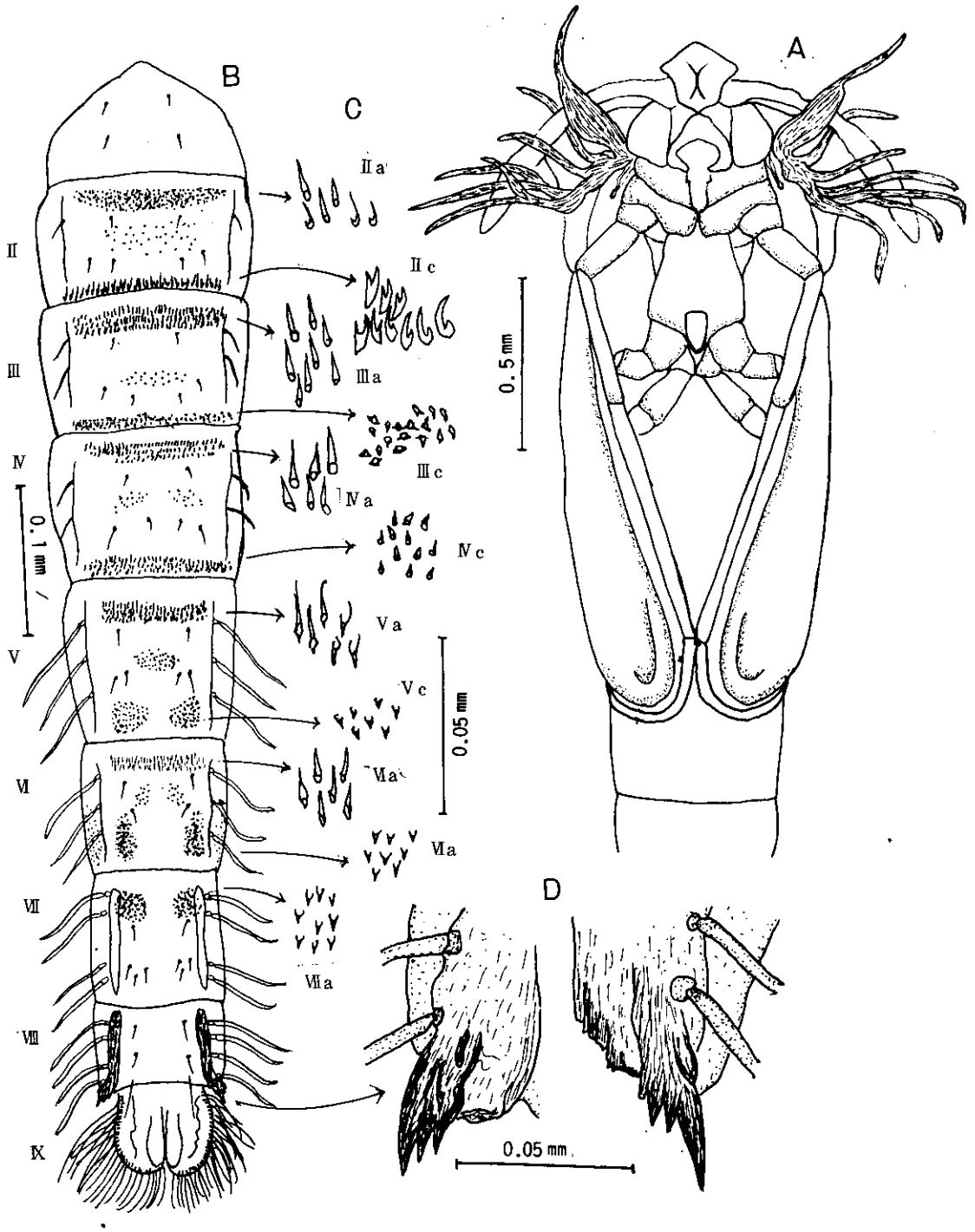

Fig. 18. *Pentapedilum shirokanensis*, sp. nov. Pupa.

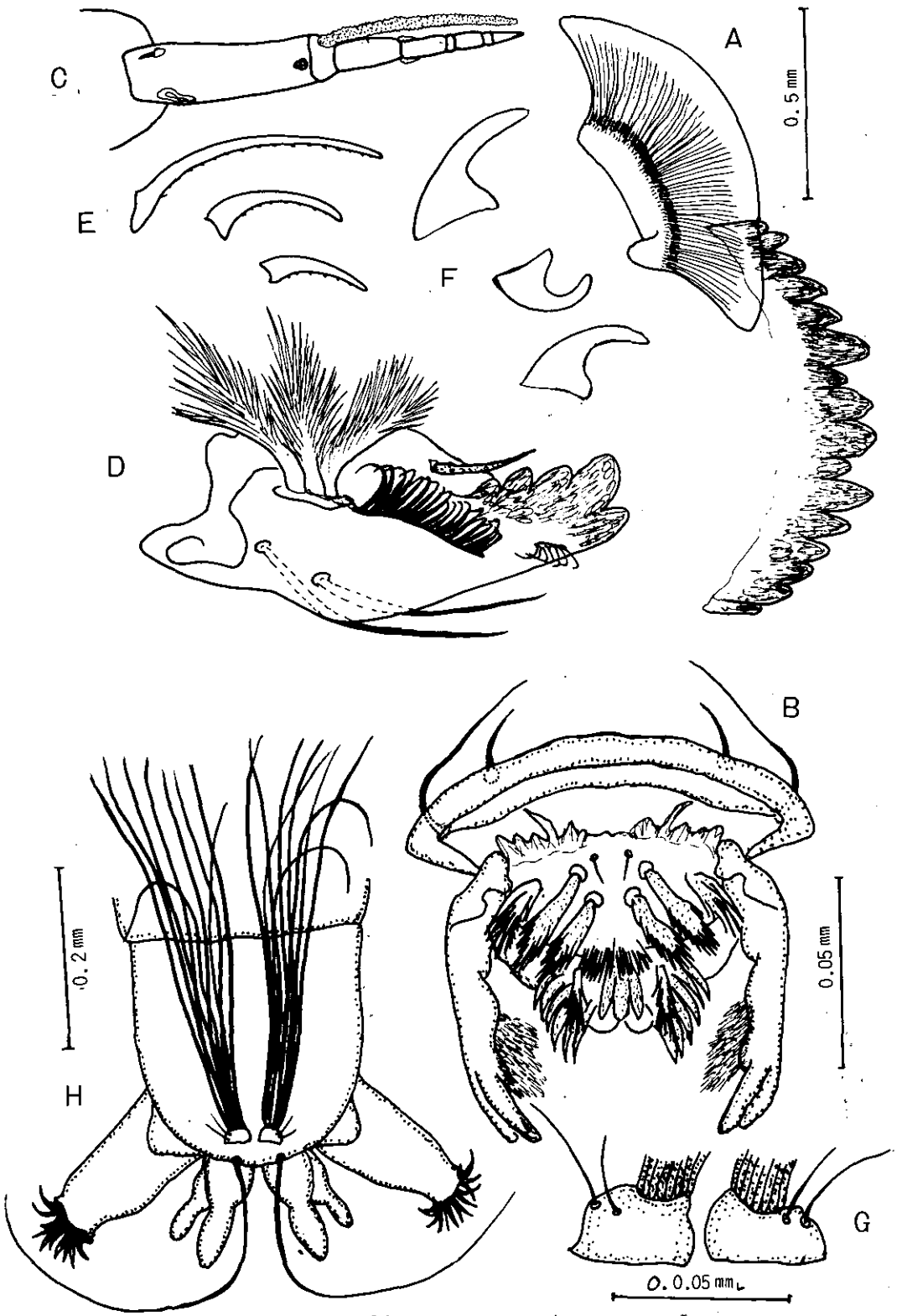

Fig. 19. *Pentapedilum shirokanensis*, sp. nov. Larva.

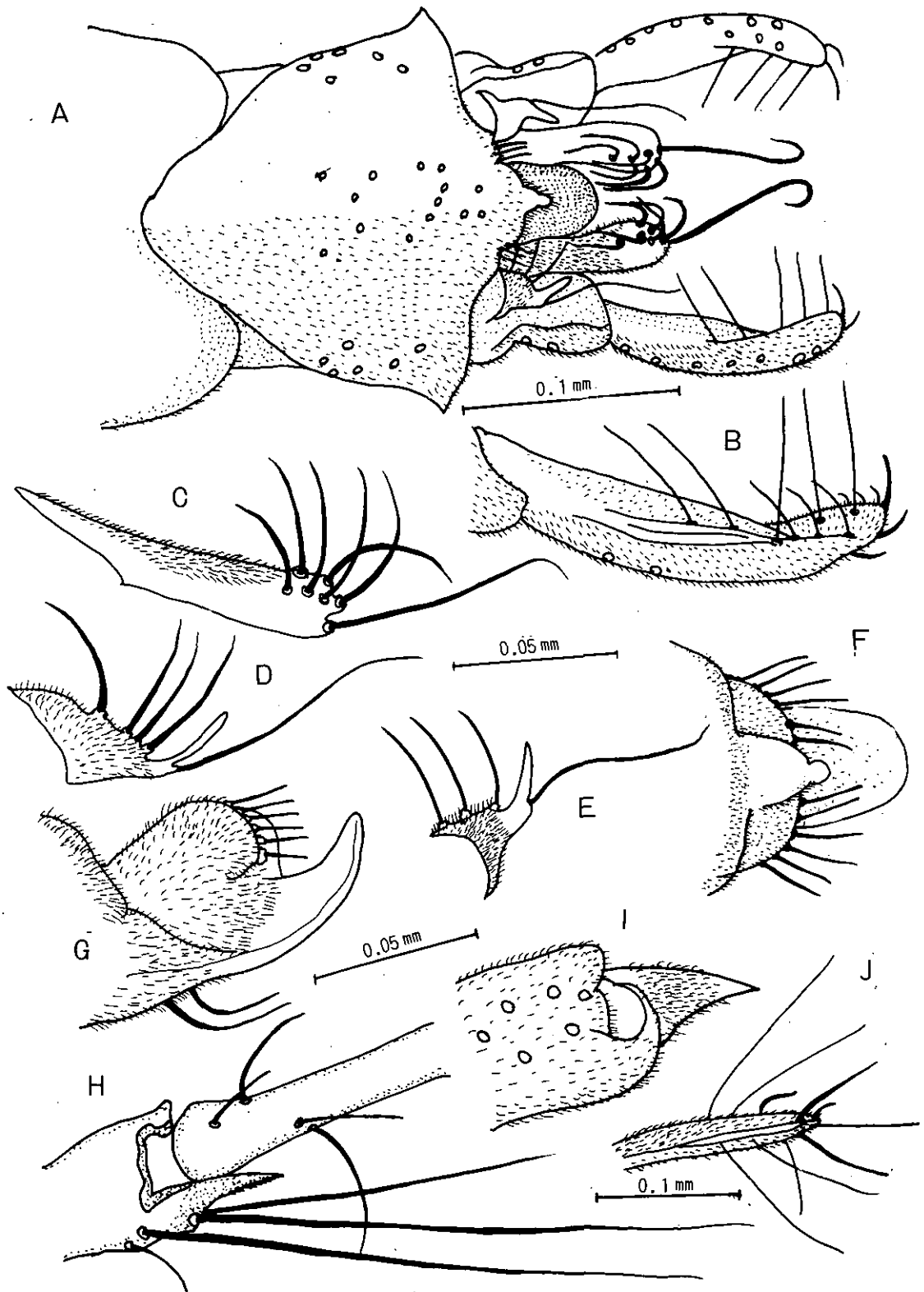

Fig. 20. *Pentapedilum kasumiensis*, sp. nov. Adult male.

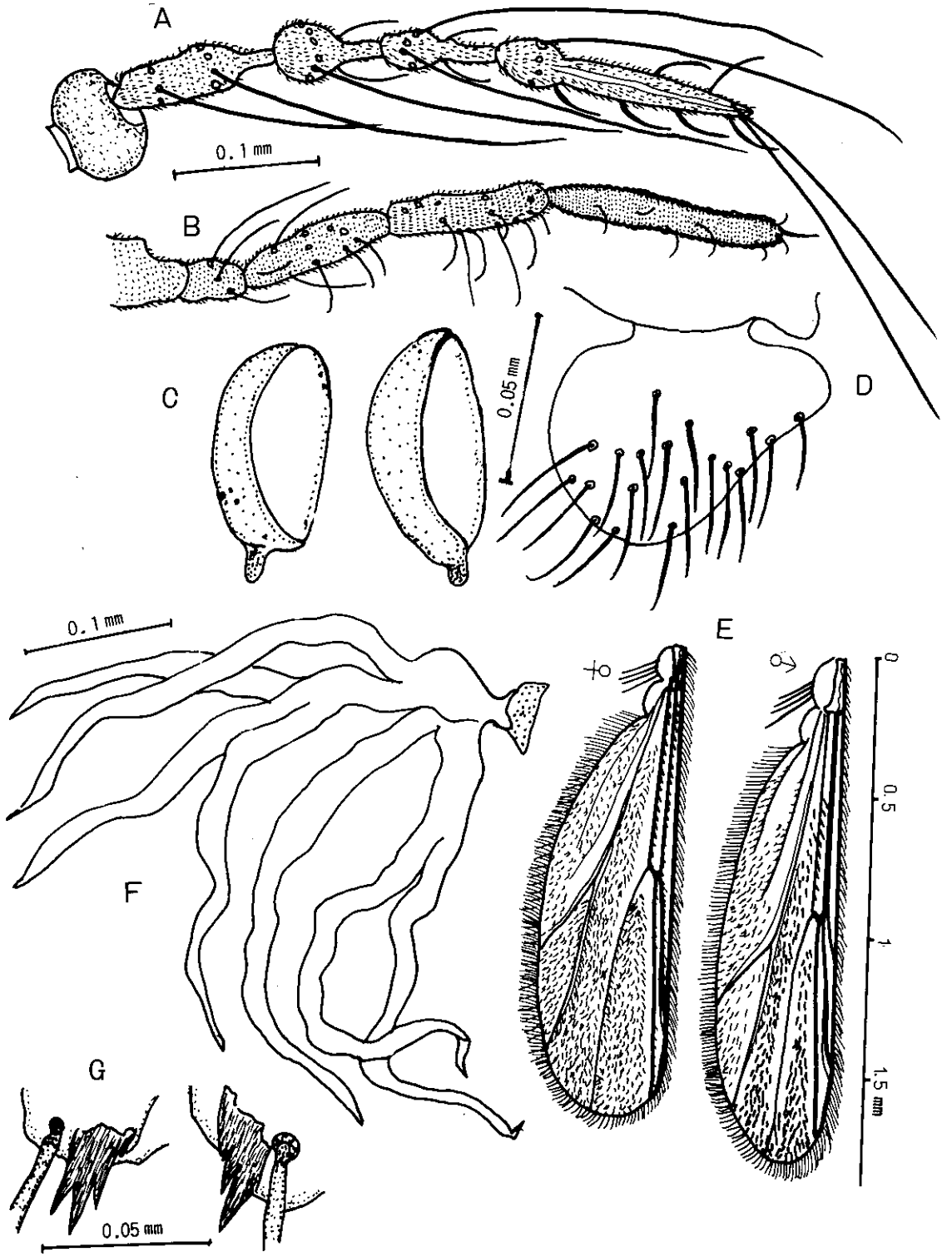

Fig. 21. *Pentapedilum kasumiensis*, sp. nov. Adult and Pupa.

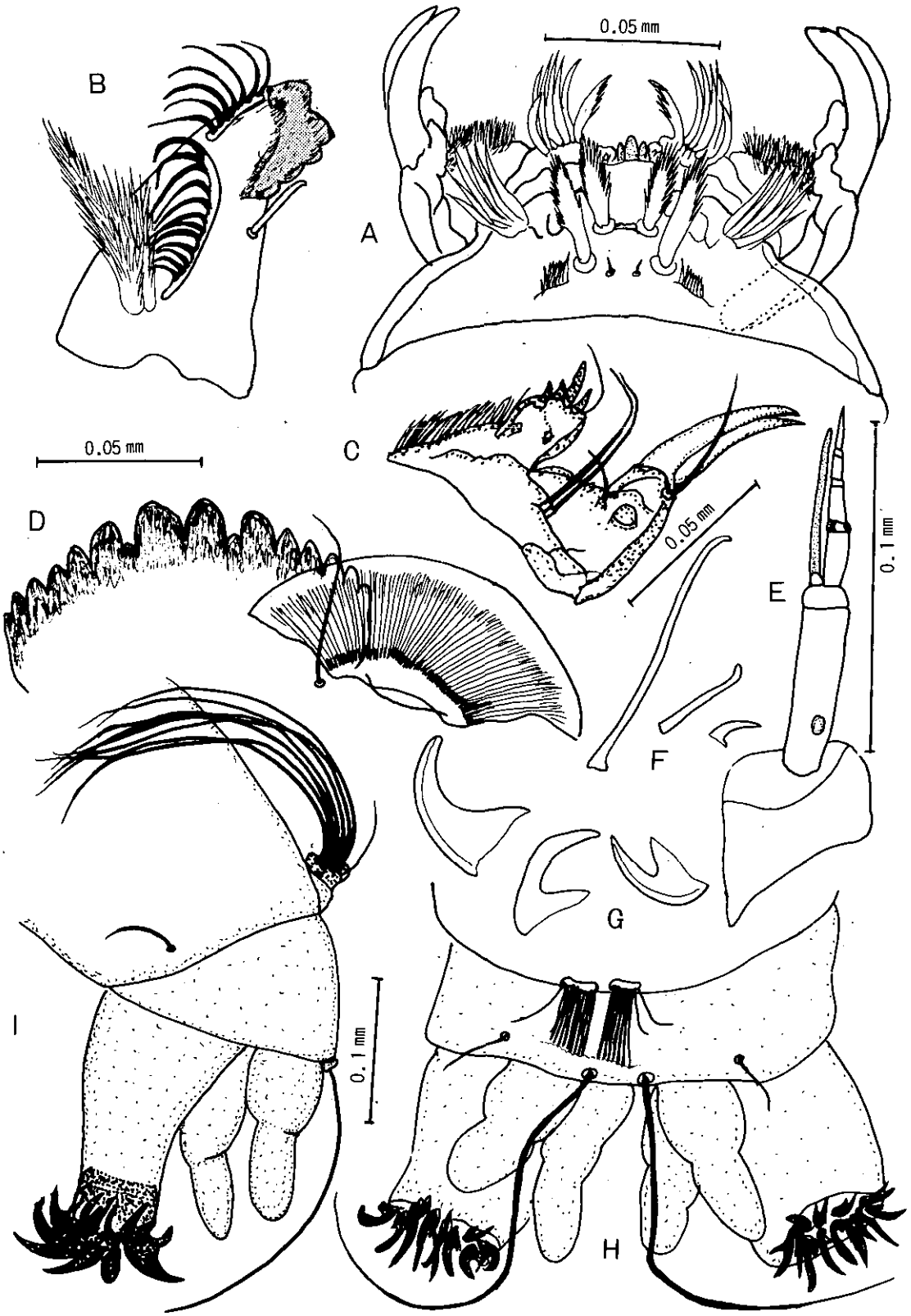

Fig. 22. *Pentapedilum kasumiensis*, sp. nov. Larva.

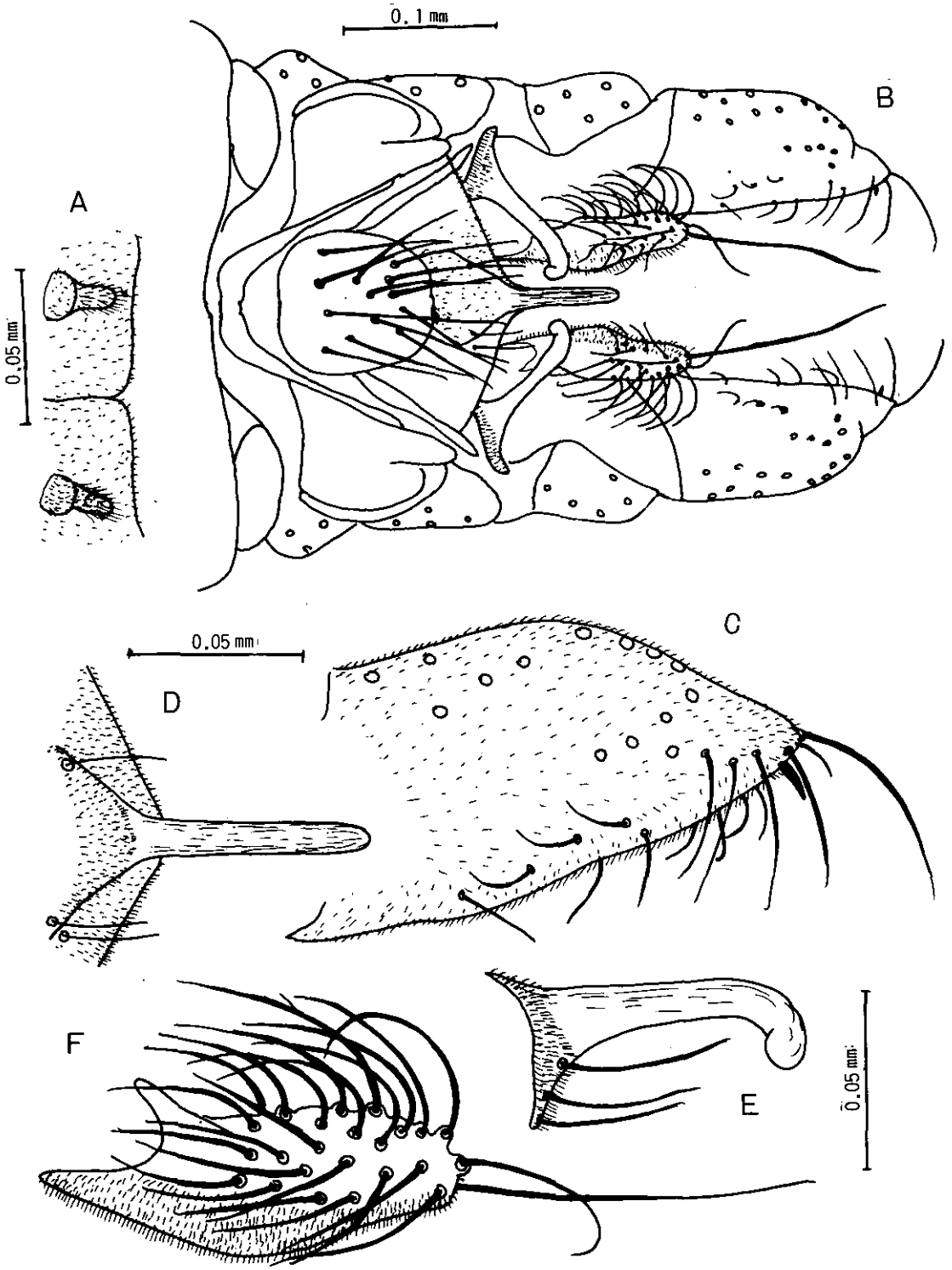

Fig. 23. *Polypedilum octoguttatum* (Tokunaga) Male.

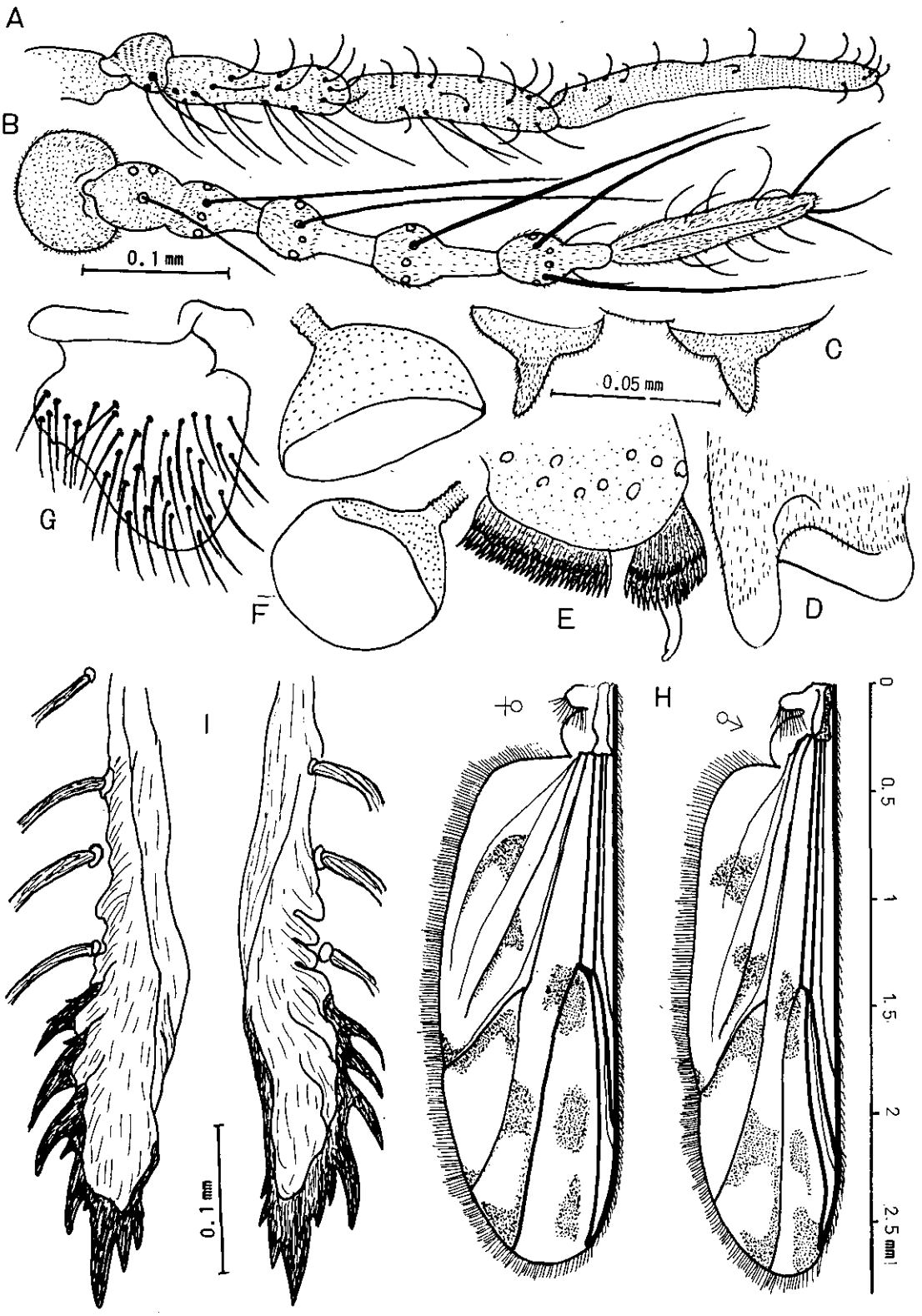

Fig. 24. *Polypedilum octoguttatum* (Tokunaga) Adult and Pupa.

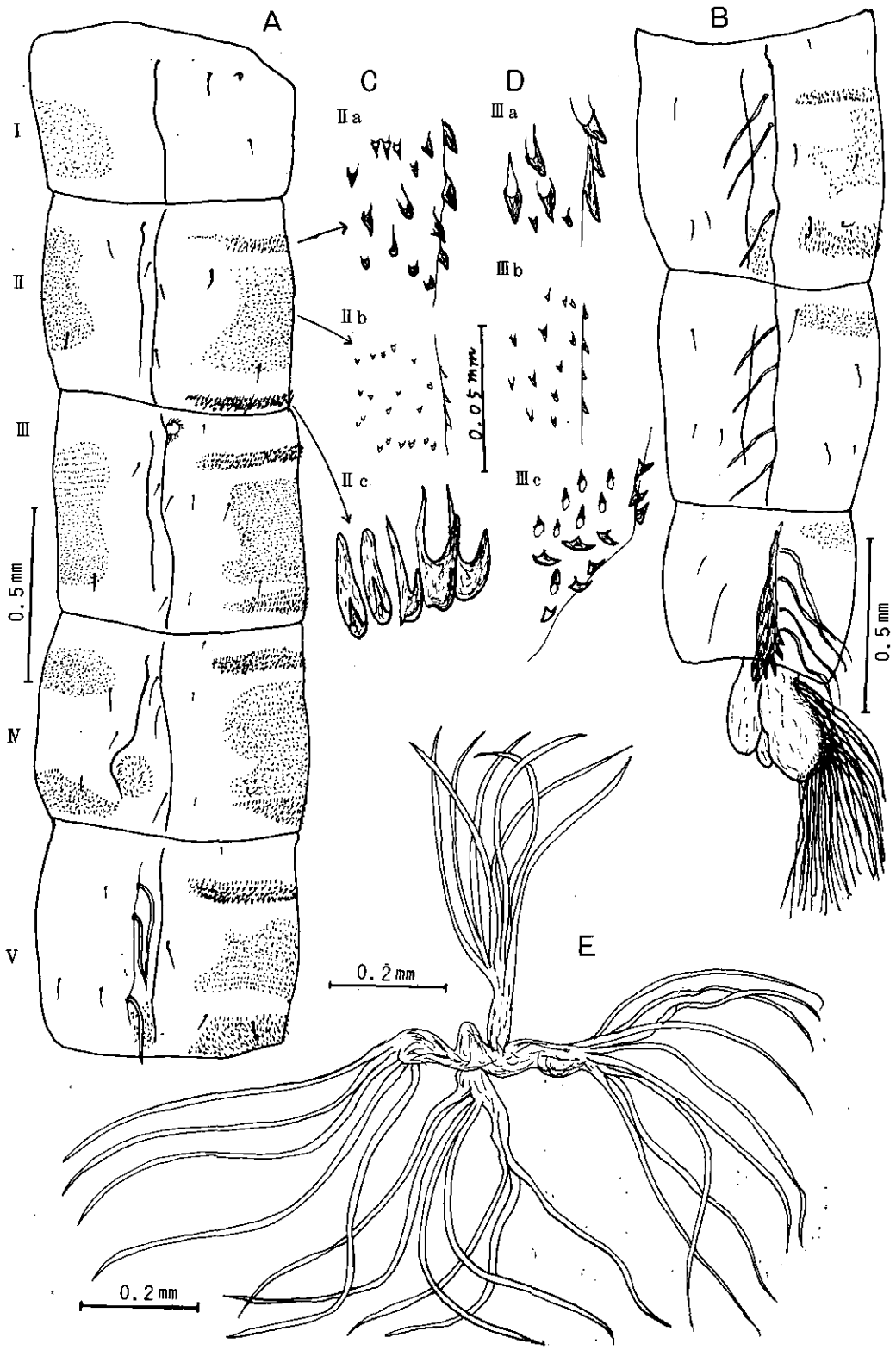

Fig. 25. *Polypedilum octoguttatum* (Tokunaga) Pupa.

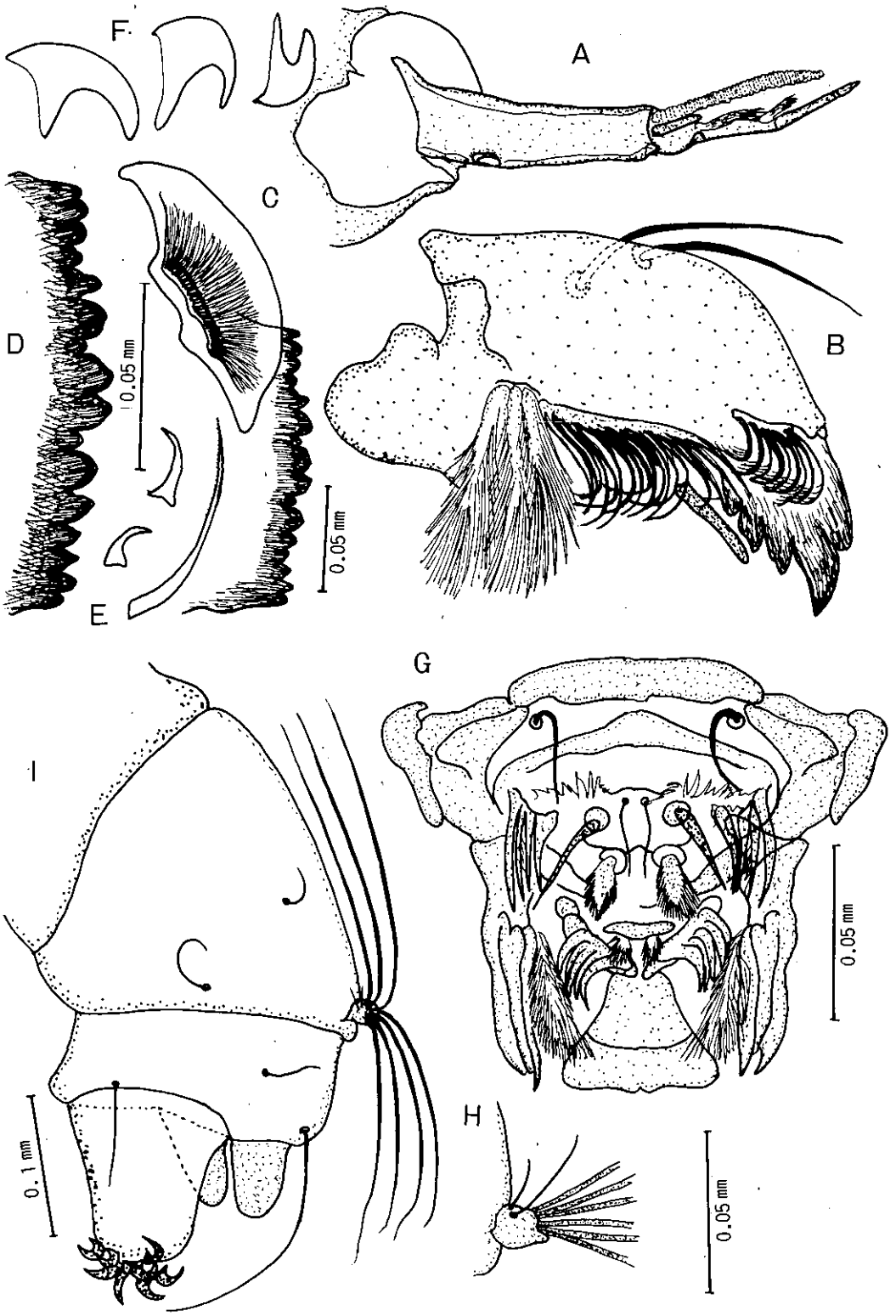

Fig. 26. *Polypedilum octoguttatum* (Tokunaga) Larva.

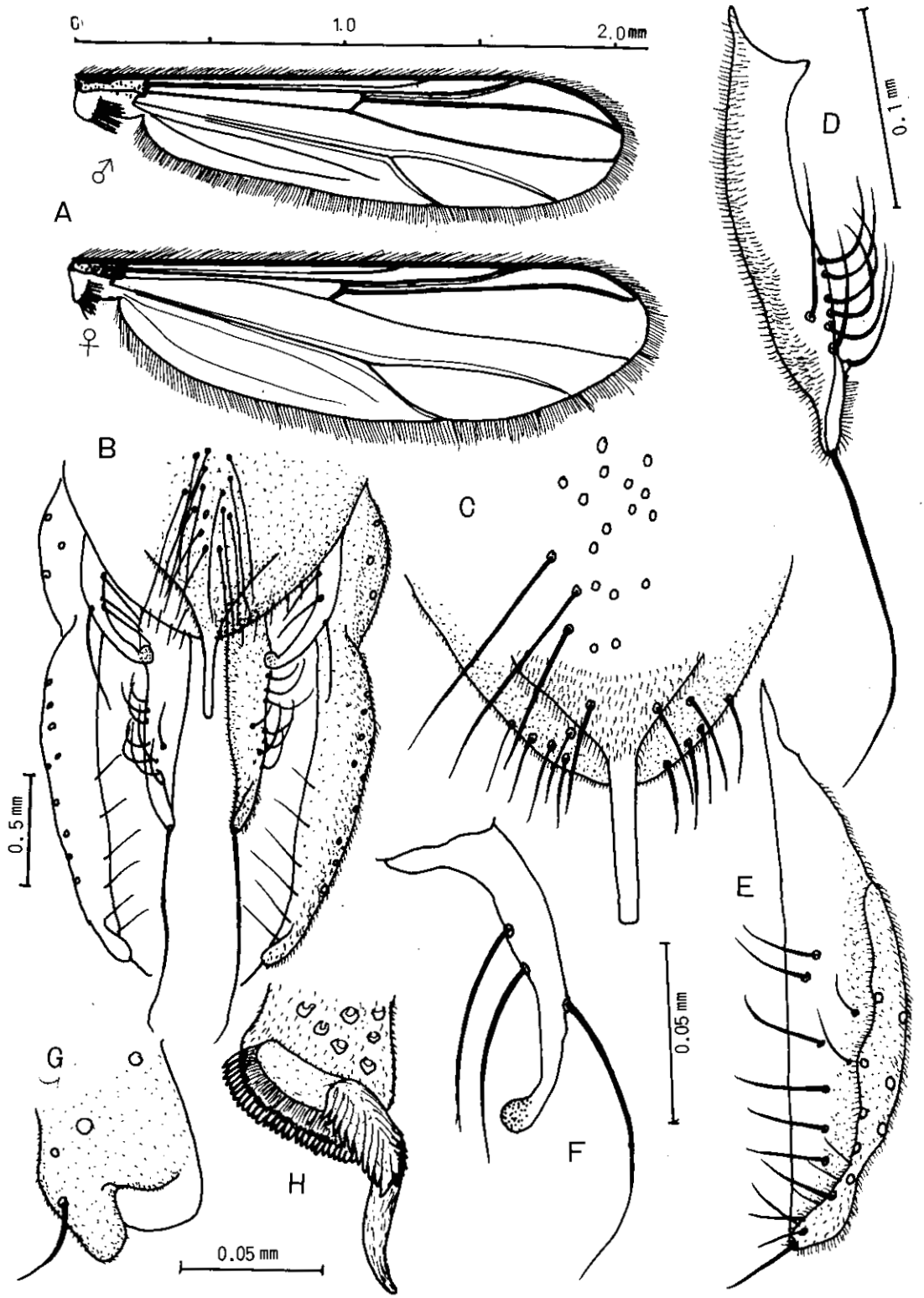

Fig. 27. *Microtendipes tsukubaensis*, sp. nov. Adult.

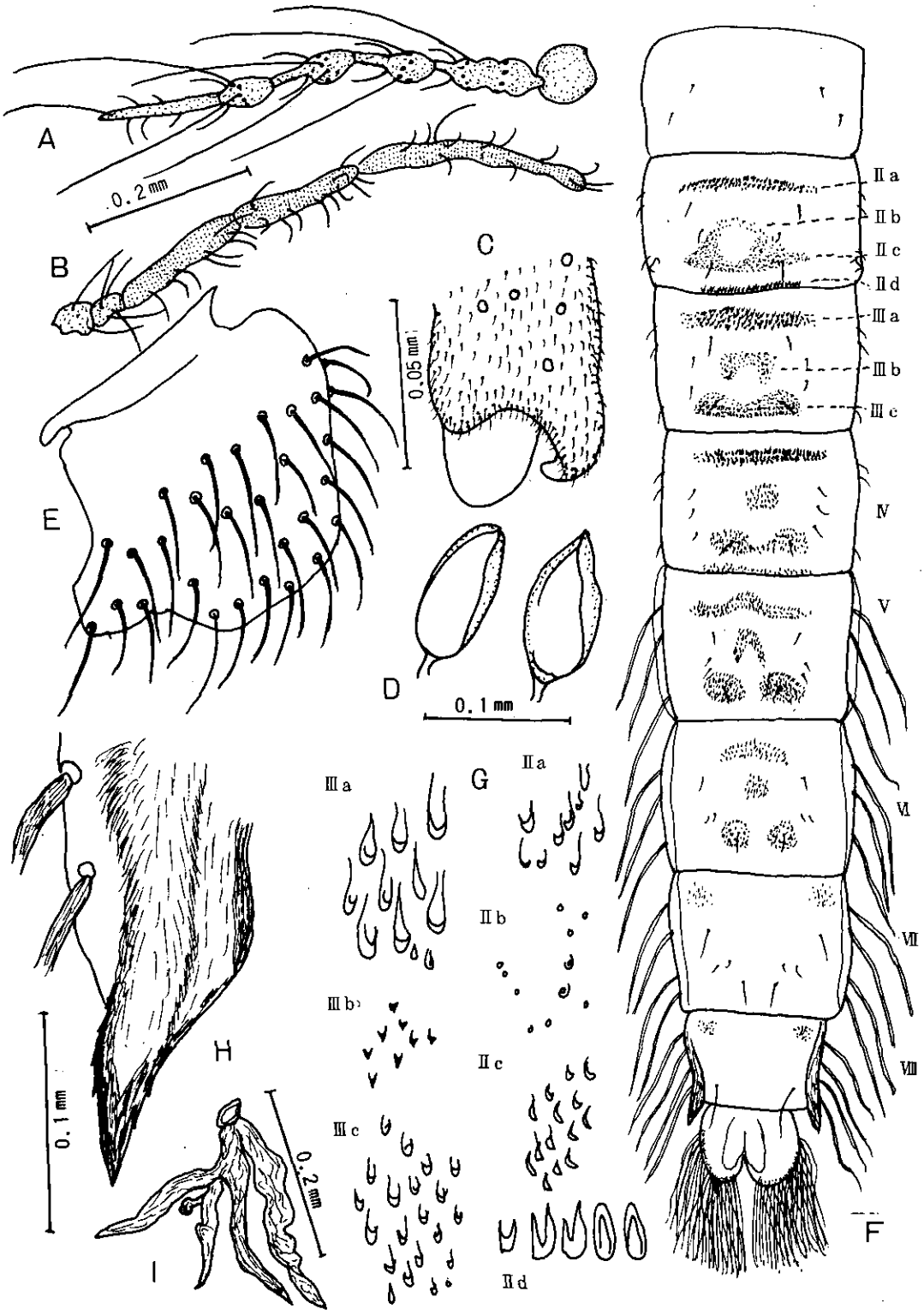

Fig. 28. *Microtendipes tsukubaensis*, sp. nov. Adult female and Pupa.

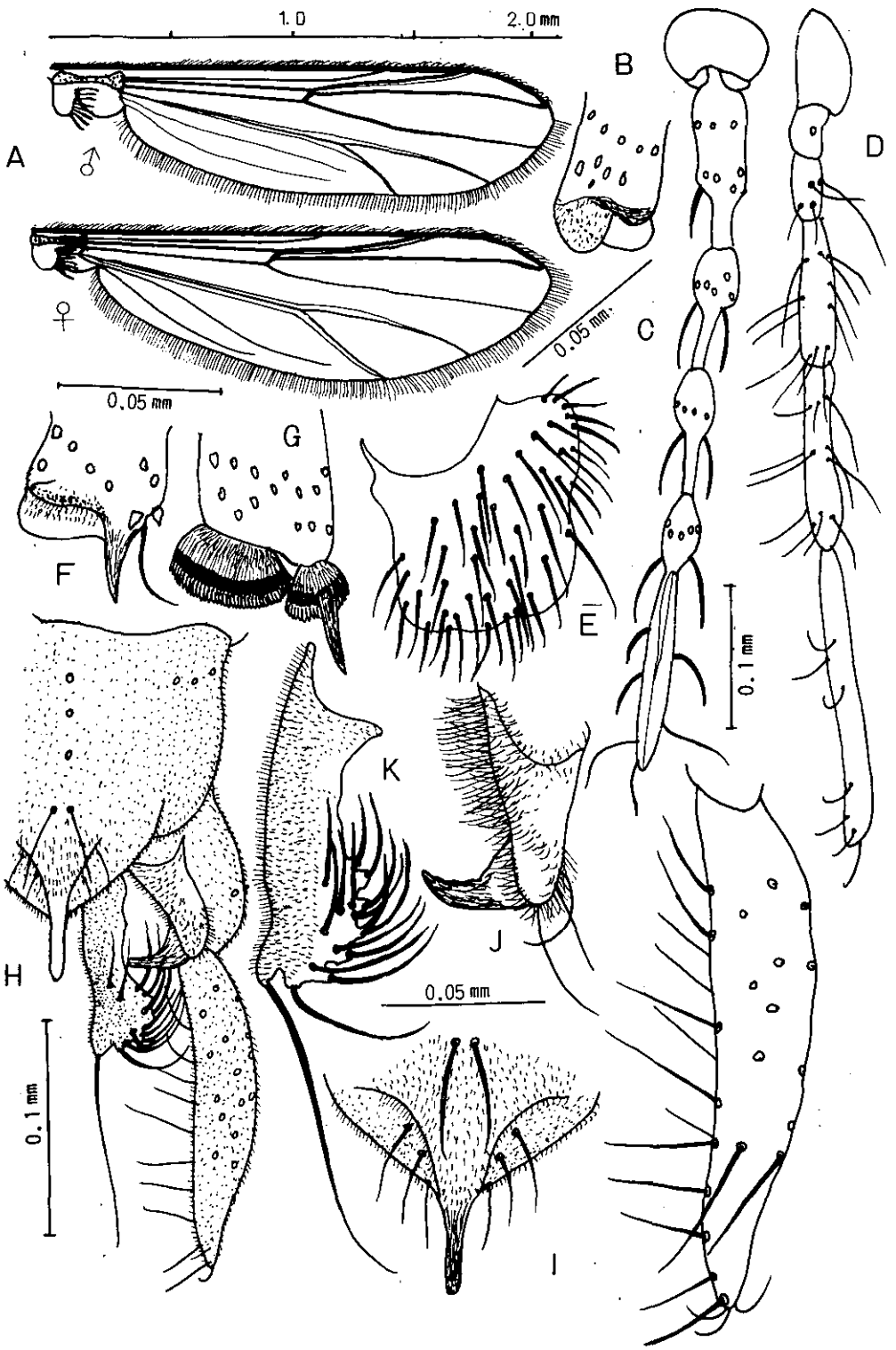

Fig. 29. *Microtendipes ureshinoensis*, sp. nov. Adult.

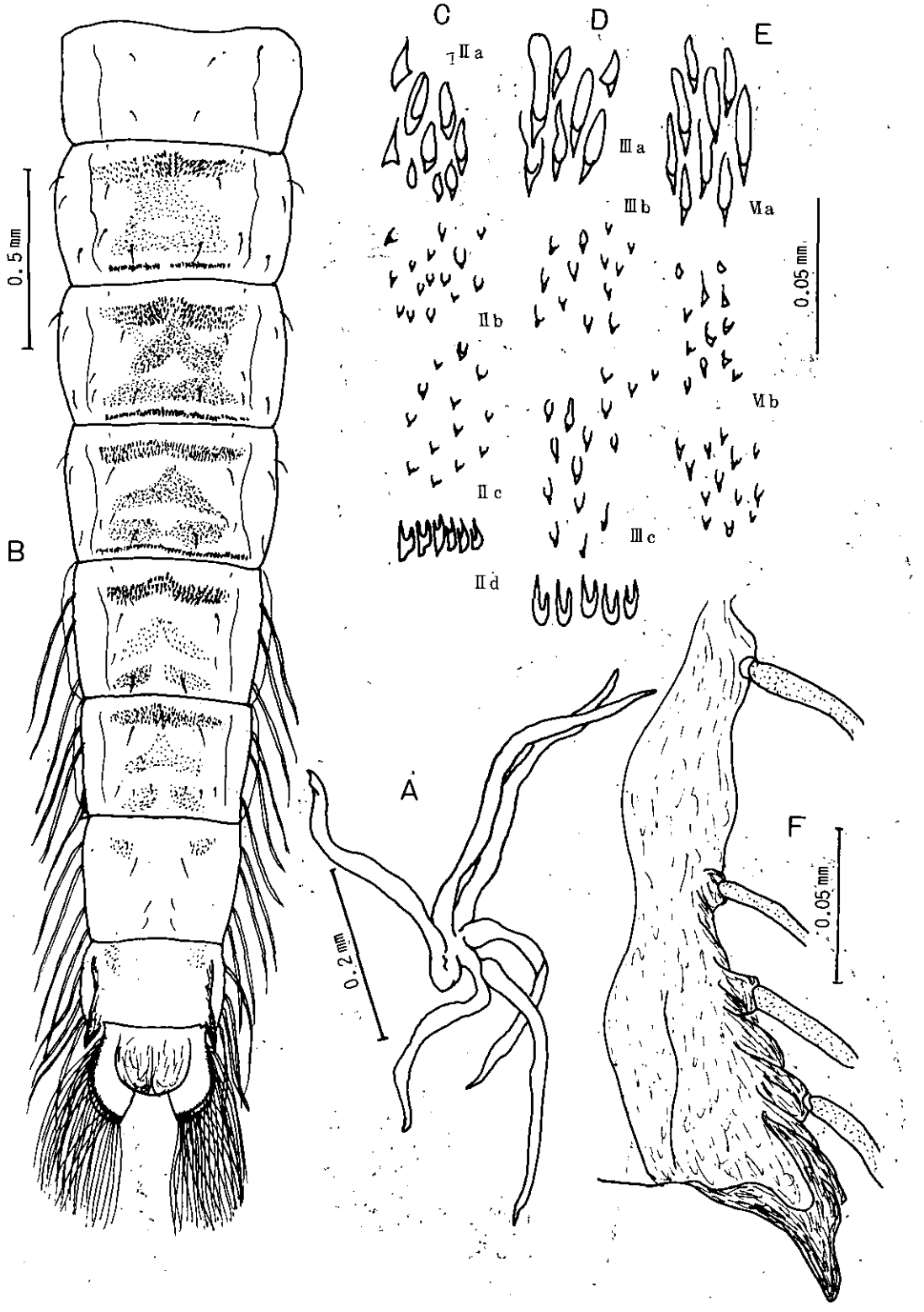

Fig. 30. *Microtendipes ureshinoensis*, sp. nov. Pupa.

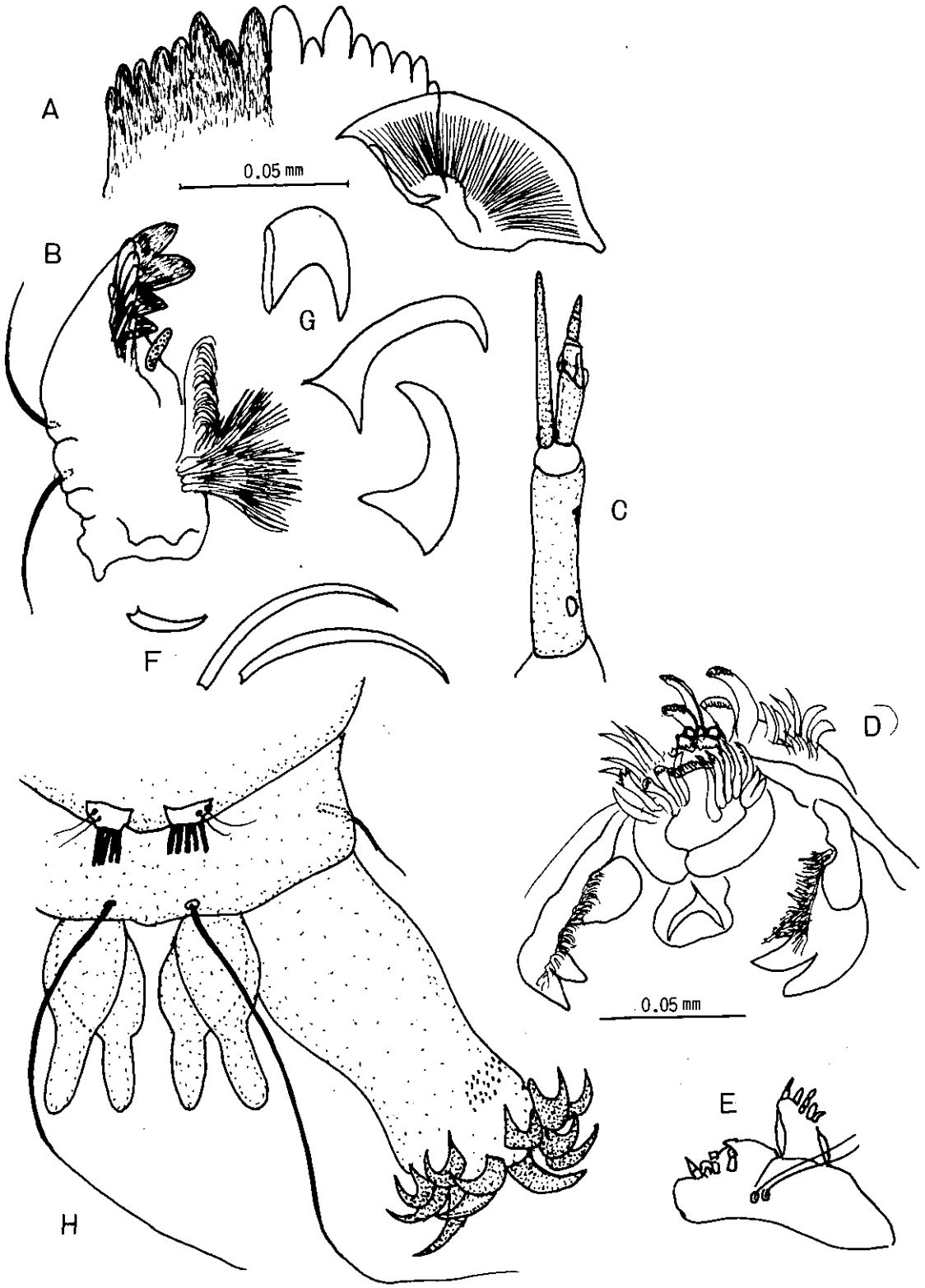

Fig. 31. *Microtendipes ureshinoensis*, sp. nov. Larva.

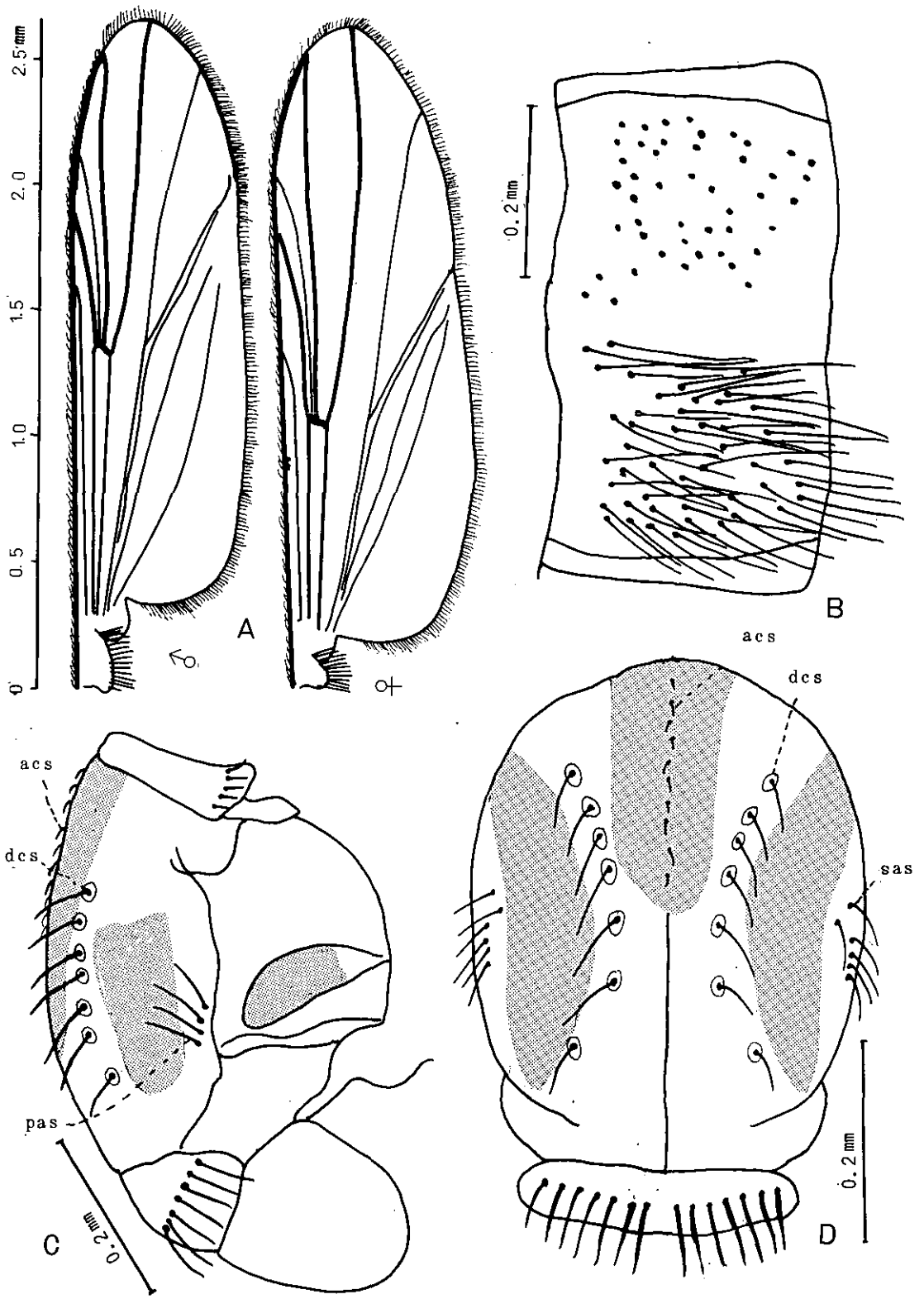

Fig. 32. *Orthocladius (Orthocladius) makabensis*, sp. nov. Adult.

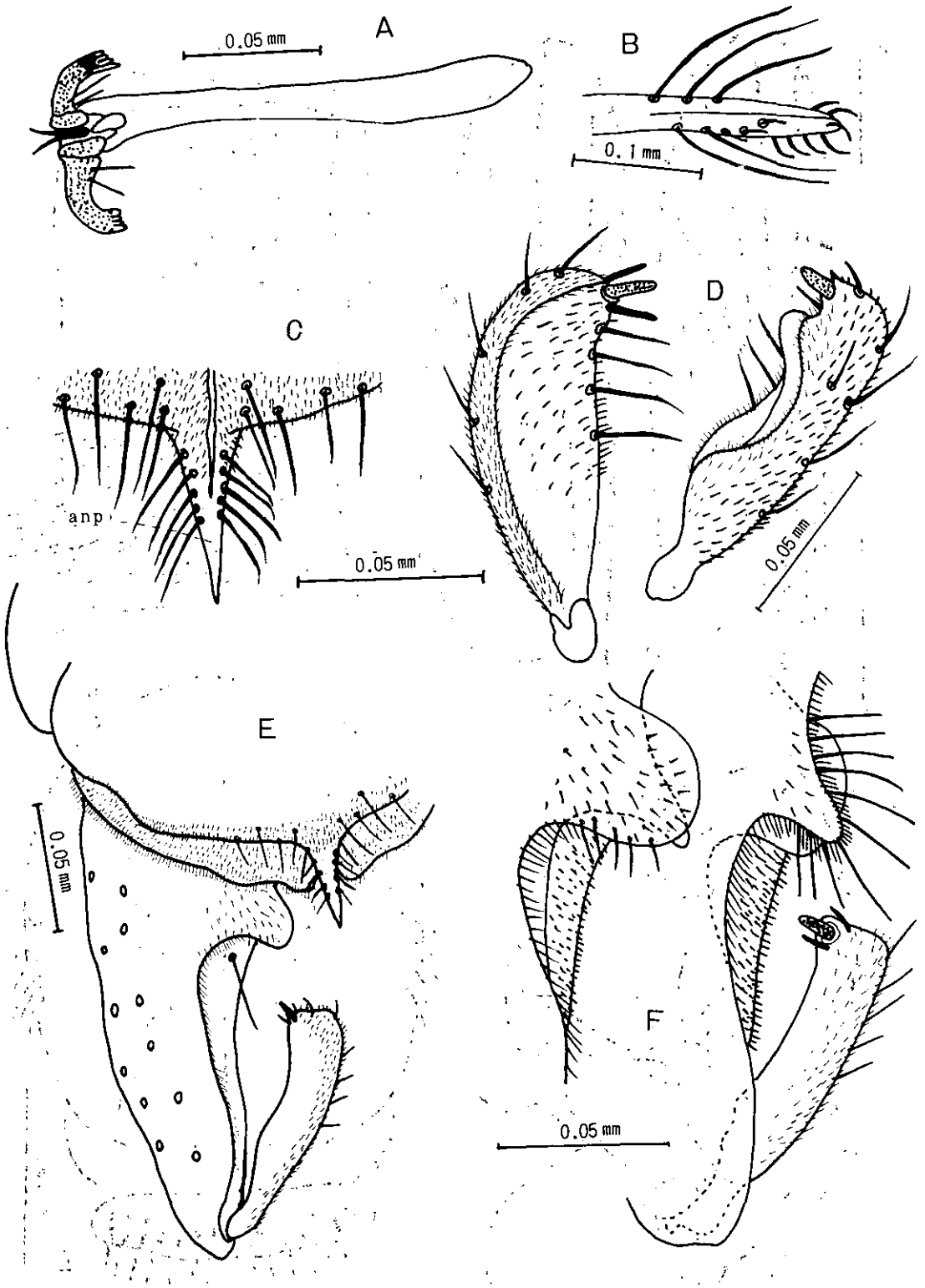

Fig. 33. *Orthocladius (Orthocladius) makabensis*, sp. nov. Adult male.

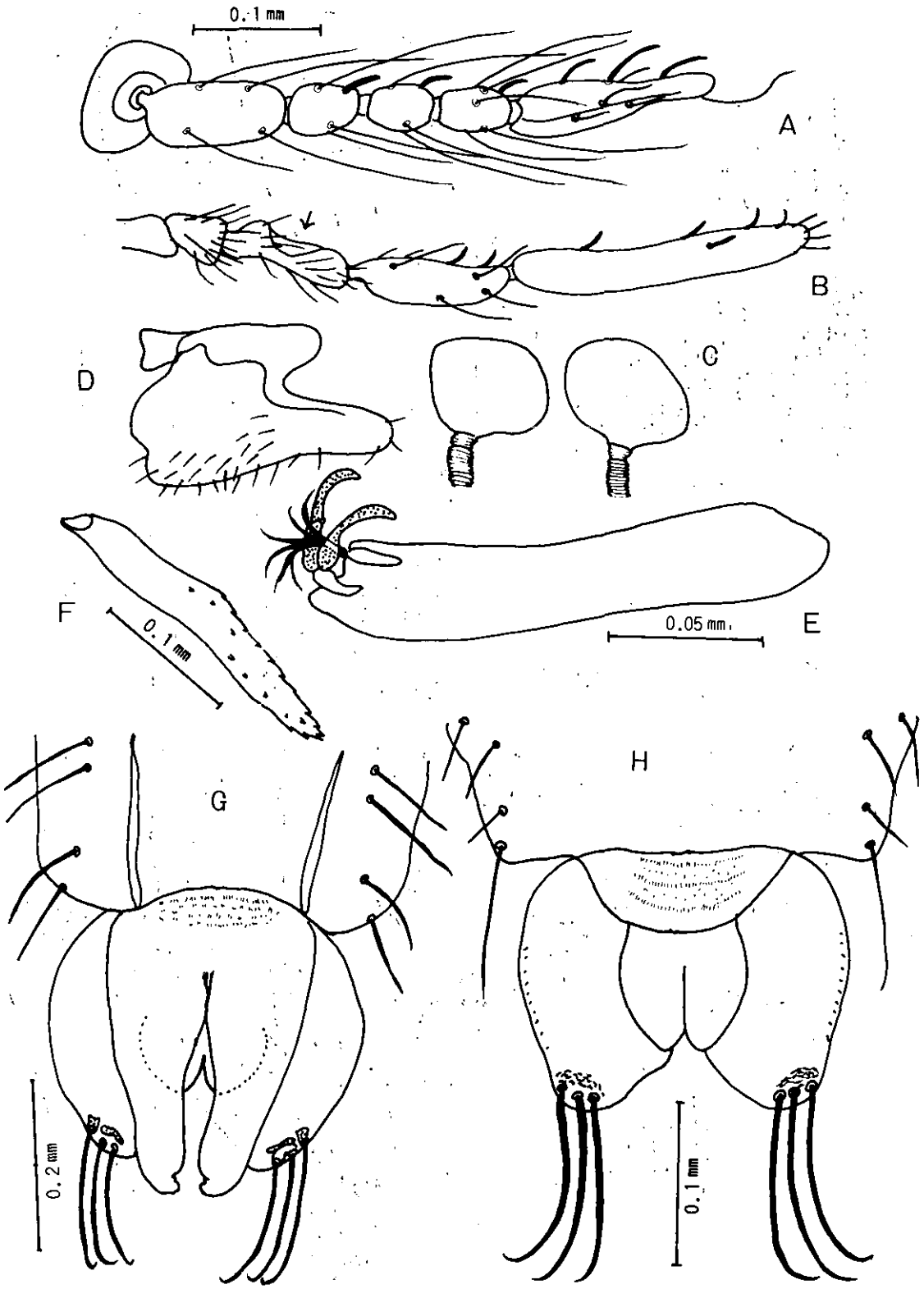

Fig. 34. *Orthocladius (Orthocladius) makabensis*, sp. nov. Female adult and Pupa.

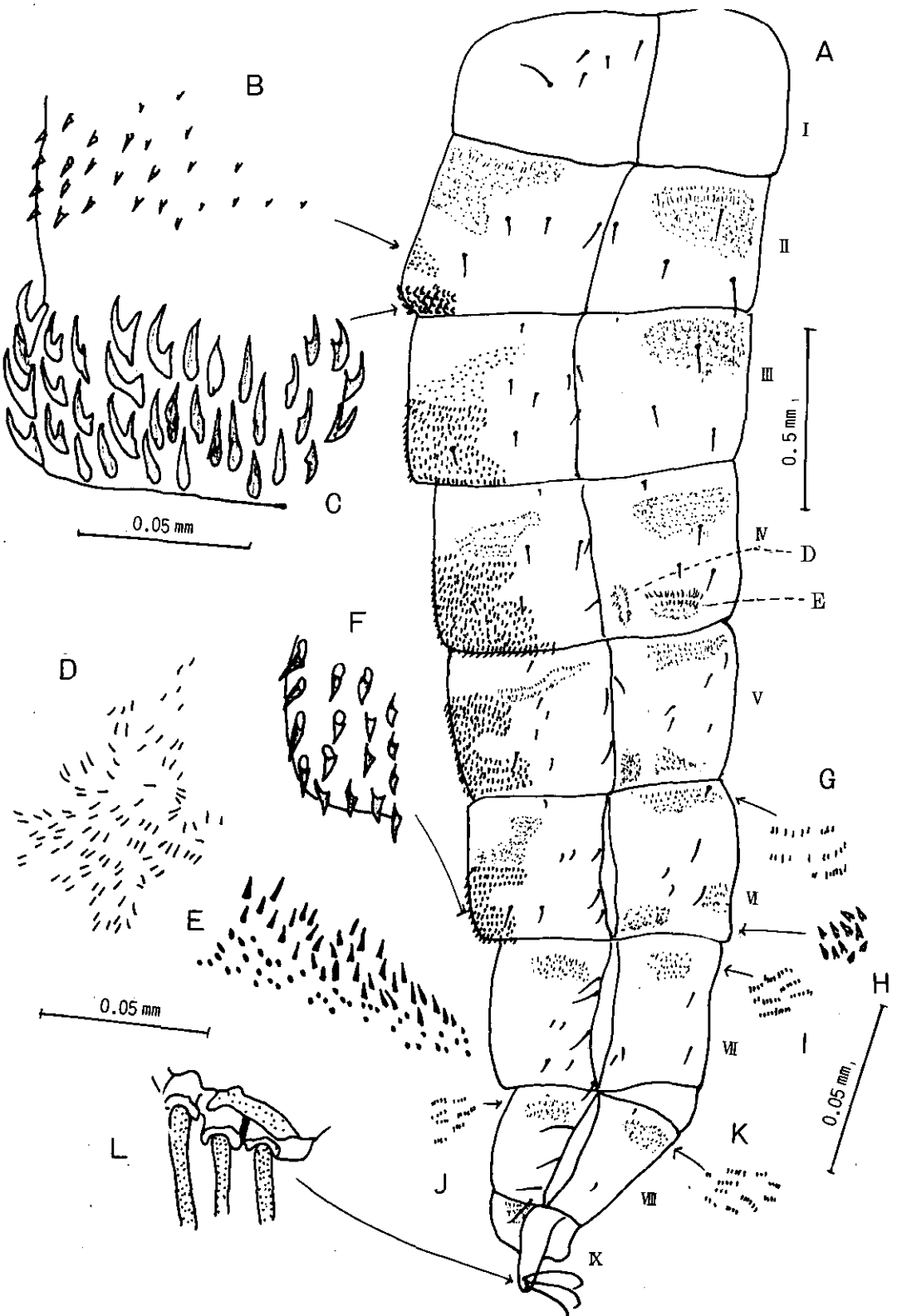

Fig. 35. *Orthocladius (Orthocladius) makabensis*, sp. nov. Pupa.

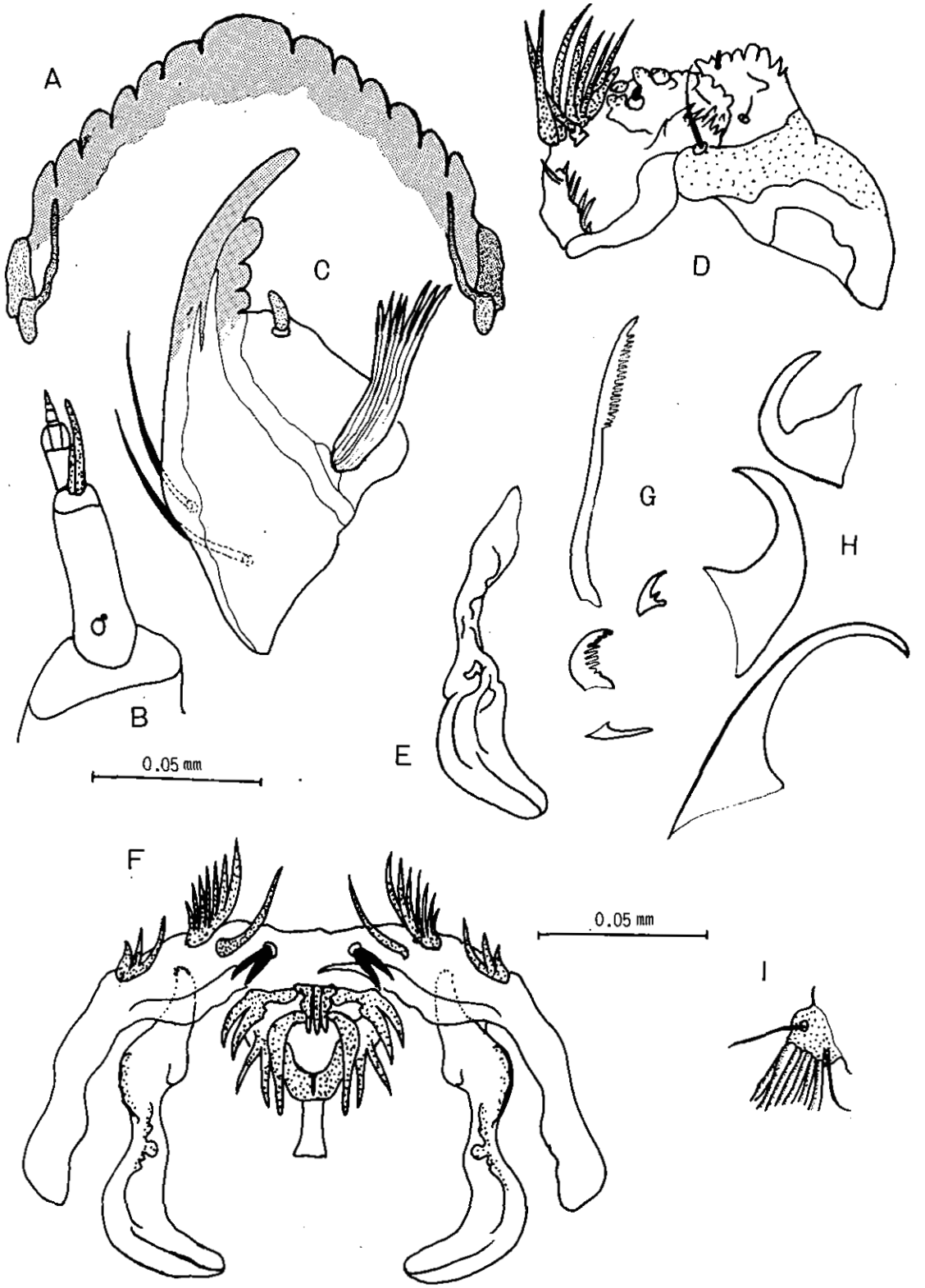

Fig. 36. *Orthocladius (Orthocladius) makabensis*, sp.nov. Larva.

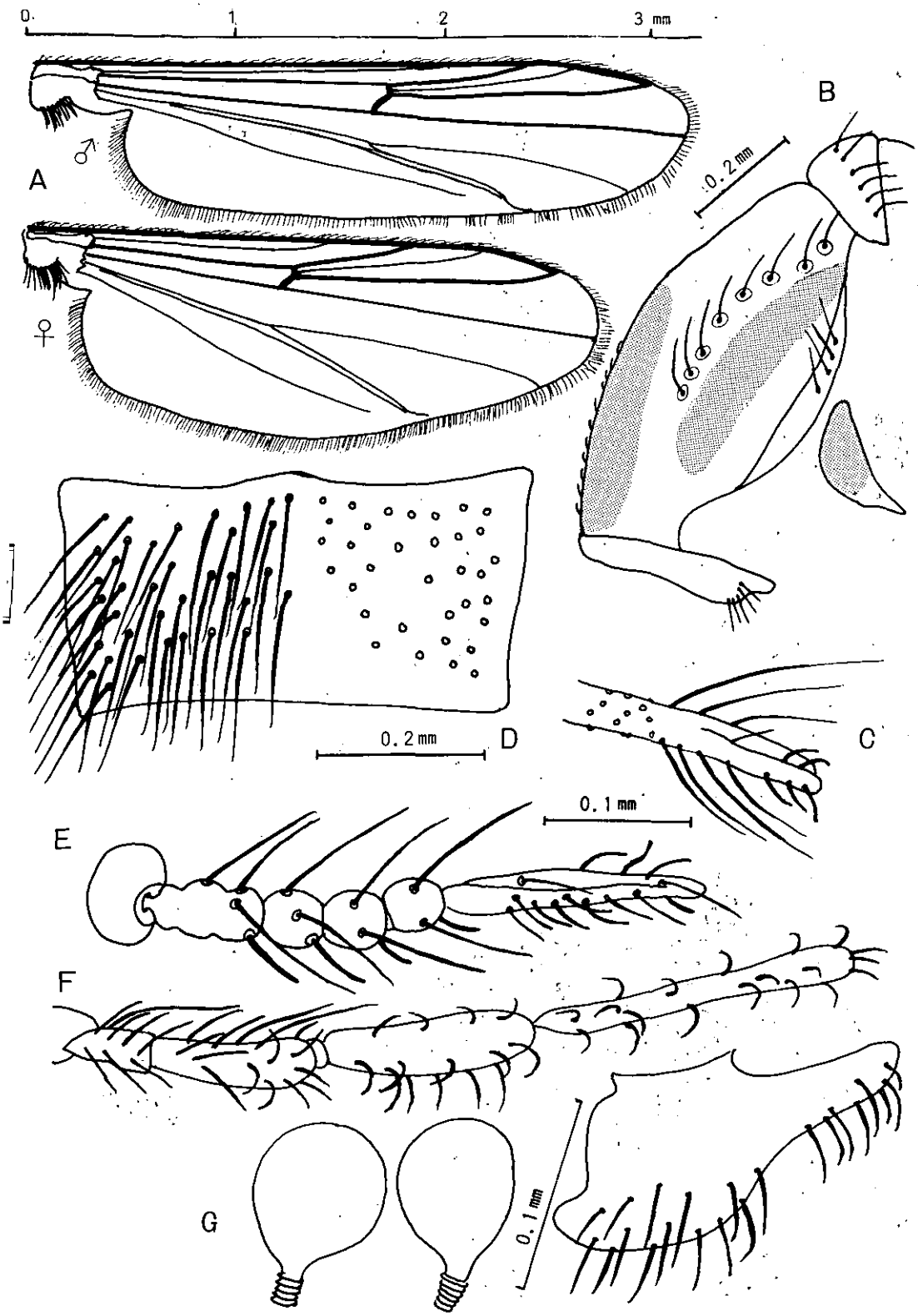

Fig. 37. *Orthocladius (Orthocladius) yugashimaensis*, sp. nov. Adult.

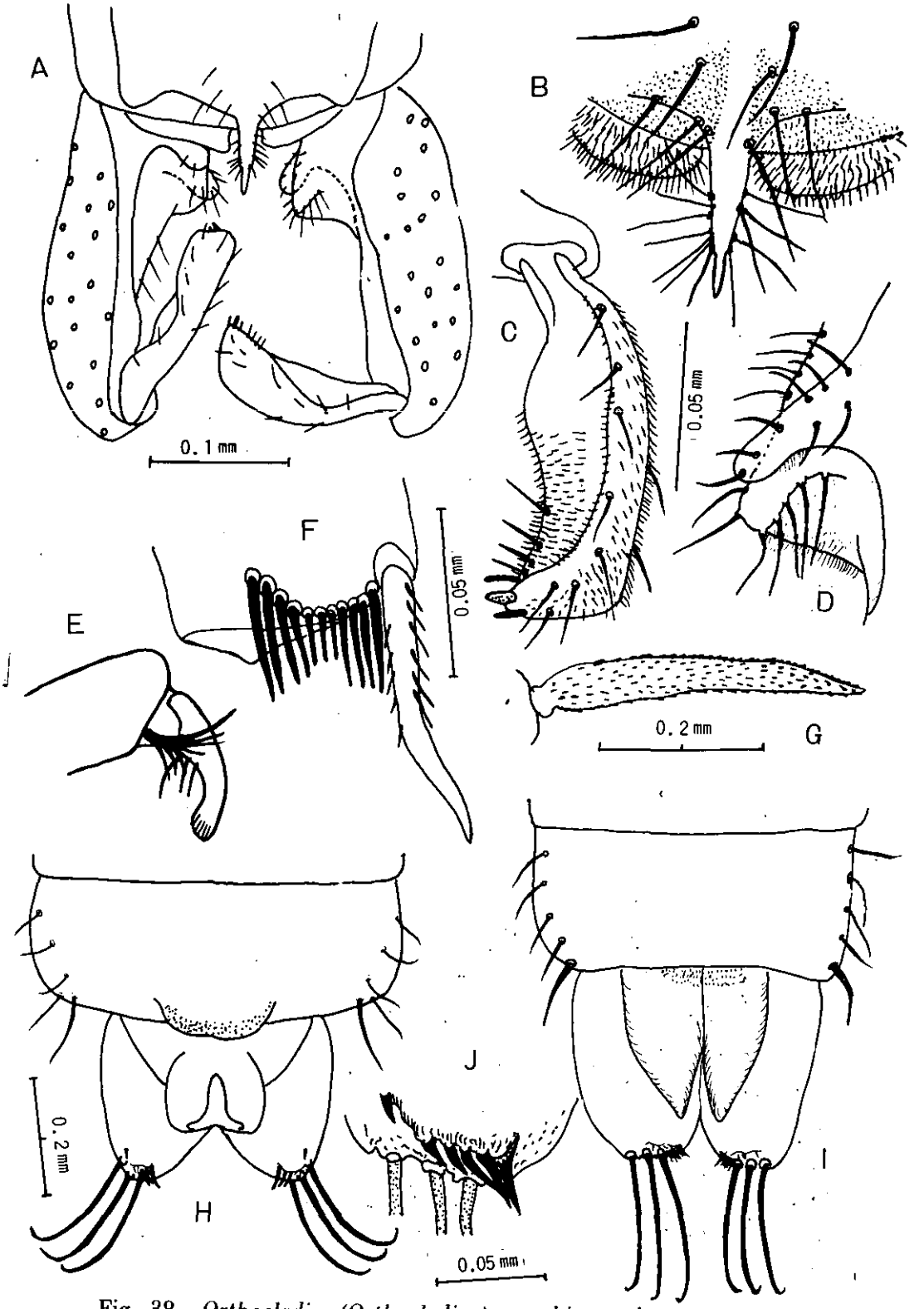

Fig. 38. *Orthocladius (Orthocladius) yugashimaensis*, sp. nov. Male adult and Pupa.

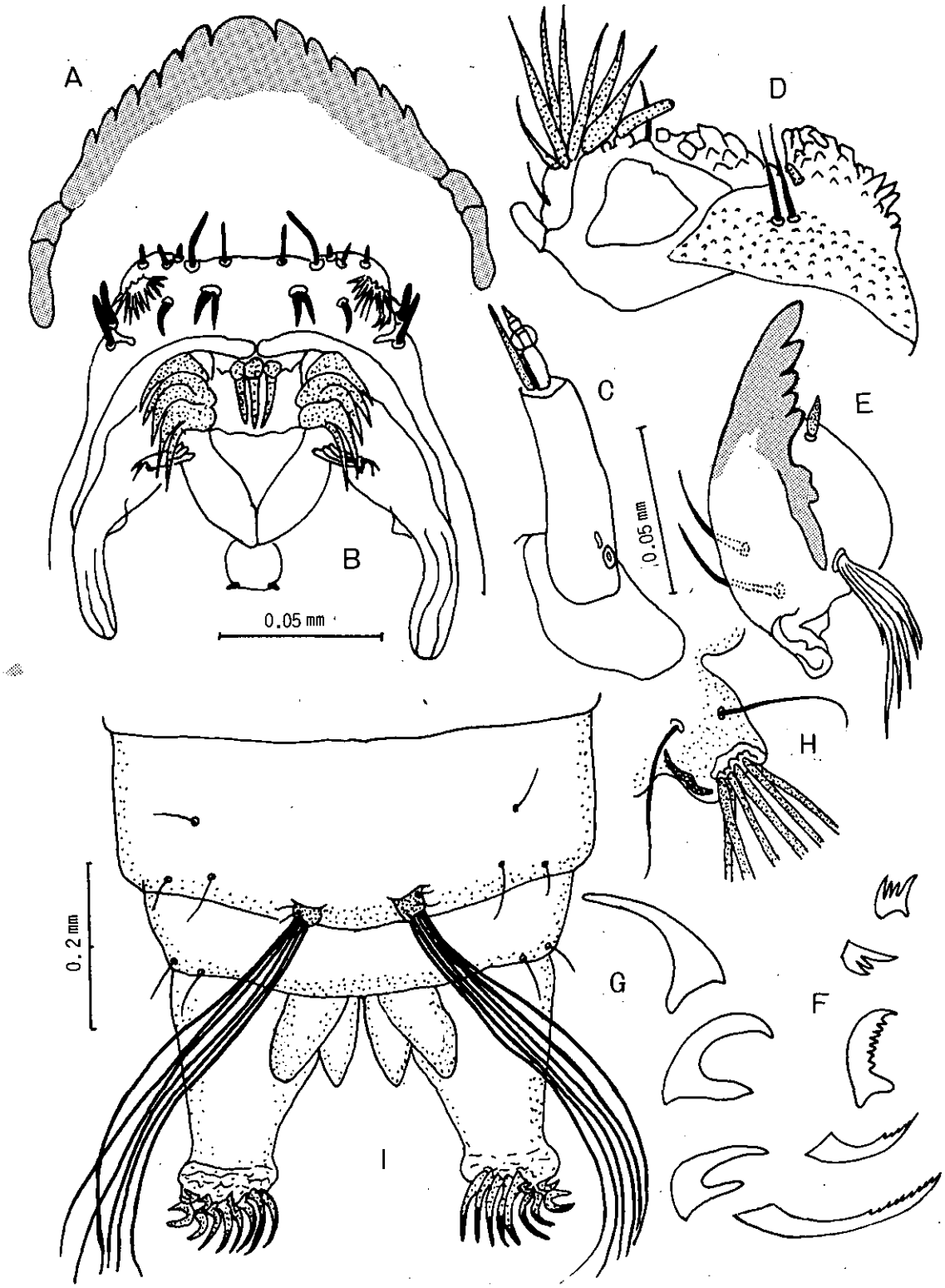

Fig. 39. *Orthocladius (Orthocladius) yugashimaensis*, sp. nov. Larva.

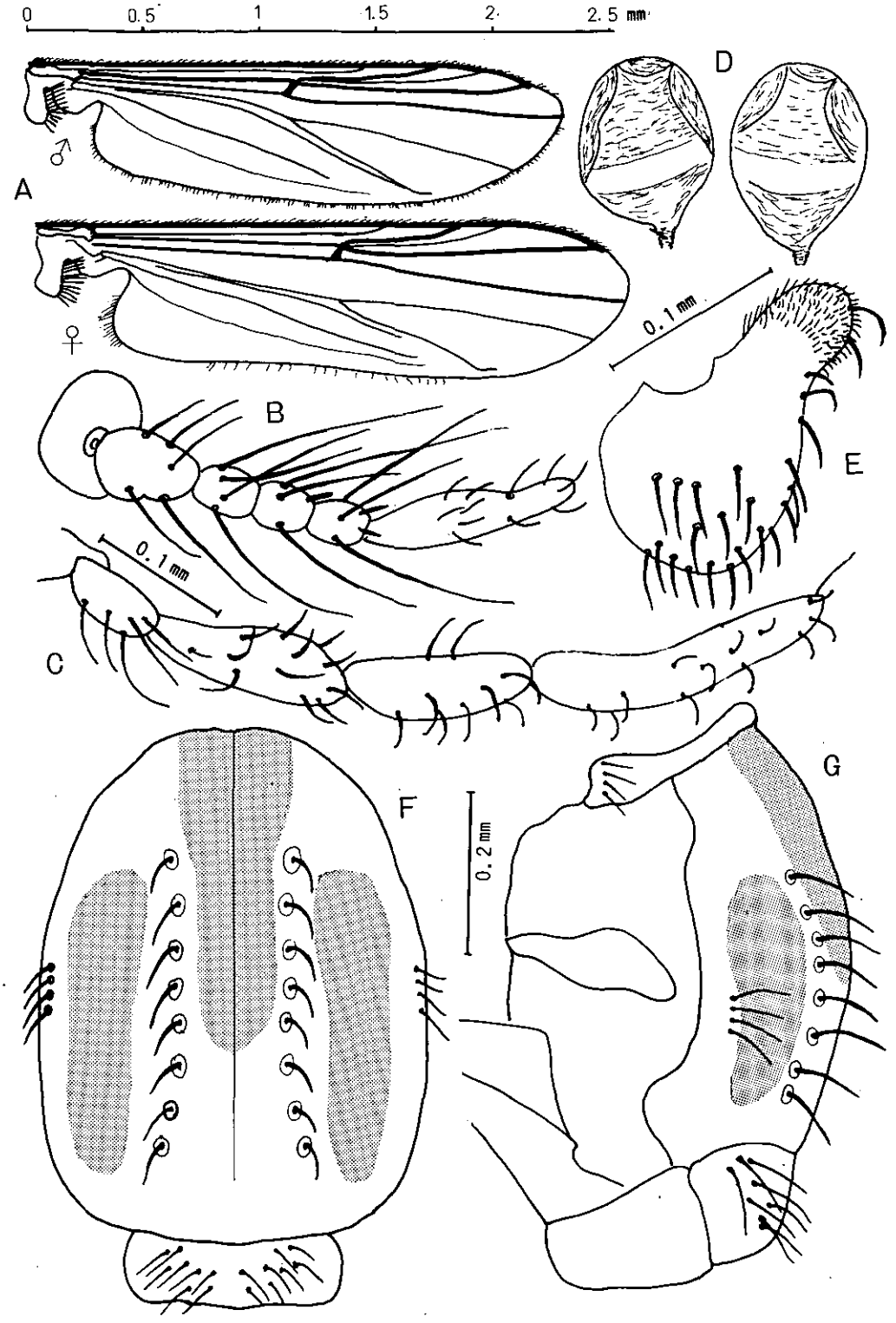

Fig. 40. *Orthocladius (Euorthocladius) kanii* (Tokunaga) Adult.

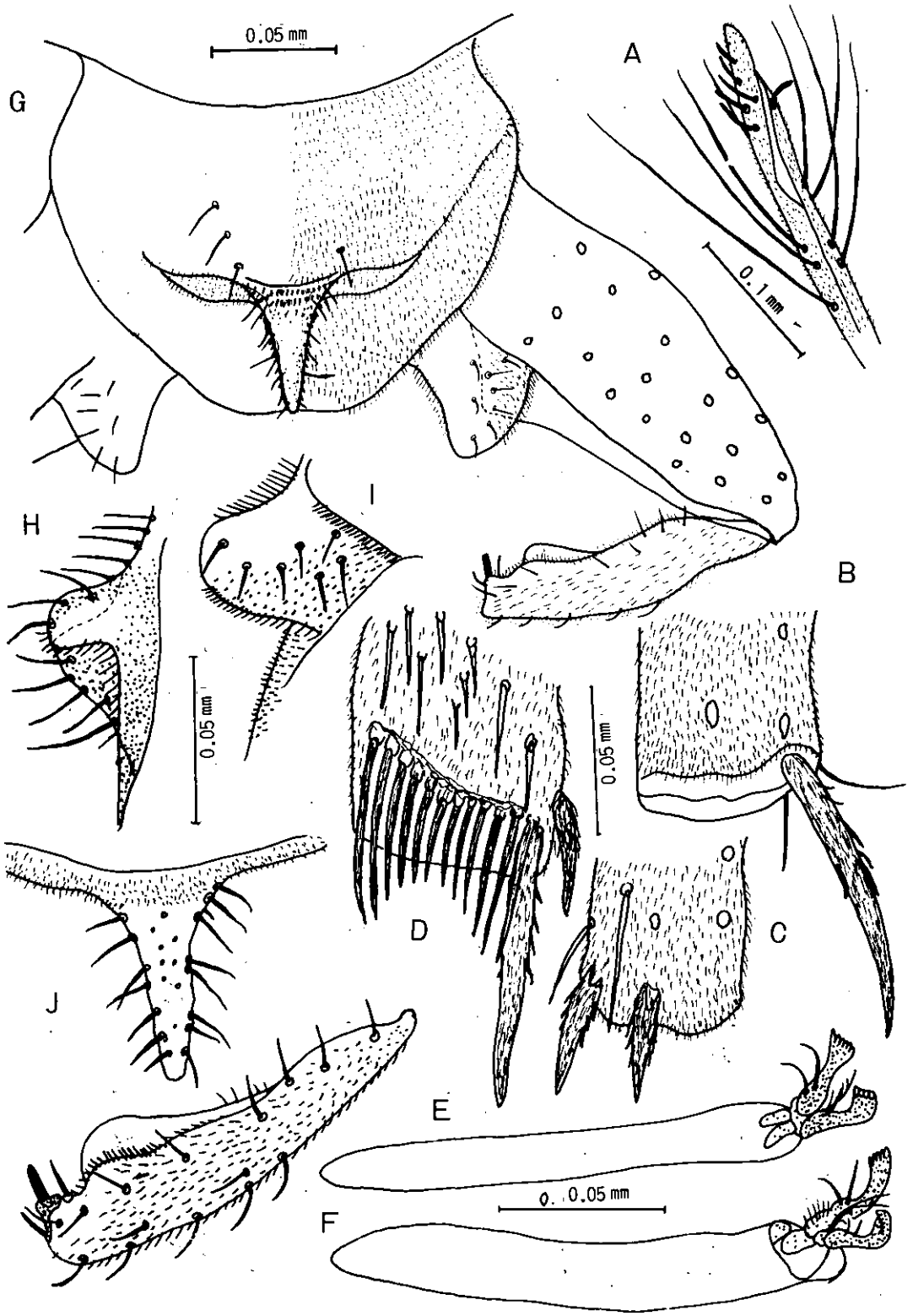

Fig. 41. *Orthocladius (Euorthocladius) kanii* (Tokunaga) Adult male.

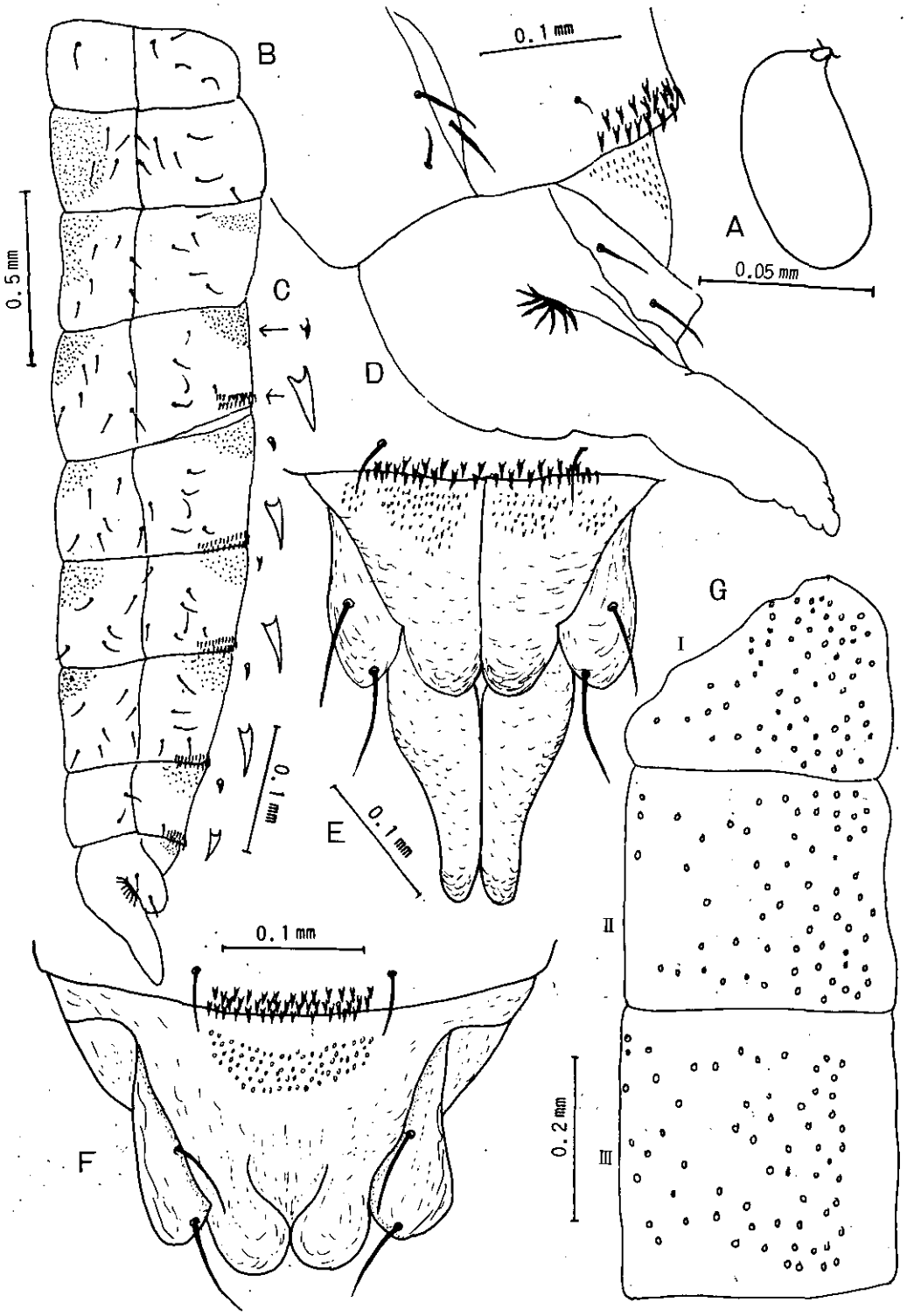

Fig. 42. *Orthocladius (Euorthocladius) kanii* (Tokunaga)
Pupa and Adult male.

Fig. 43. *Orthocladius (Euorthocladius) kanii* (Tokunaga) Larva.

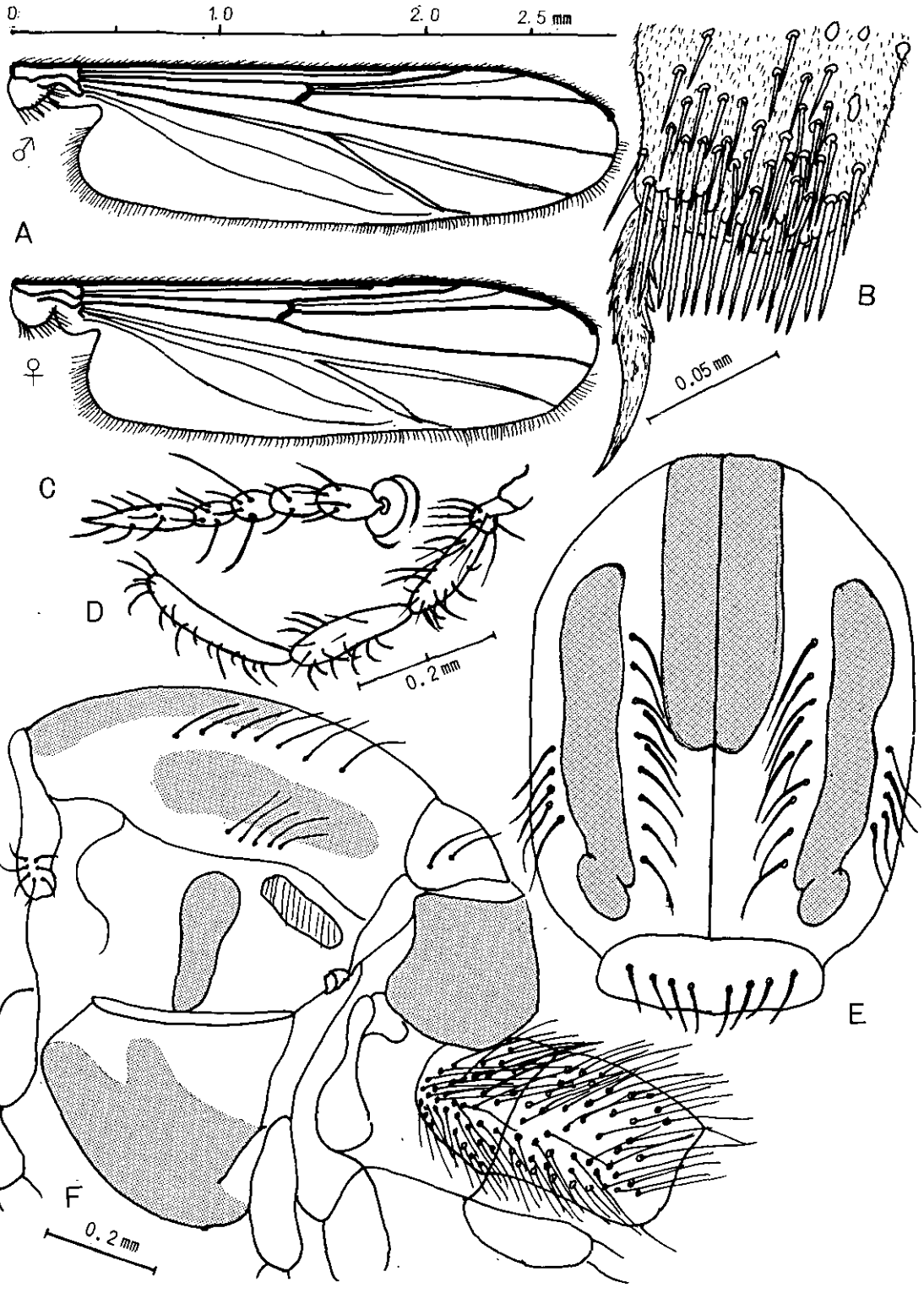

Fig. 44. *Psectrocladius aquatoronus*, sp. nov. Adult.

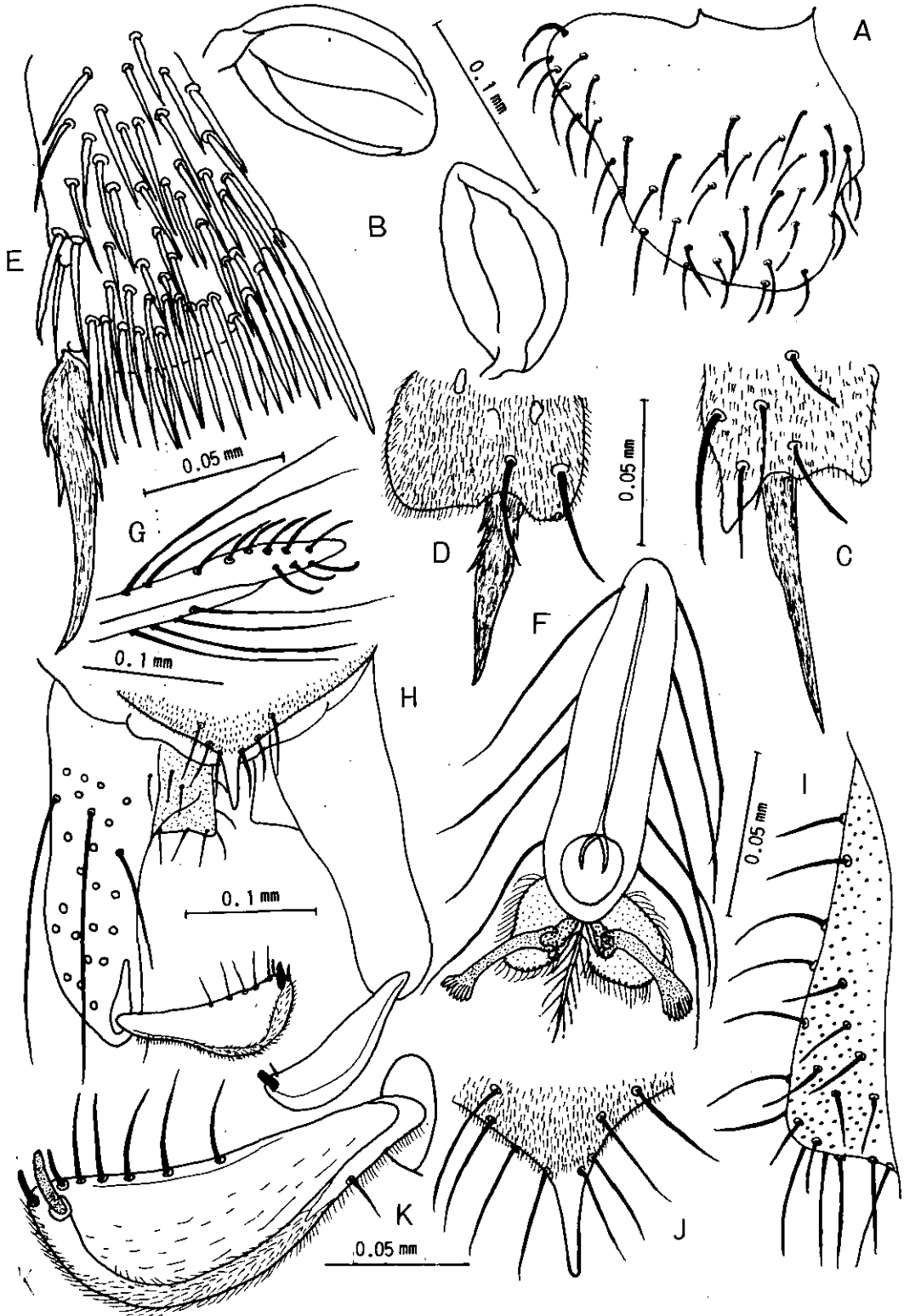

Fig. 45. *Psectrocladius aquatoronus*, sp. nov. Adult.

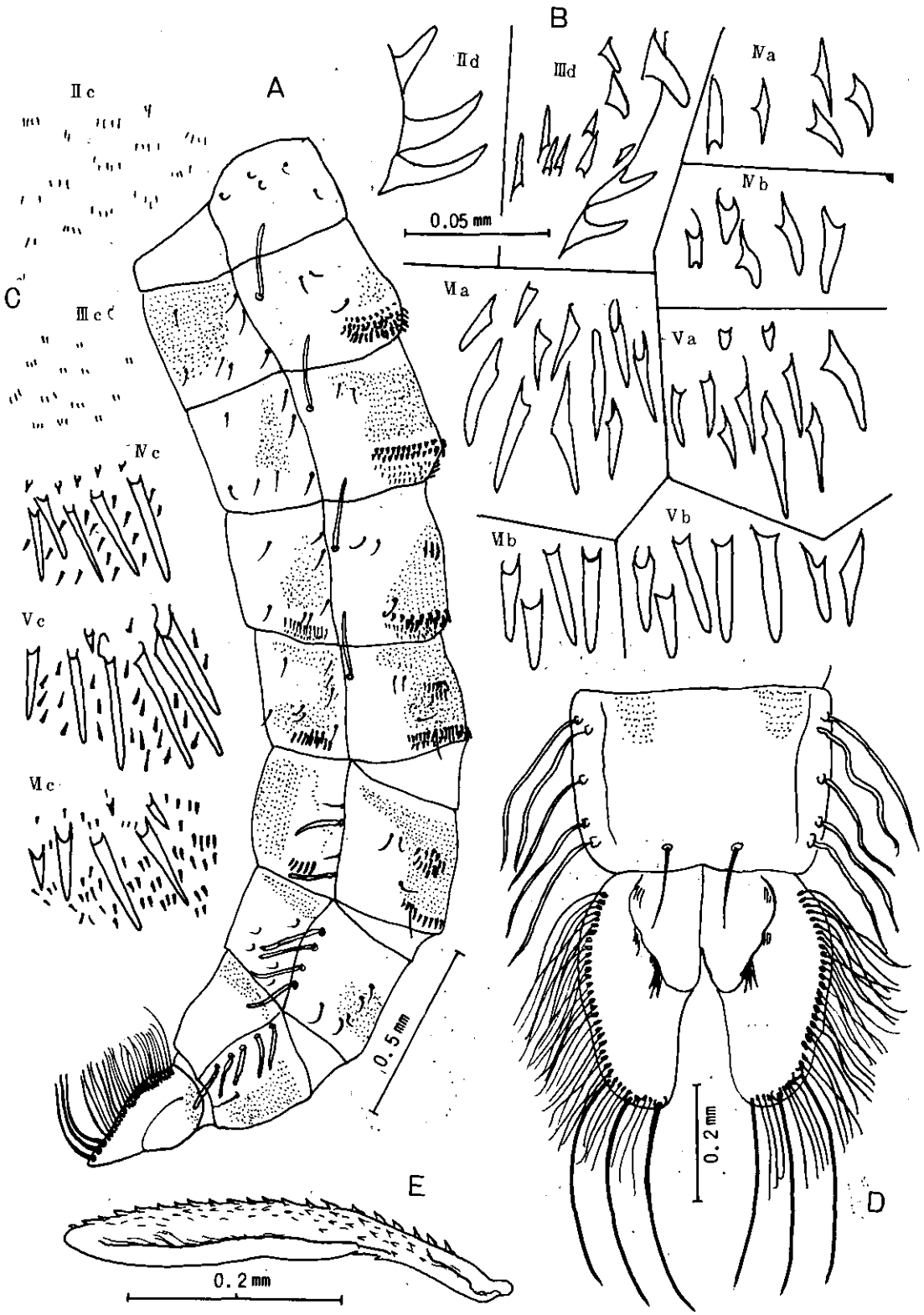

Fig. 46. *Psectrocladius aquatoronus*, sp. nov. Pupa.

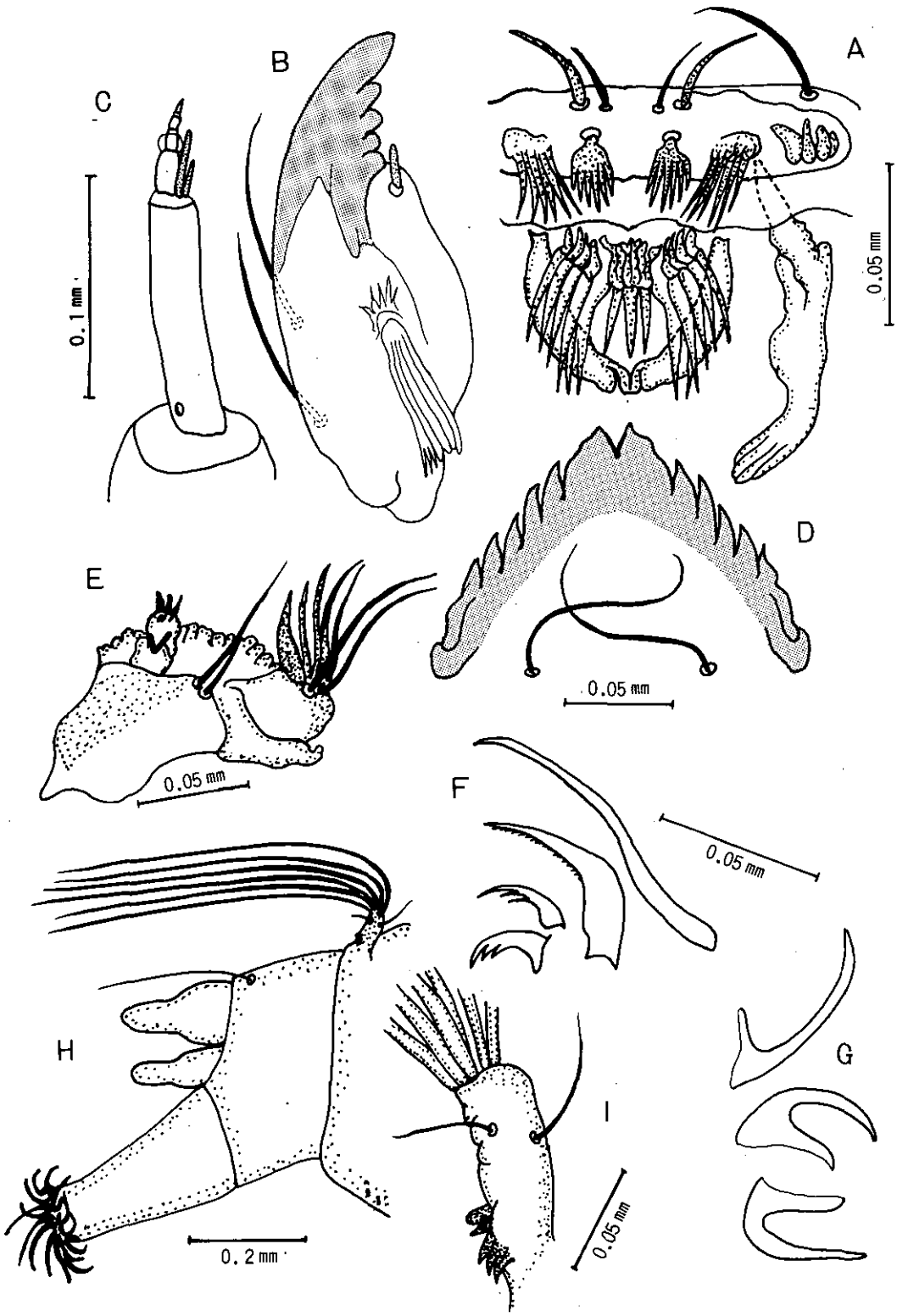

Fig. 47. *Psectrocladius aquatoronus*, sp. nov. Larva.

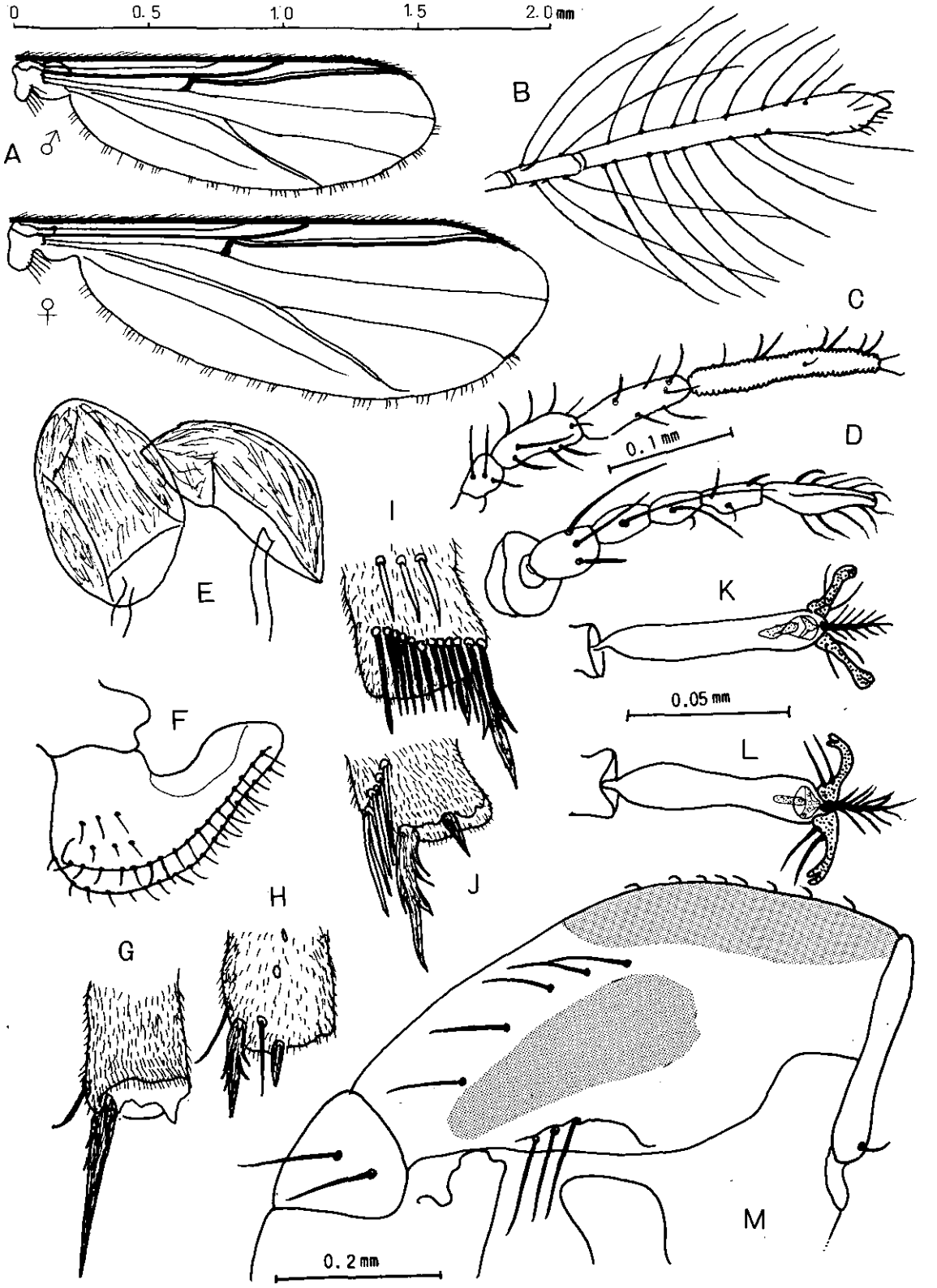

Fig. 48. *Eukiefferiella yasunoi*, sp. nov. Adult.

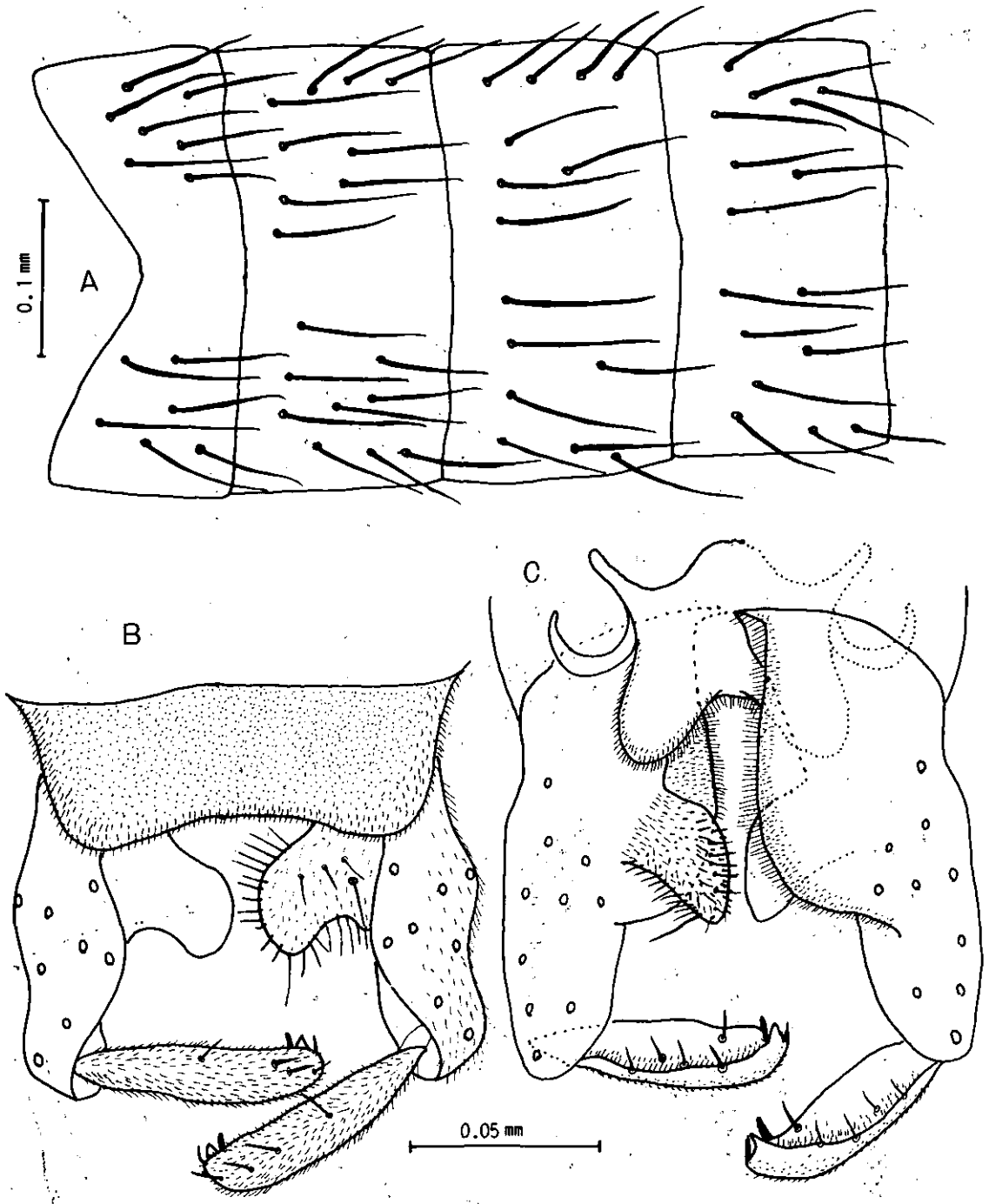

Fig. 49. *Eukiefferiella yasunoi*, sp. nov. Adult male.

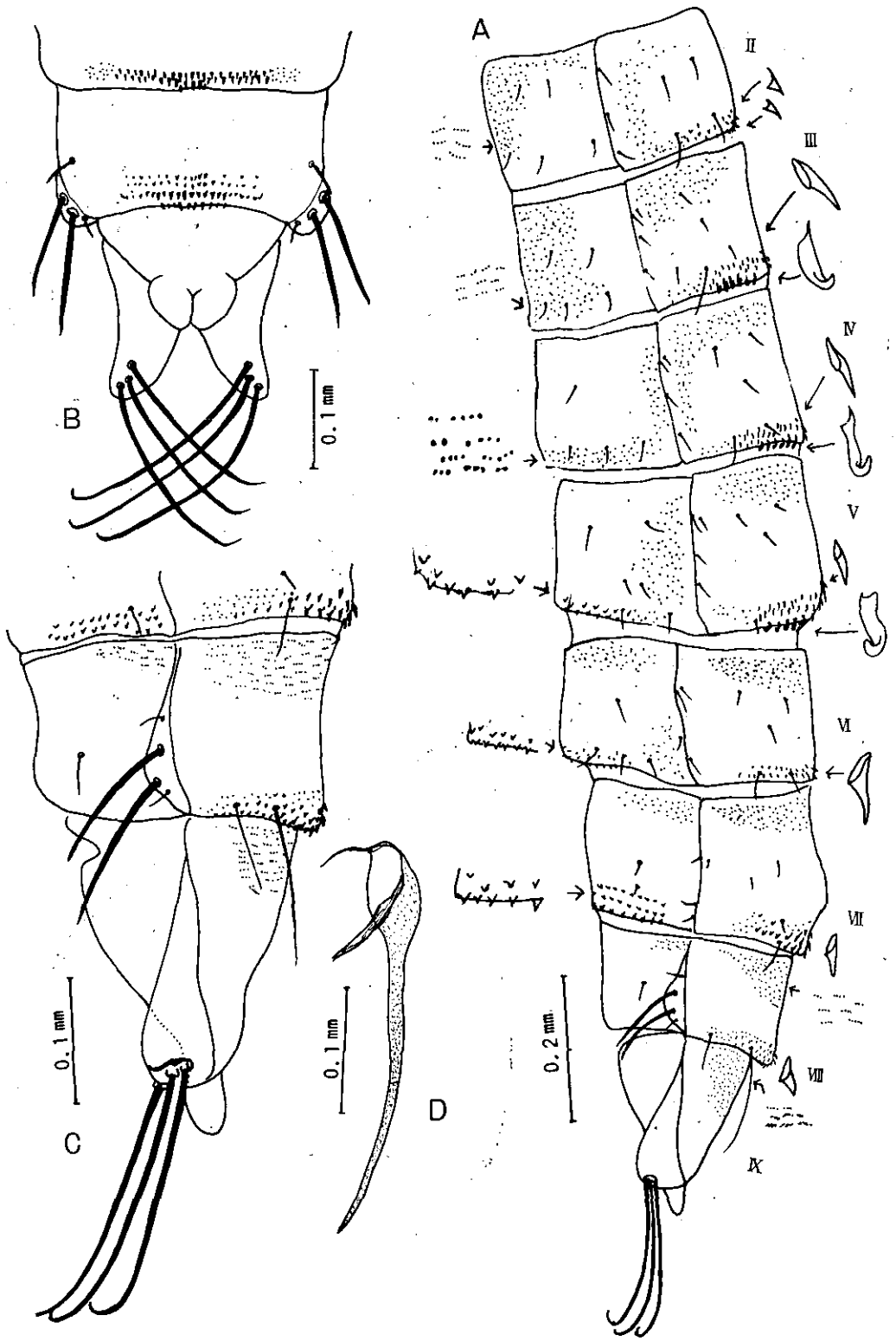

Fig. 50. *Eukiefferiella yasunoi*, sp. nov. Pupa.

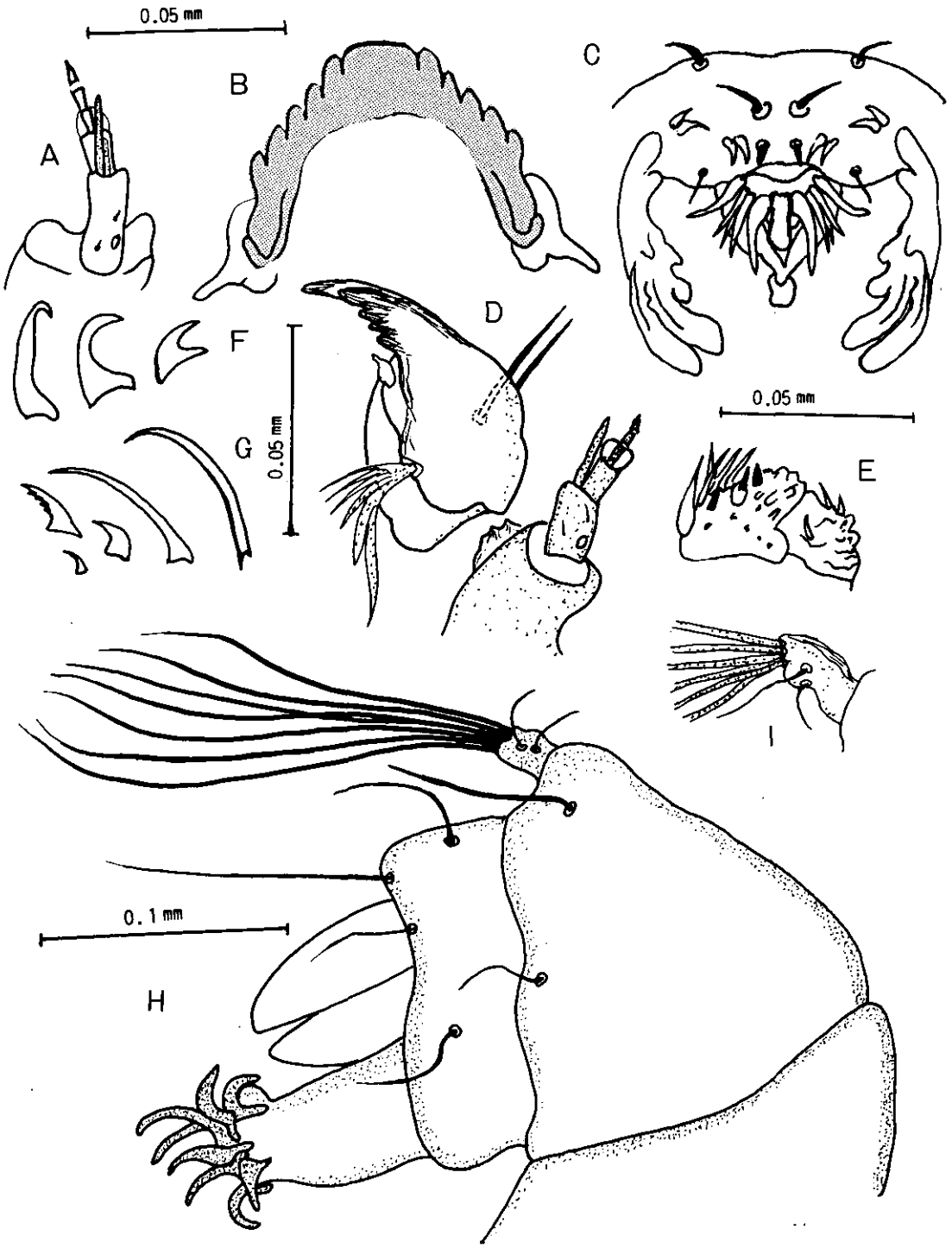

Fig. 51. *Eukiefferiella yasunoi*, sp. nov. Larva.

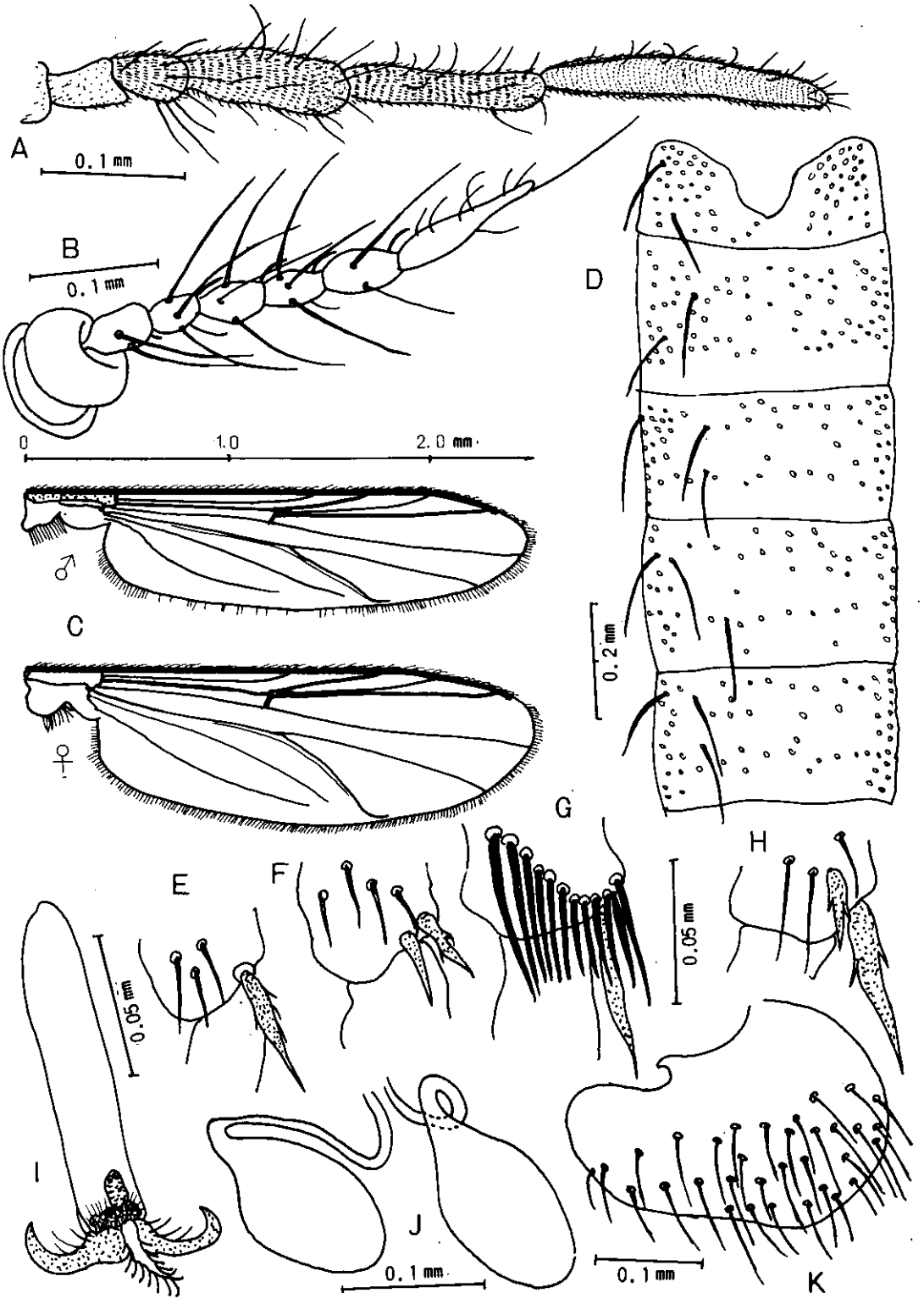

Fig. 52. *Paratrichocladius rufiventris* (Meigen) Adult.

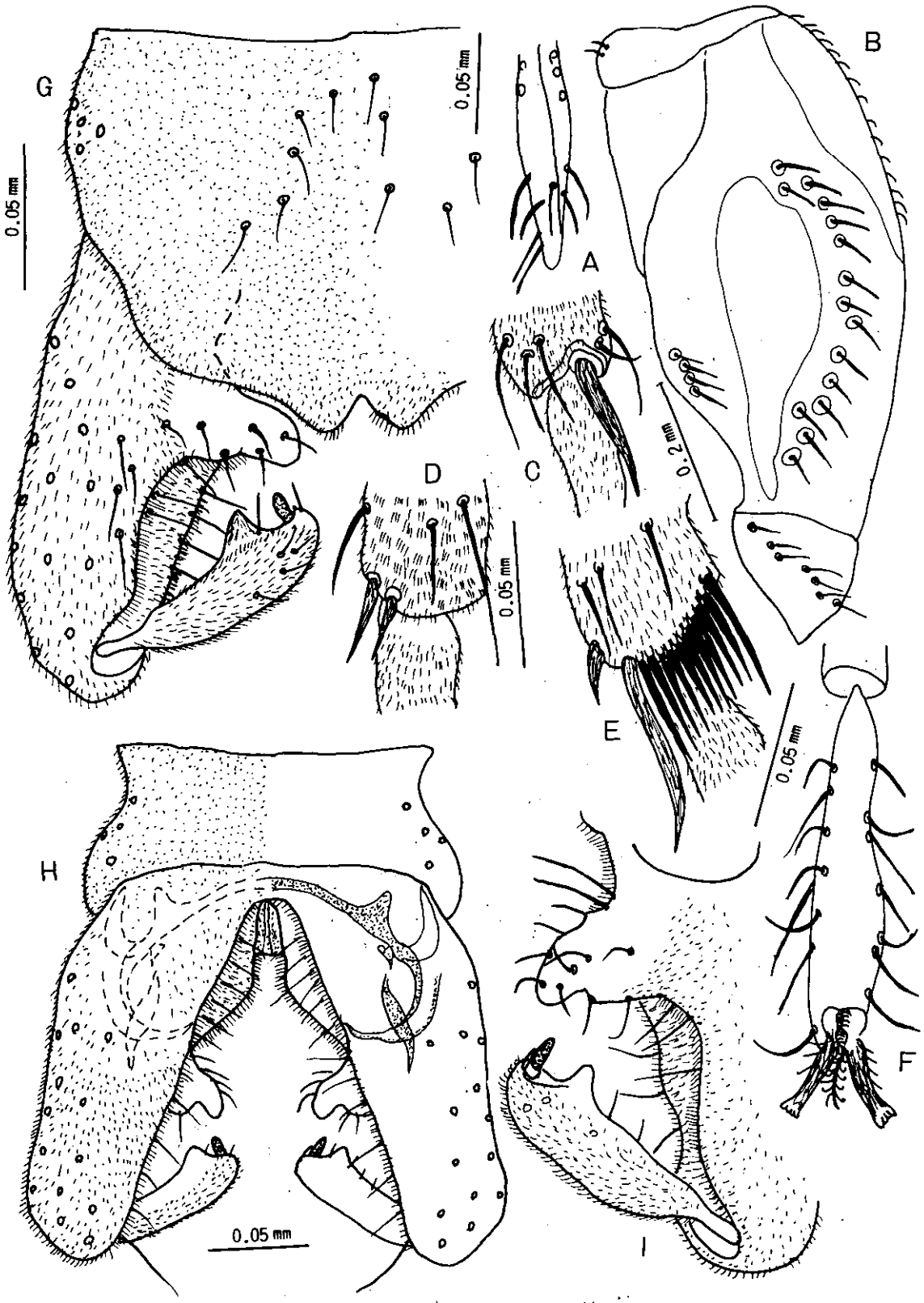

Fig. 53. *Paratrichocladius rufiventris* (Meigen) Adult male.

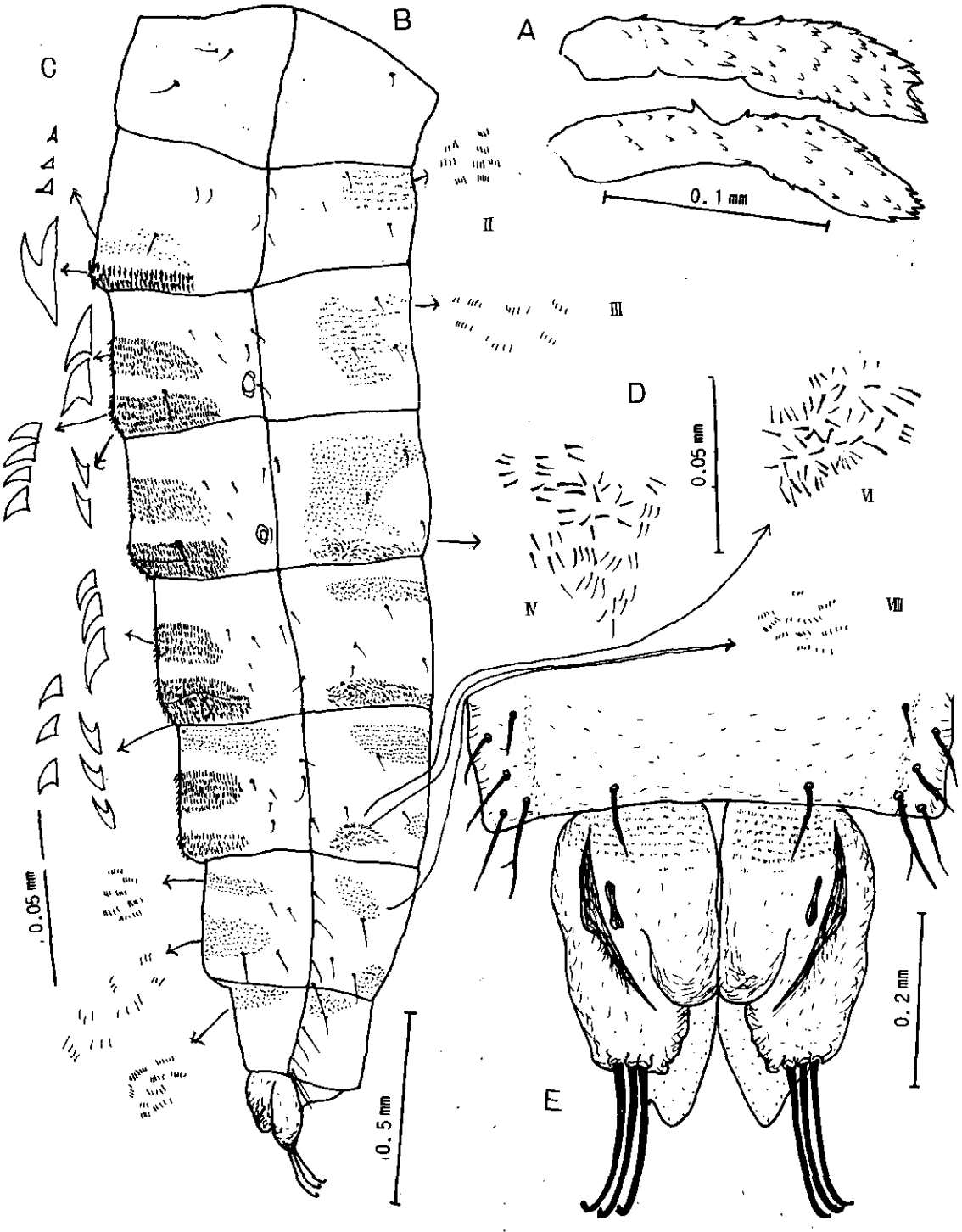

Fig. 54: *Paratrichocladius rufiventris* (Meigen) Pupa.

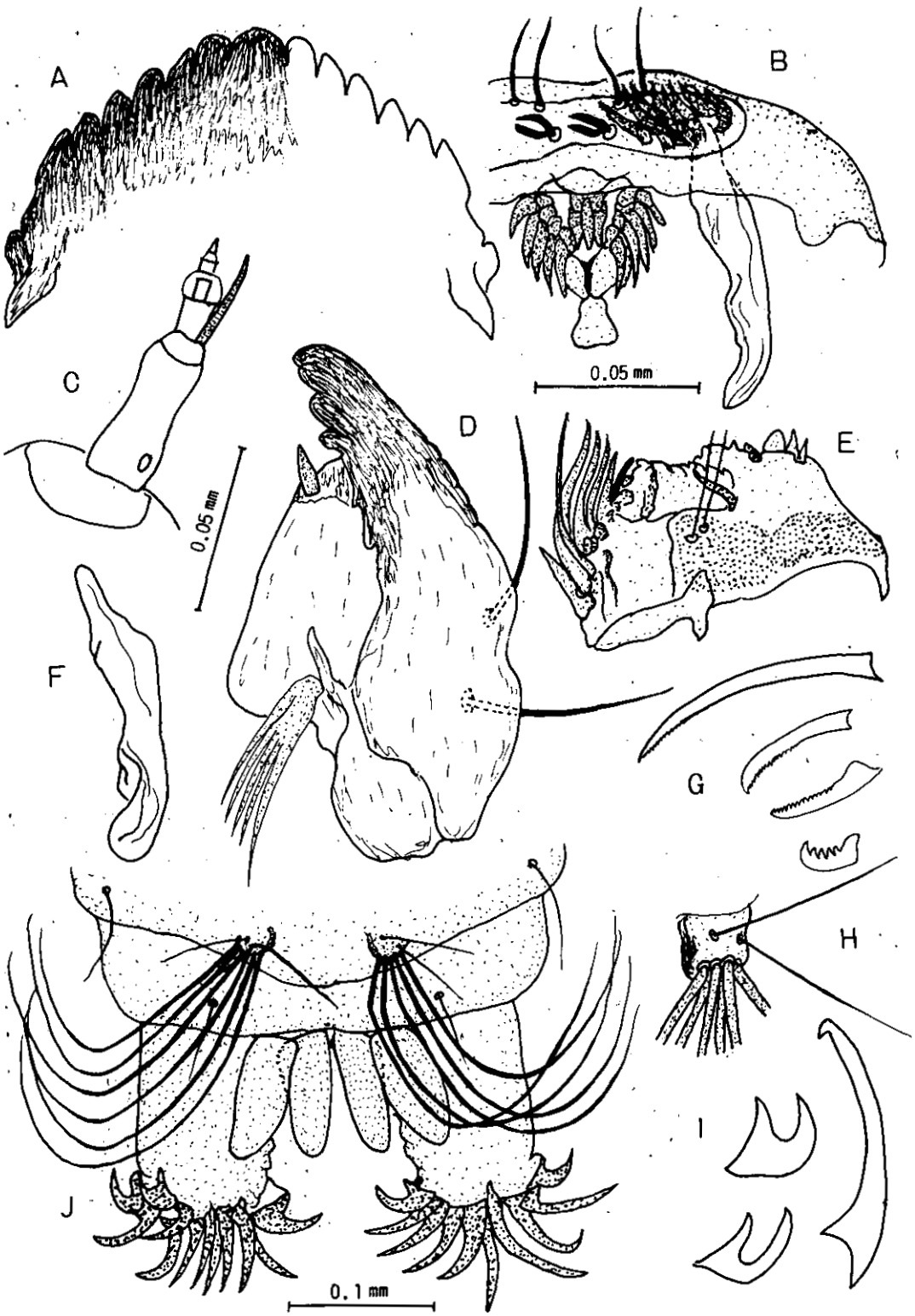

Fig. 55. *Paratrichocladius rufiventris* (Meigen) Larva.

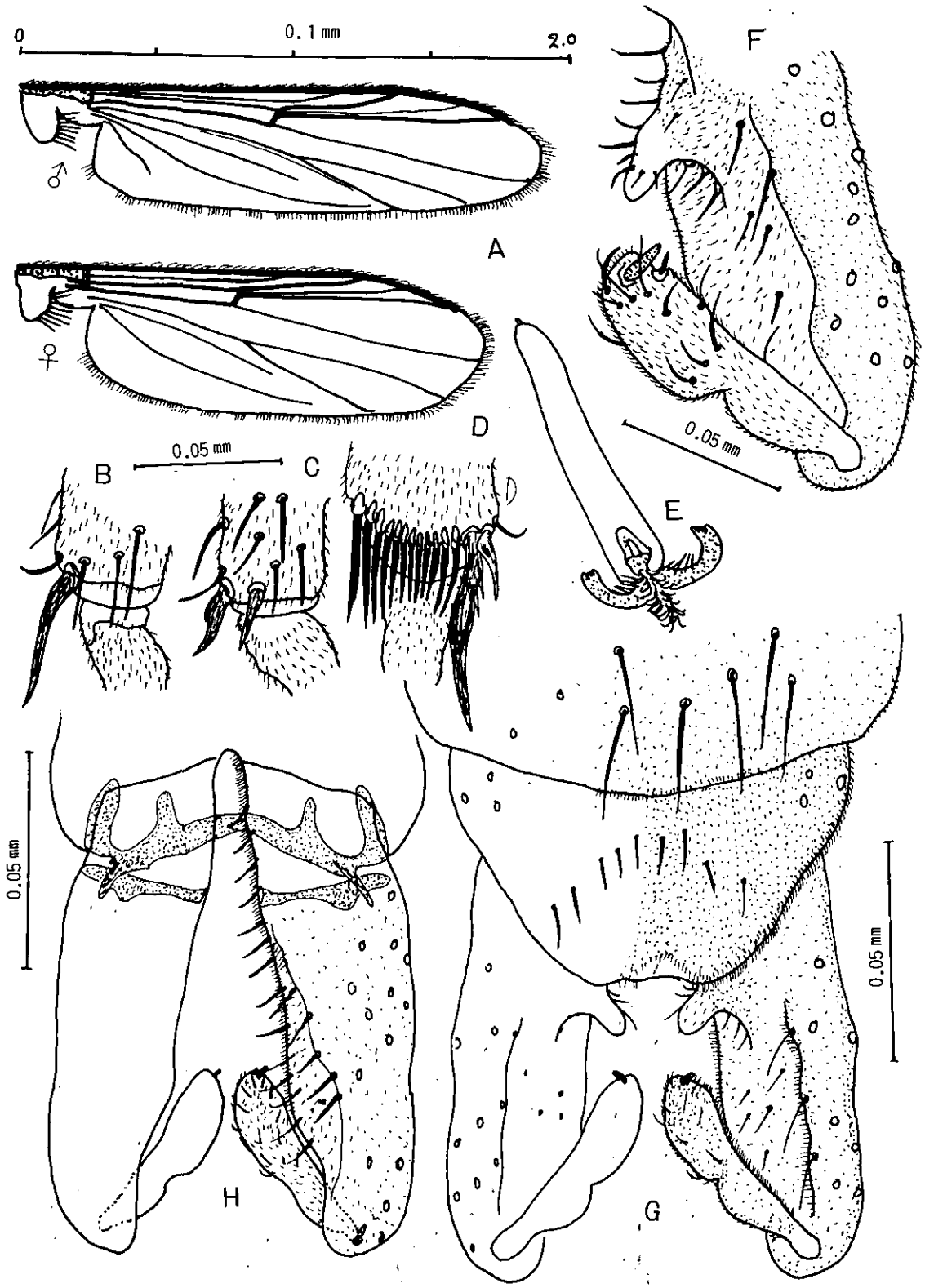

Fig. 56. *Cricotopus bicinctus* (Meigen) Adult.

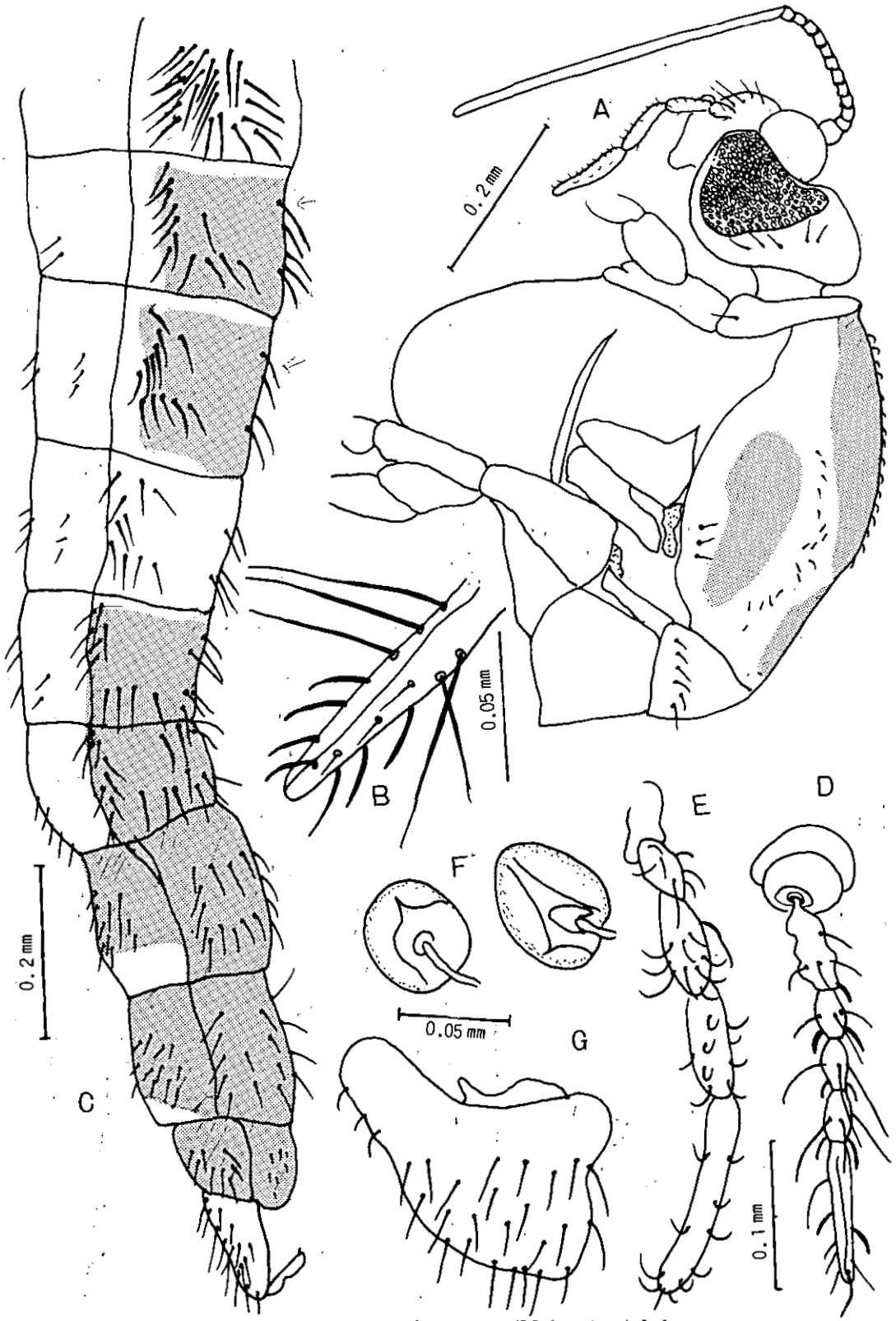

Fig. 57. *Cricotopus bicinctus* (Meigen) Adult.

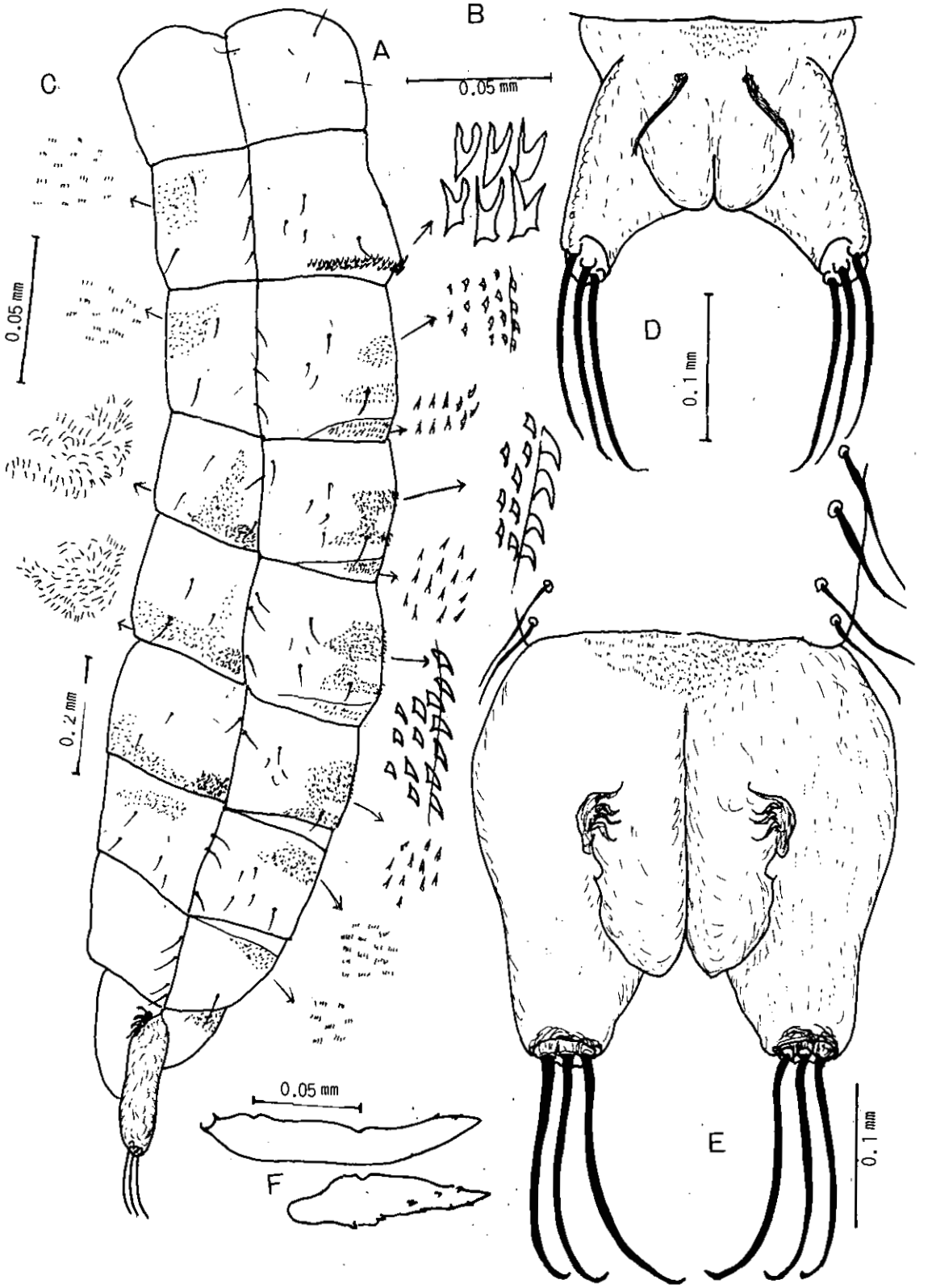

Fig. 58. *Cricotopus bicinctus* (Meigen) Pupa.

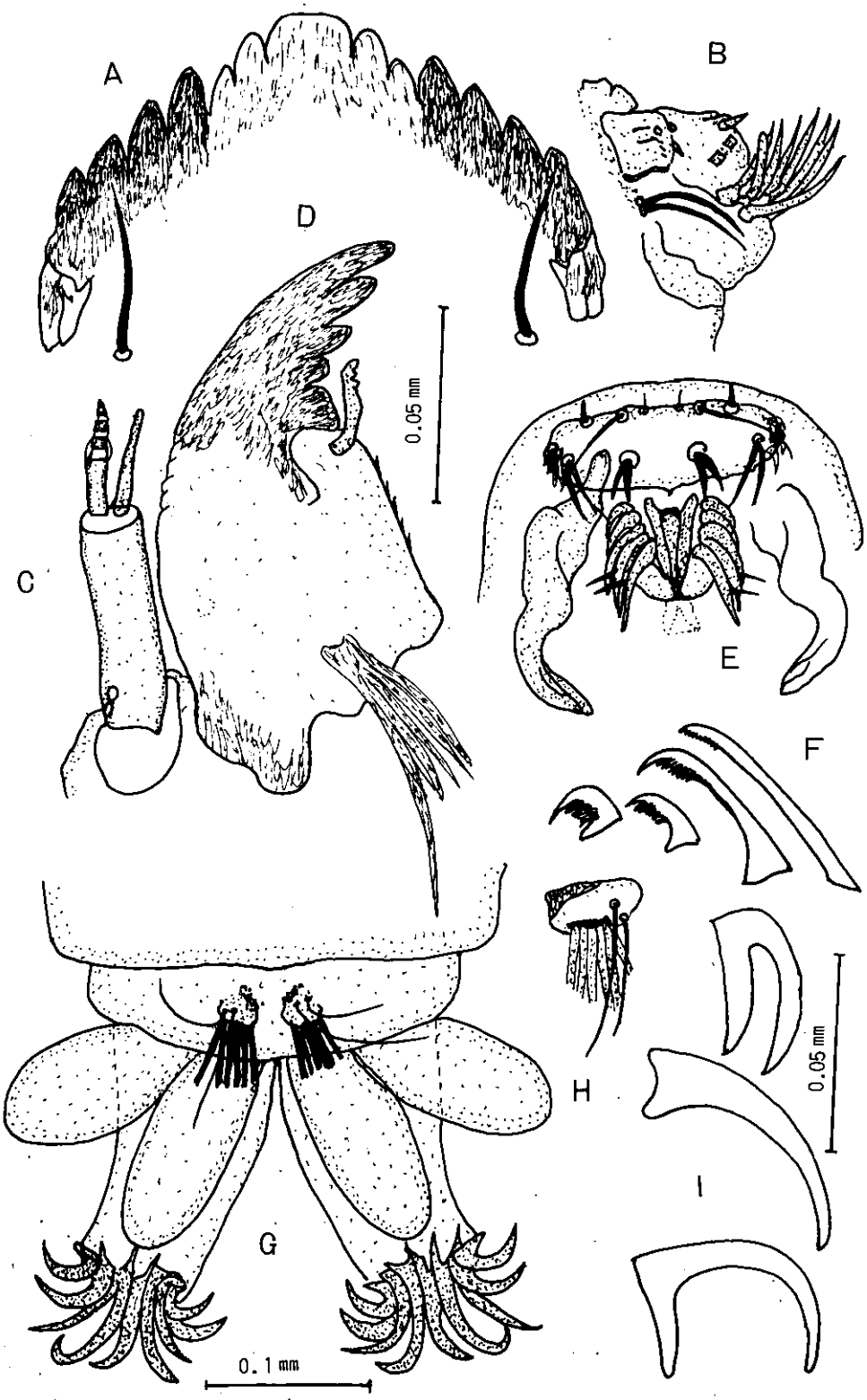

Fig. 59. *Cricotopus bicinctus* (Meigen) Larva.

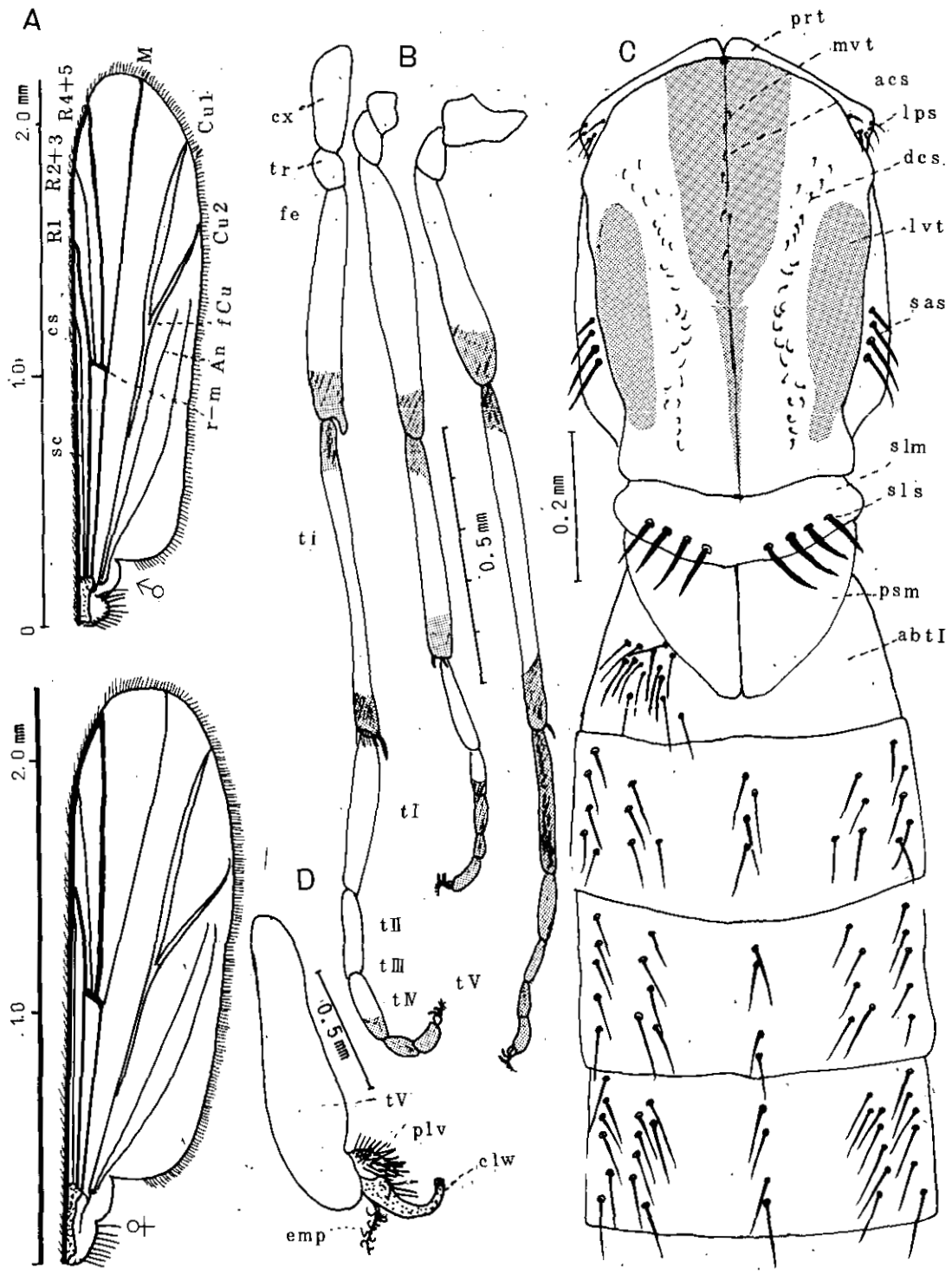

Fig. 60. *Cricotopus sylvestris* (Fabricius) Adult.

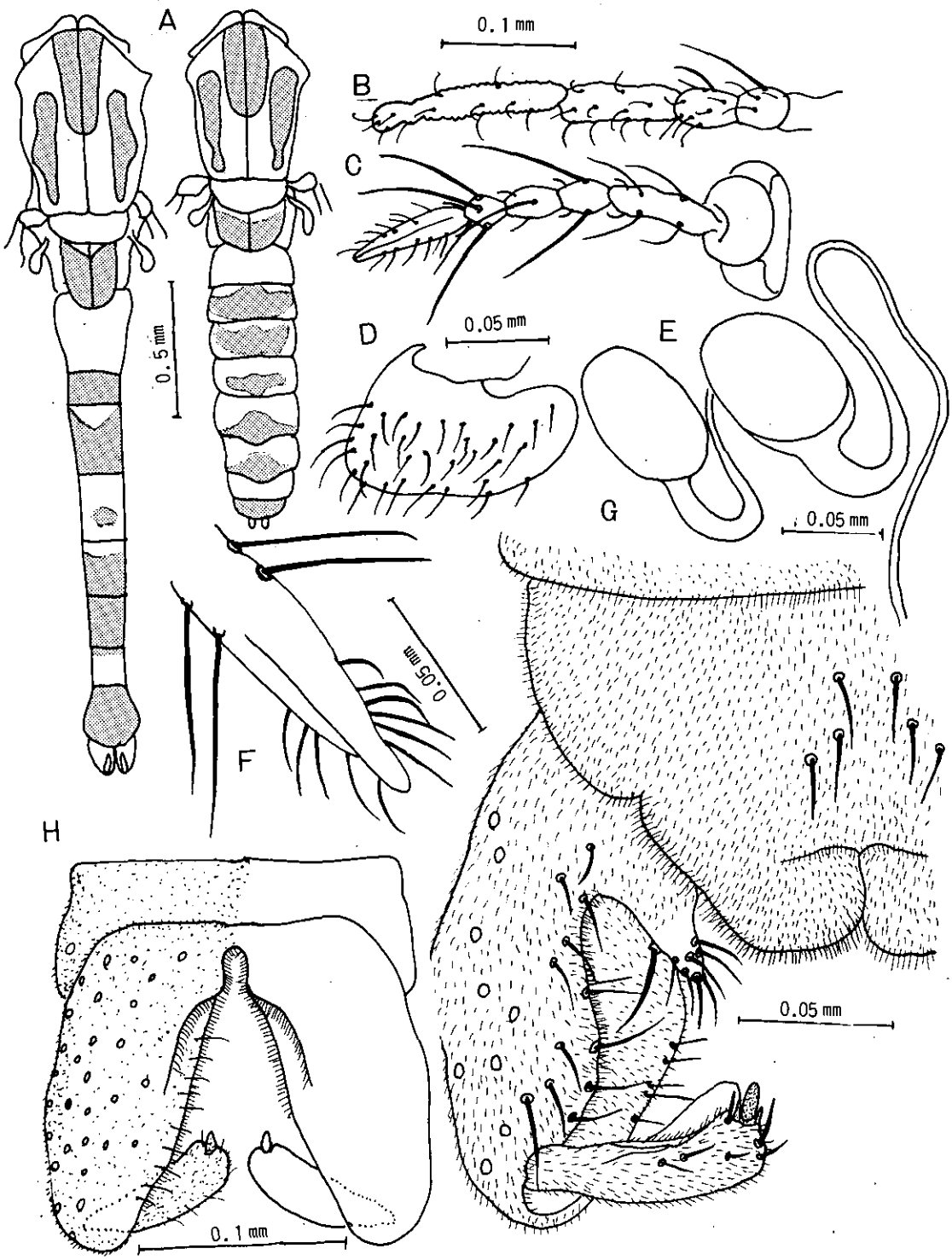

Fig. 61. *Cricotopus sylvestris* (Fabricius) Adult.

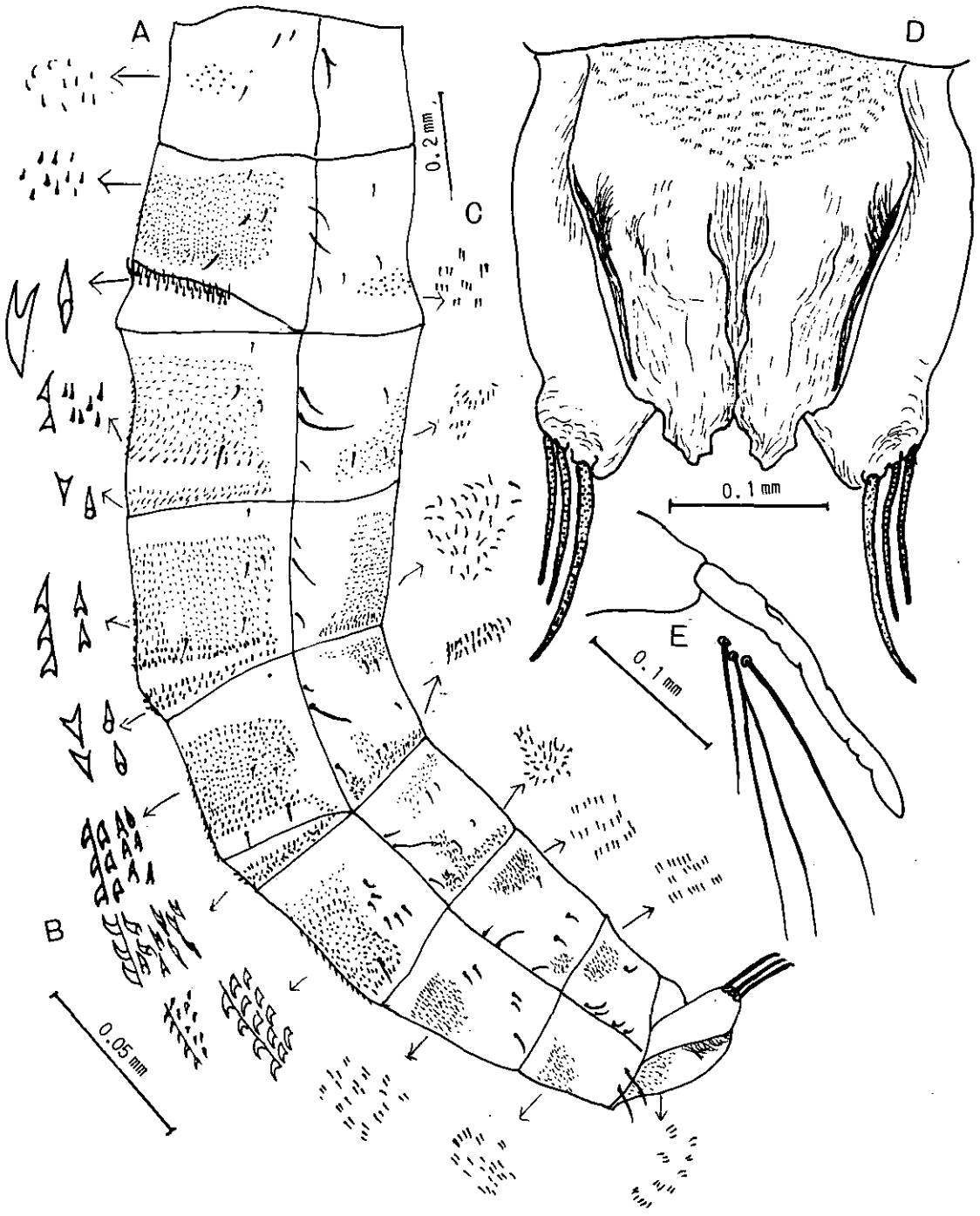

Fig. 62. *Cricotopus sylvestris* (Fabricius) Pupa.

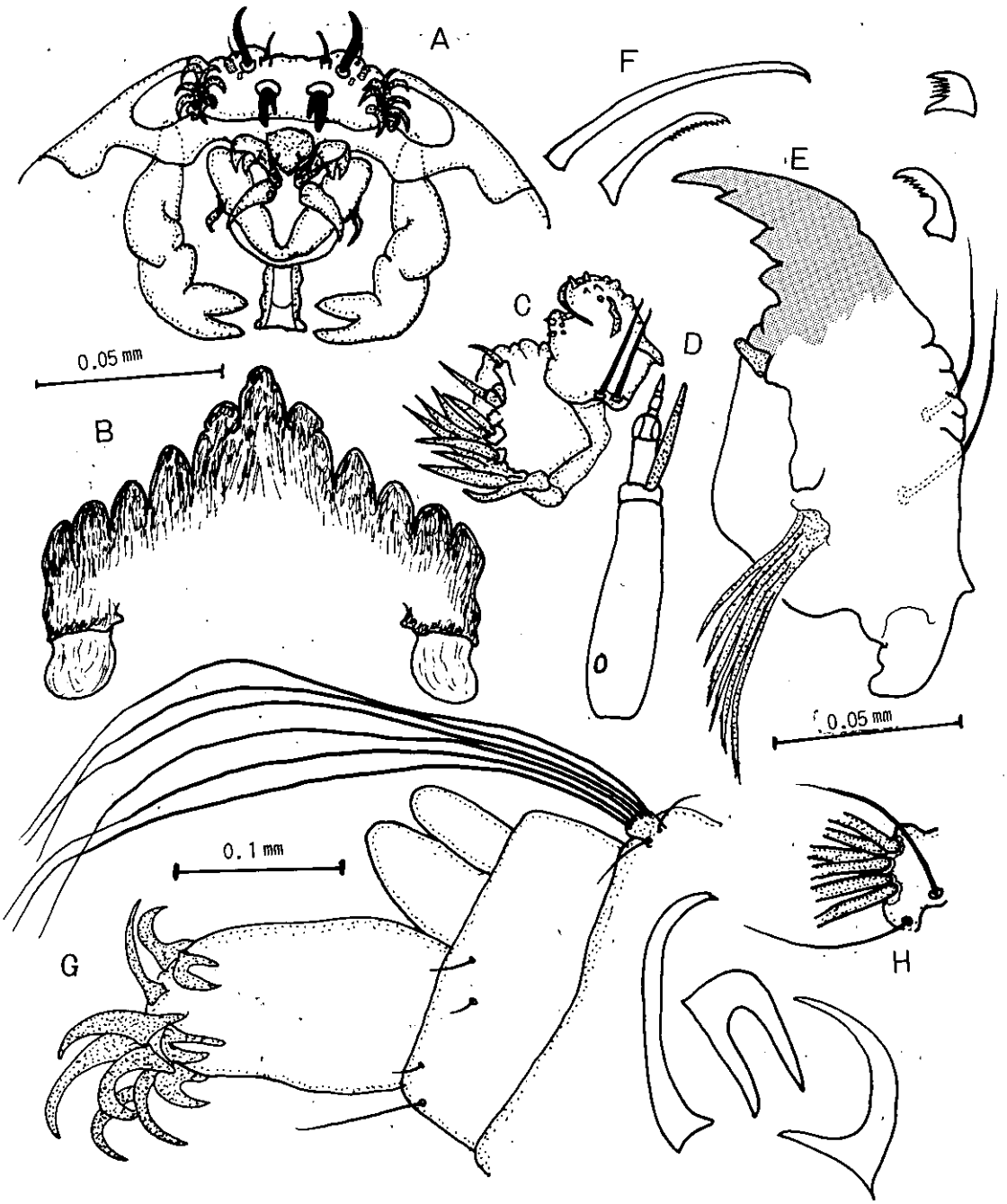

Fig. 63. *Cricotopus sylvestris* (Fabricius) Larva.

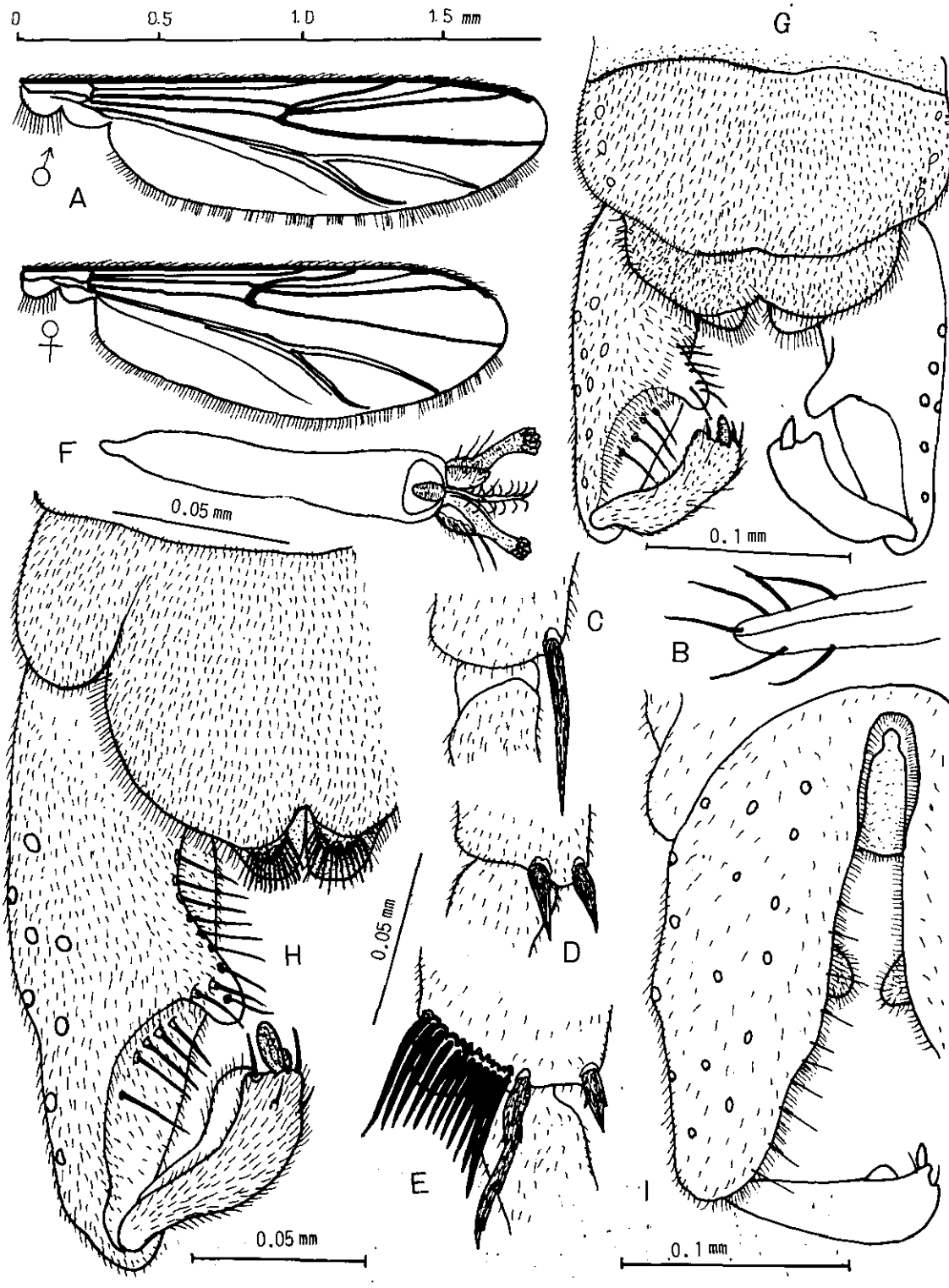

Fig. 64. *Cricotopus yatabensis*, sp. nov. Adult.

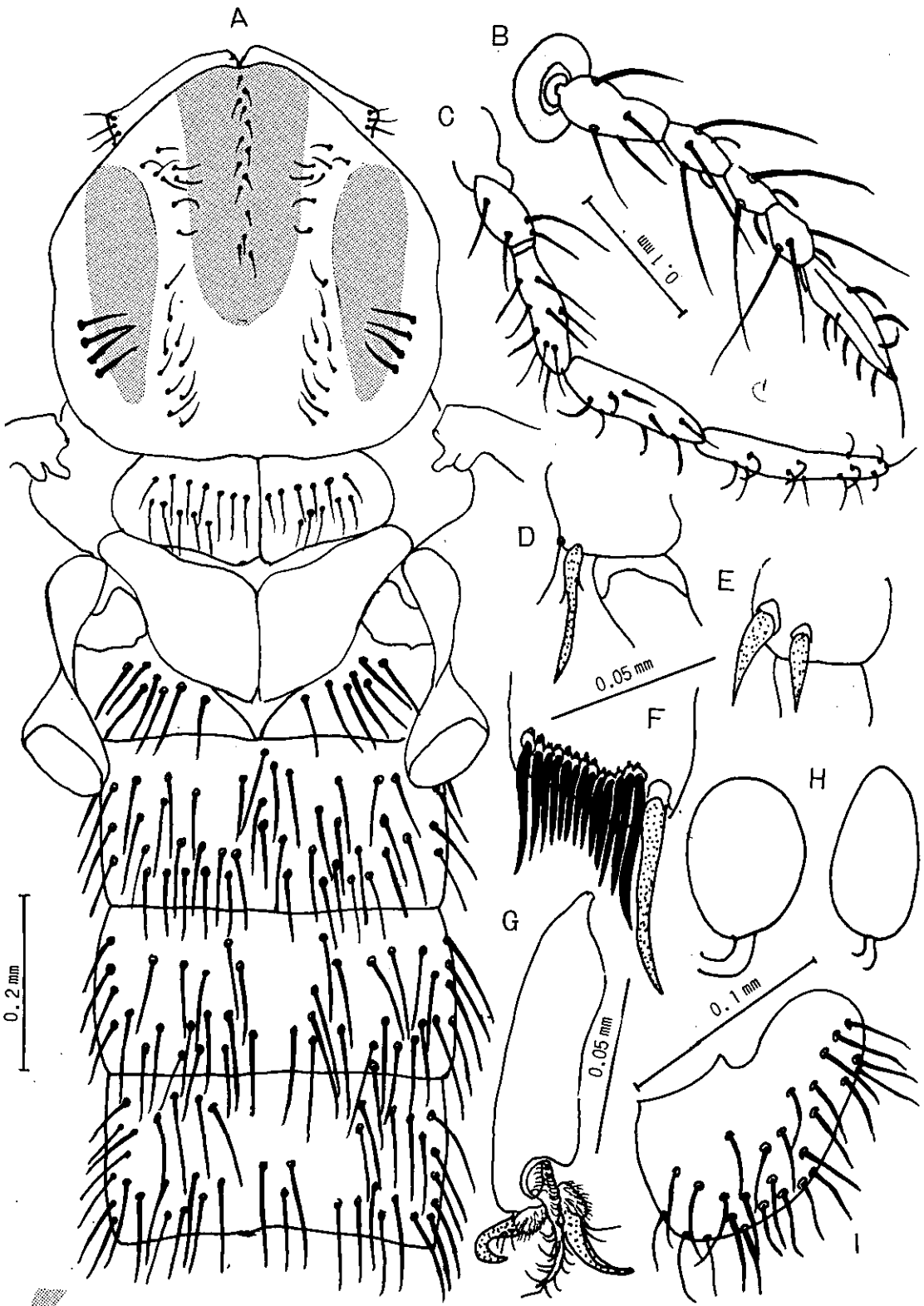

Fig. 65. *Cricotopus yatabensis*, sp. nov. Adult.

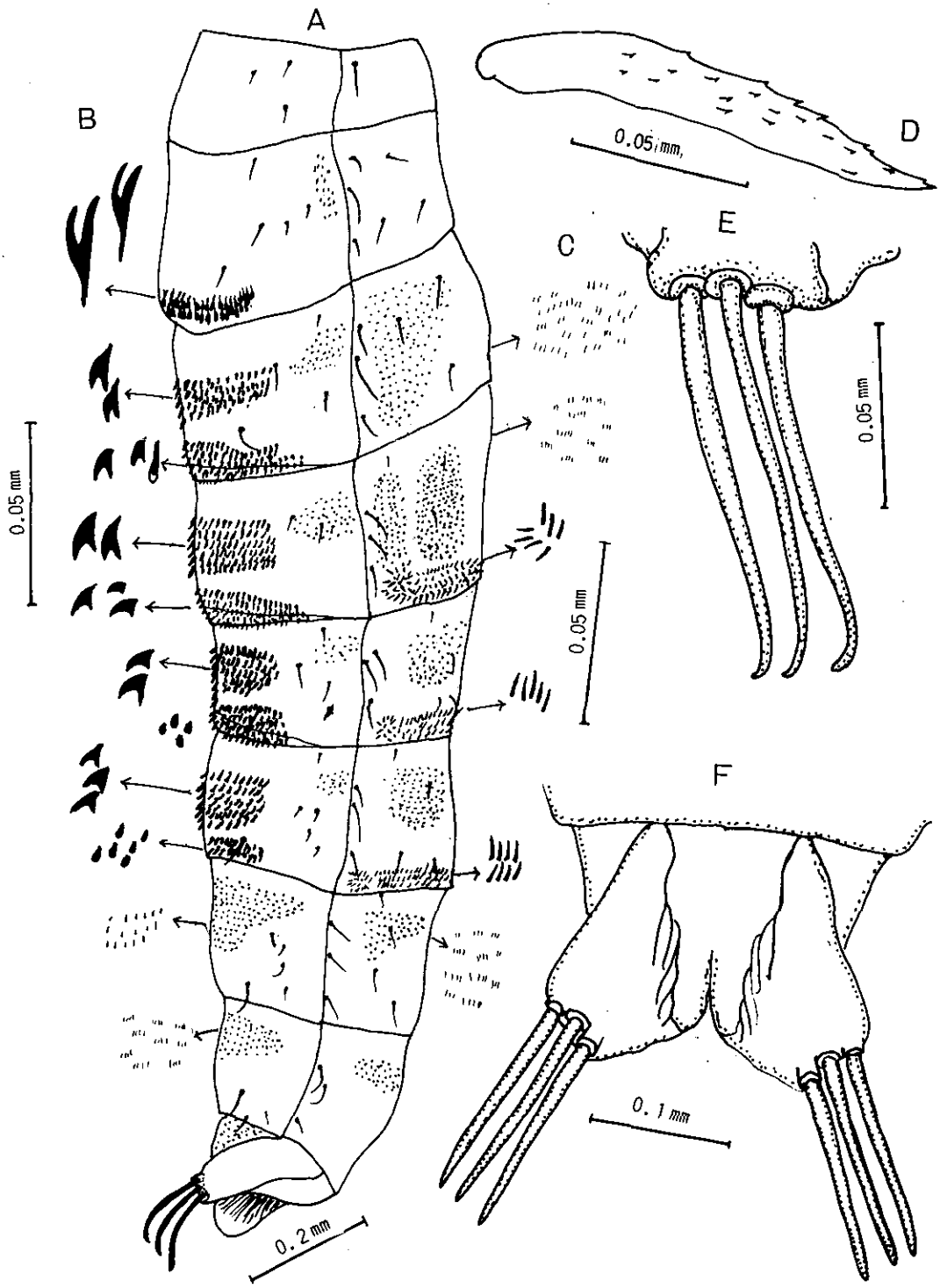

Fig. 66. *Cricotopus yatabensis*, sp. nov. Pupa.

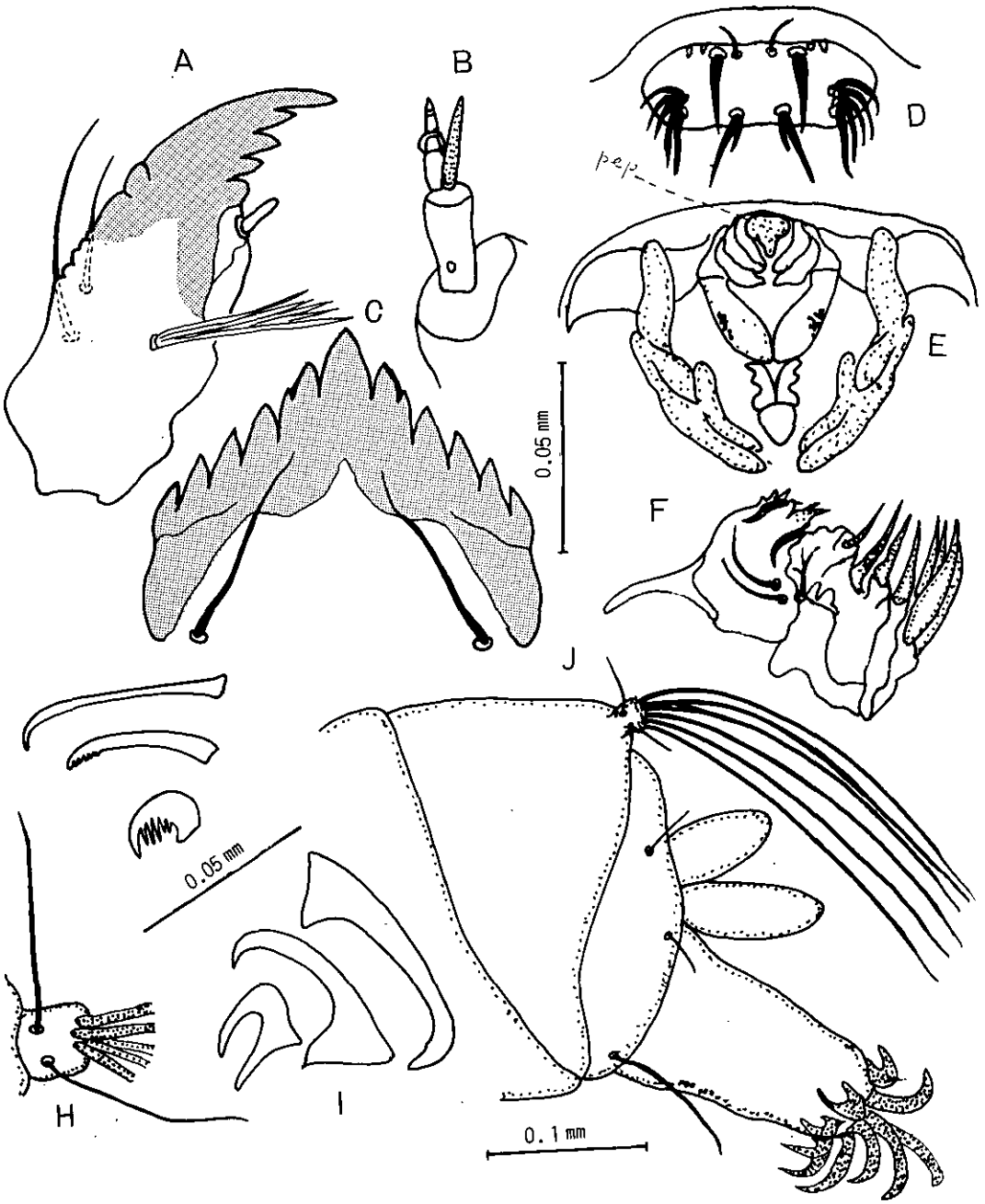

Fig. 67. *Cricotopus yatabensis*, sp. nov. Larva.

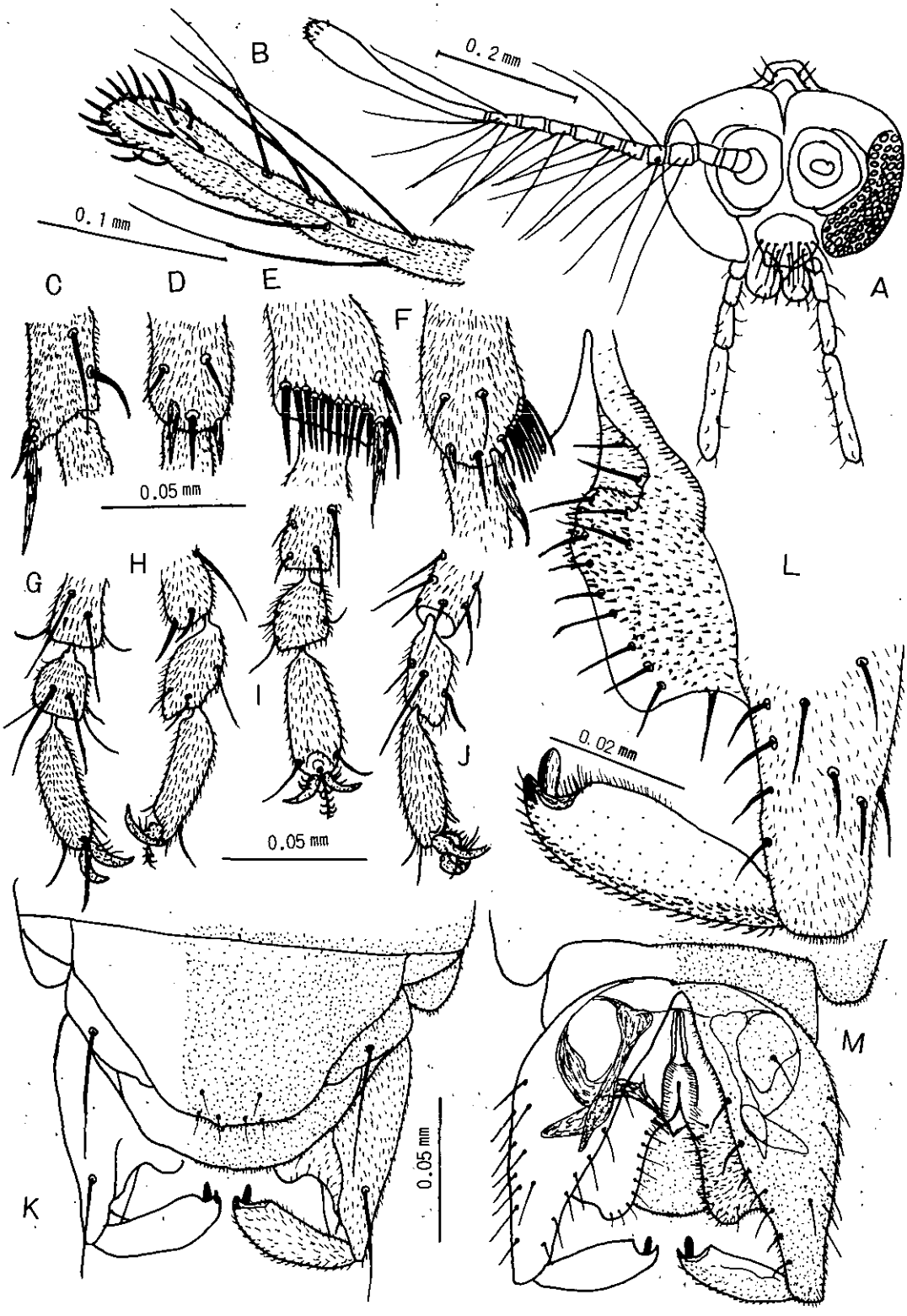

Fig. 68. *Thienemanniella majuscula* (Edwards) Male adult.

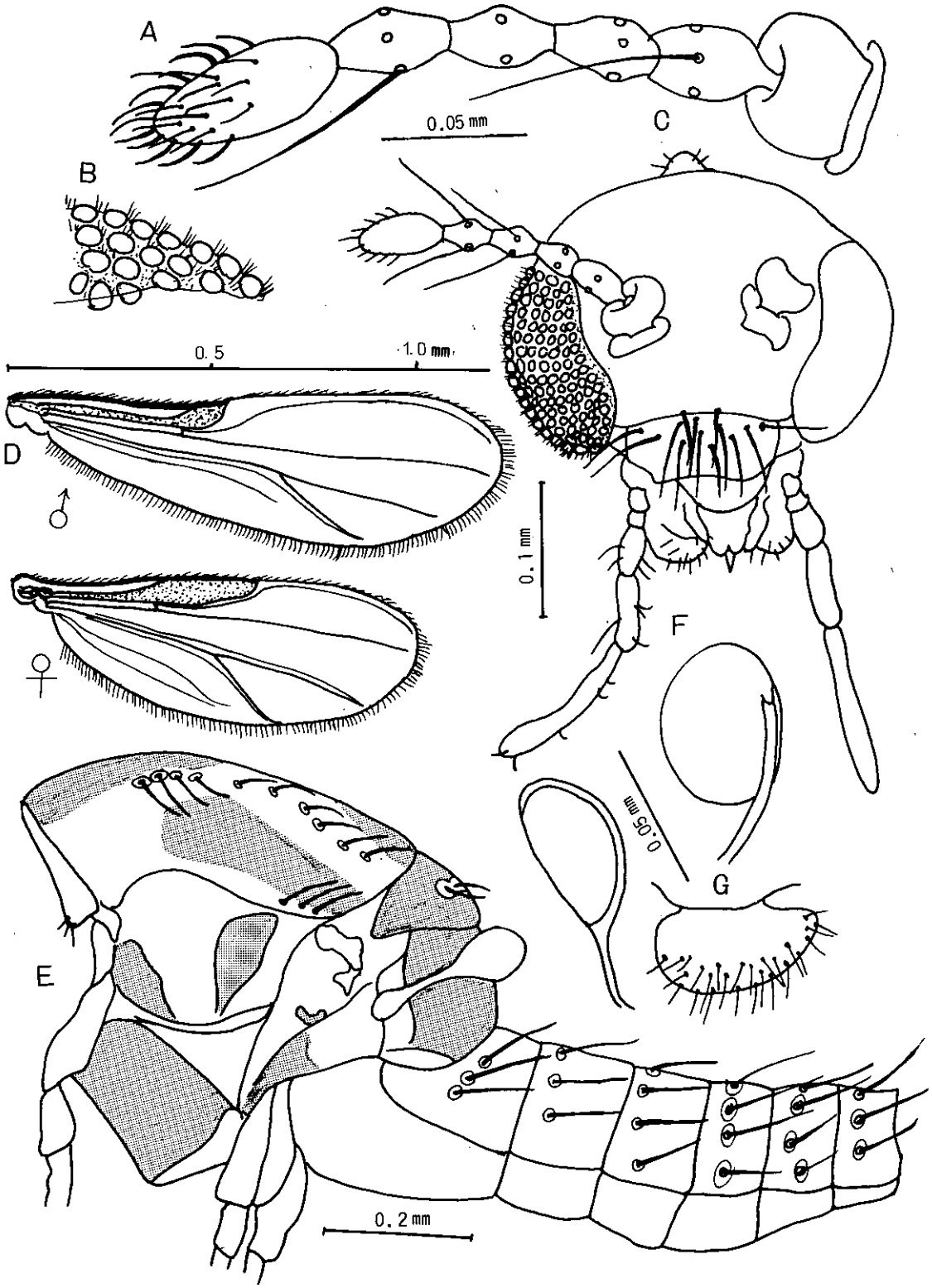

Fig. 69. *Thienemanniella majuscula* (Edwards) Adult.

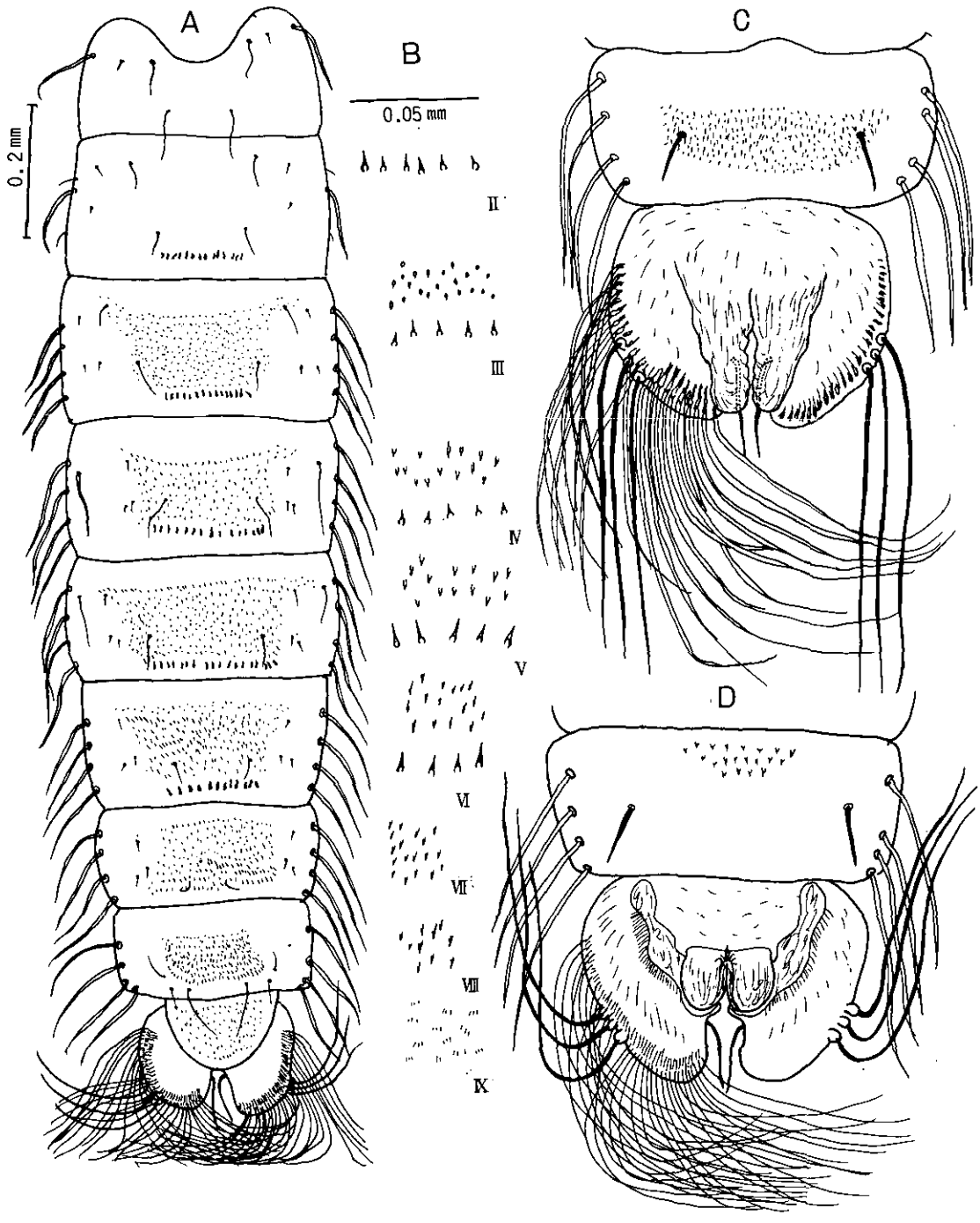

Fig. 70. *Thienemanniella majuscula* (Edwards) Pupa.

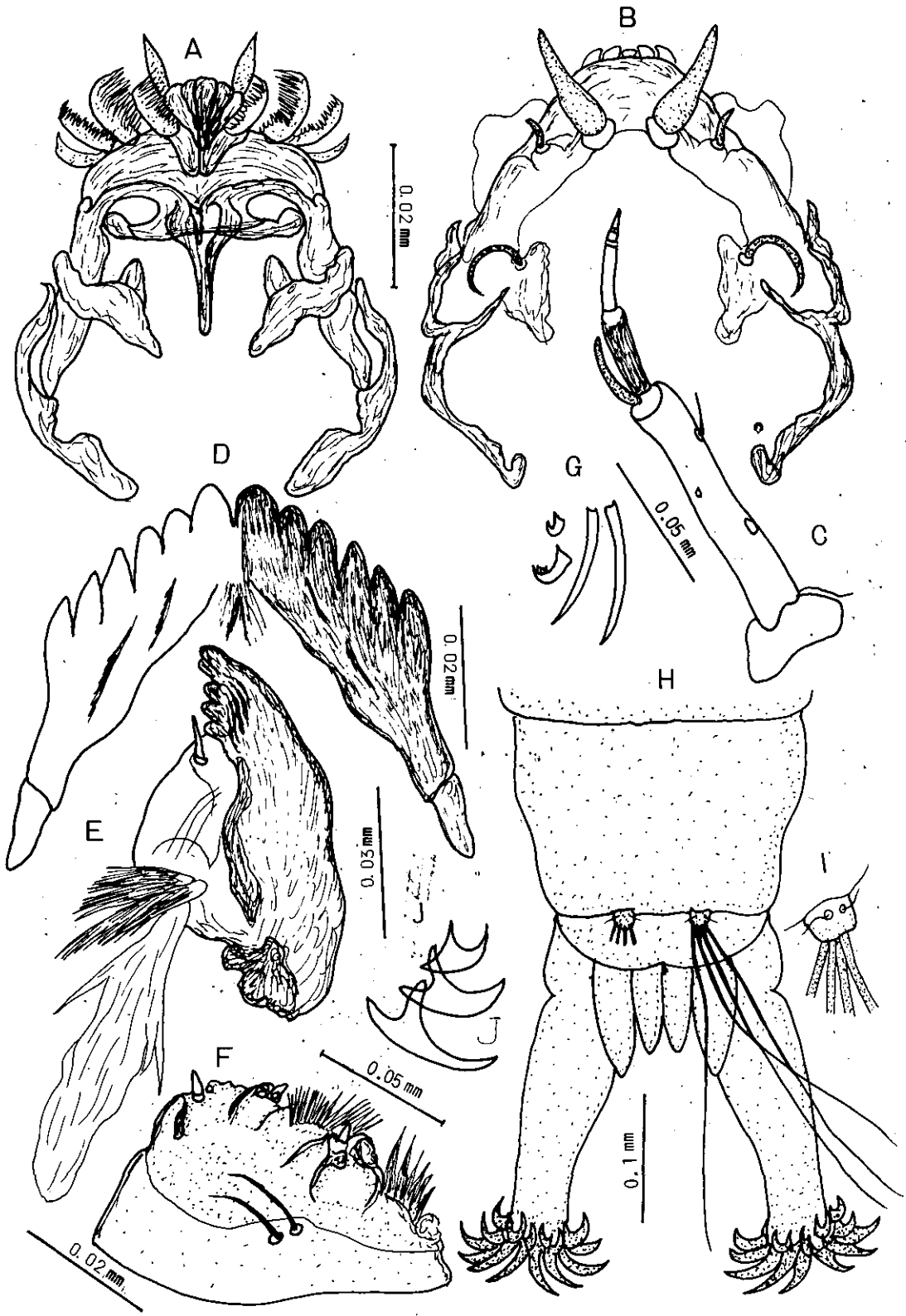

Fig. 71. *Thienemanniella majuscula* (Edwards) Larva.

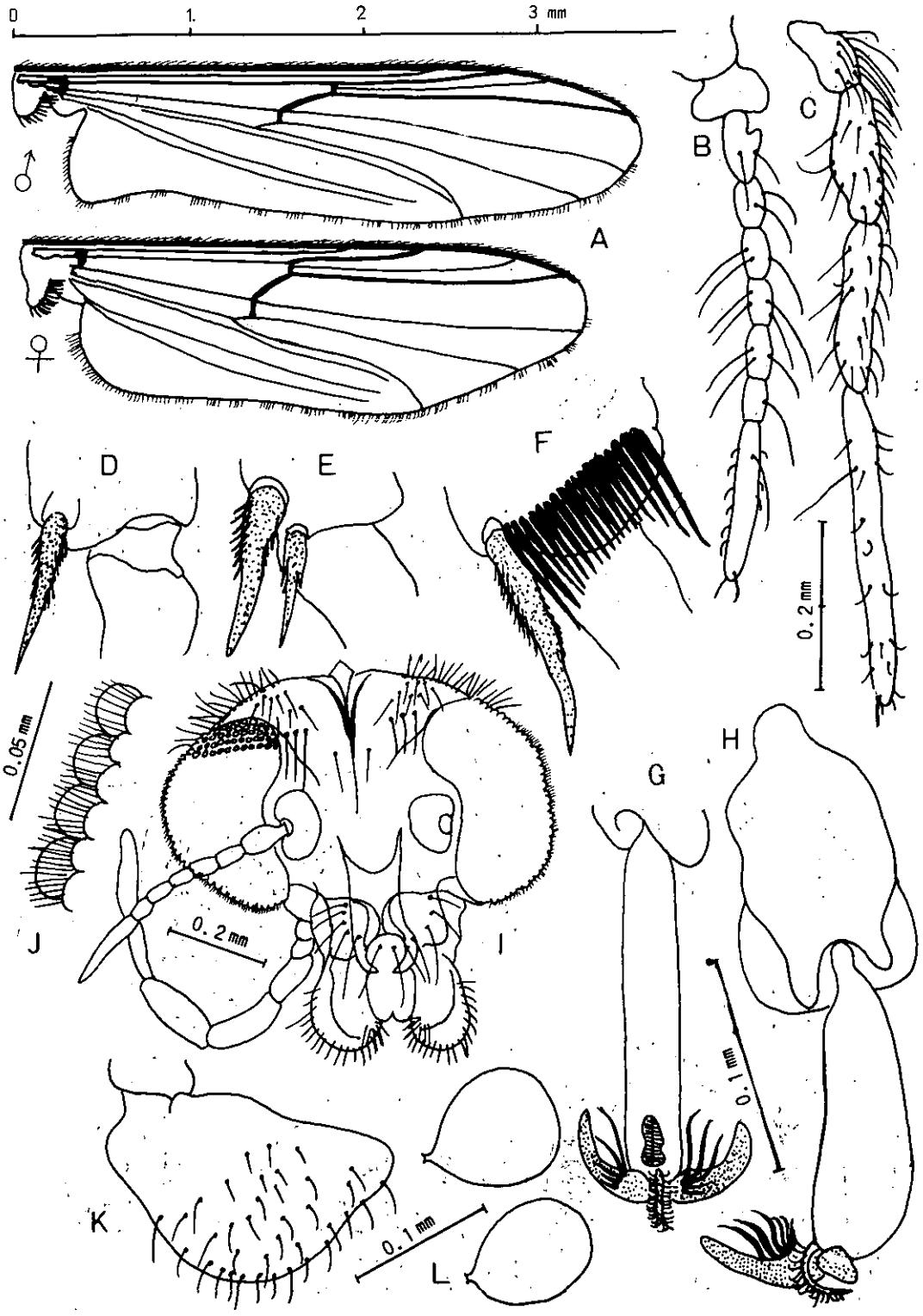

Fig. 72. *Diamesa tsukuba*, sp. nov. Adult.

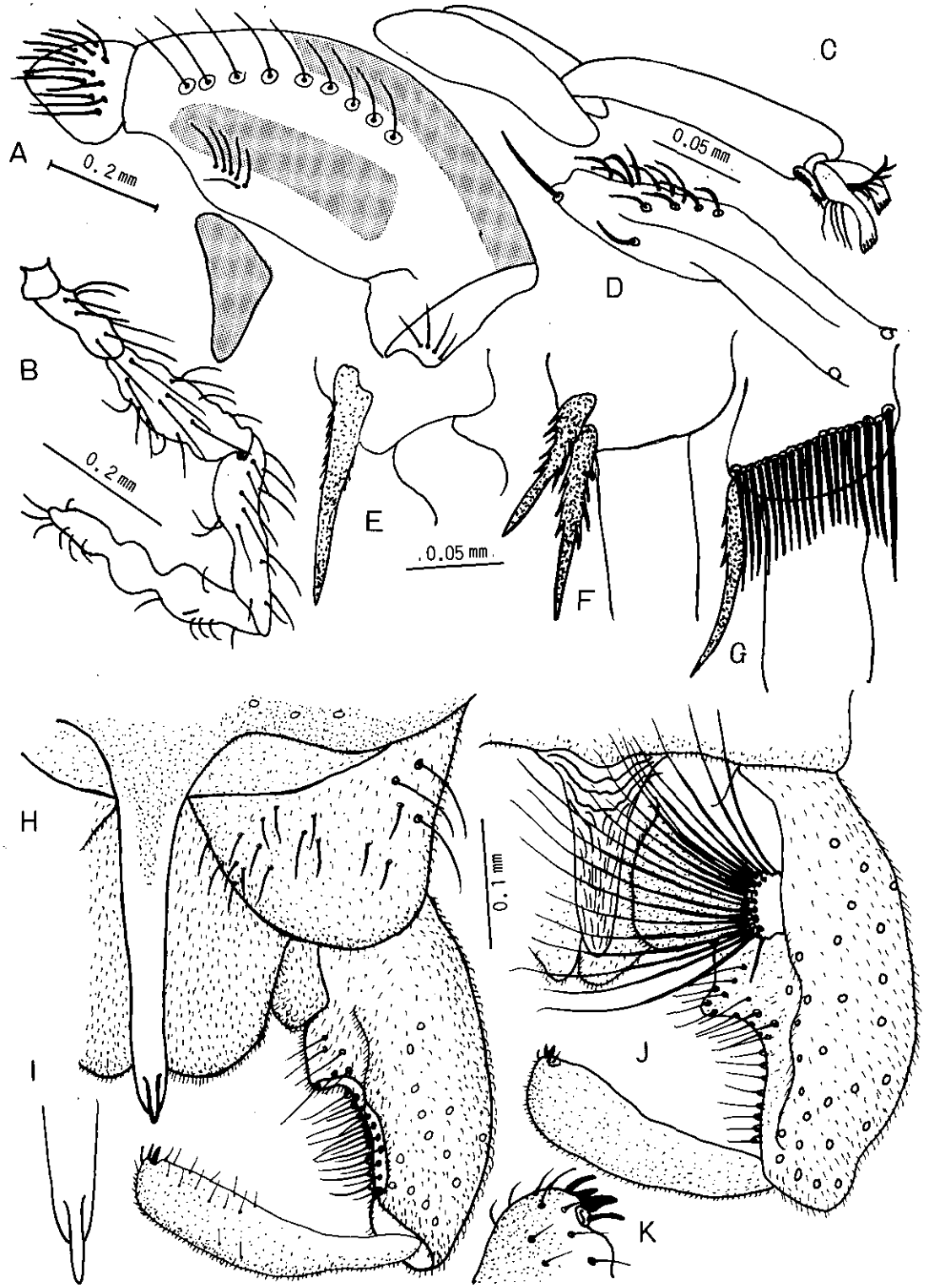

Fig. 73. *Diamesa tsukuba*, sp. nov. Adult male.

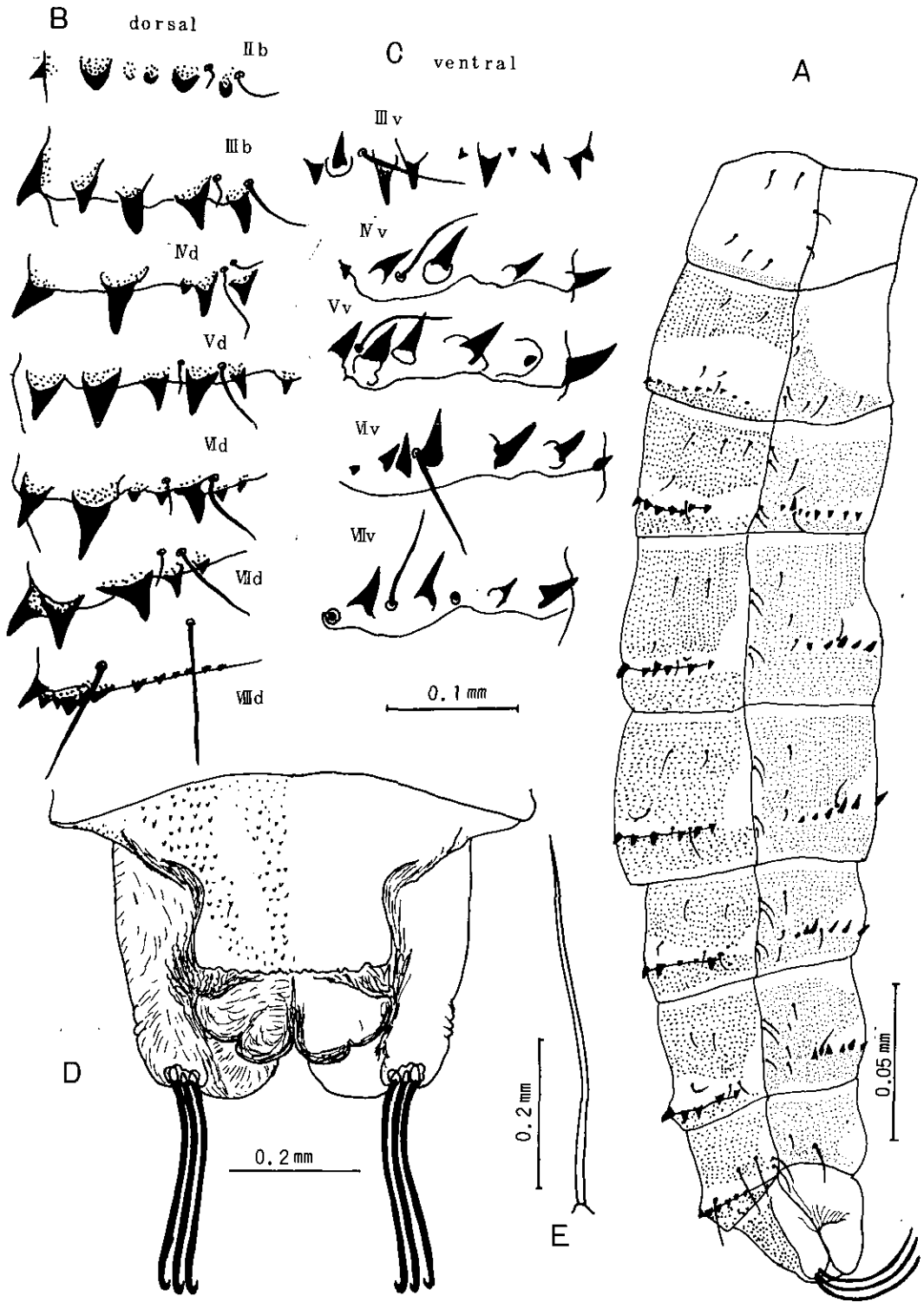

Fig. 74. *Diamesa tsukuba*, sp. nov. Pupa.

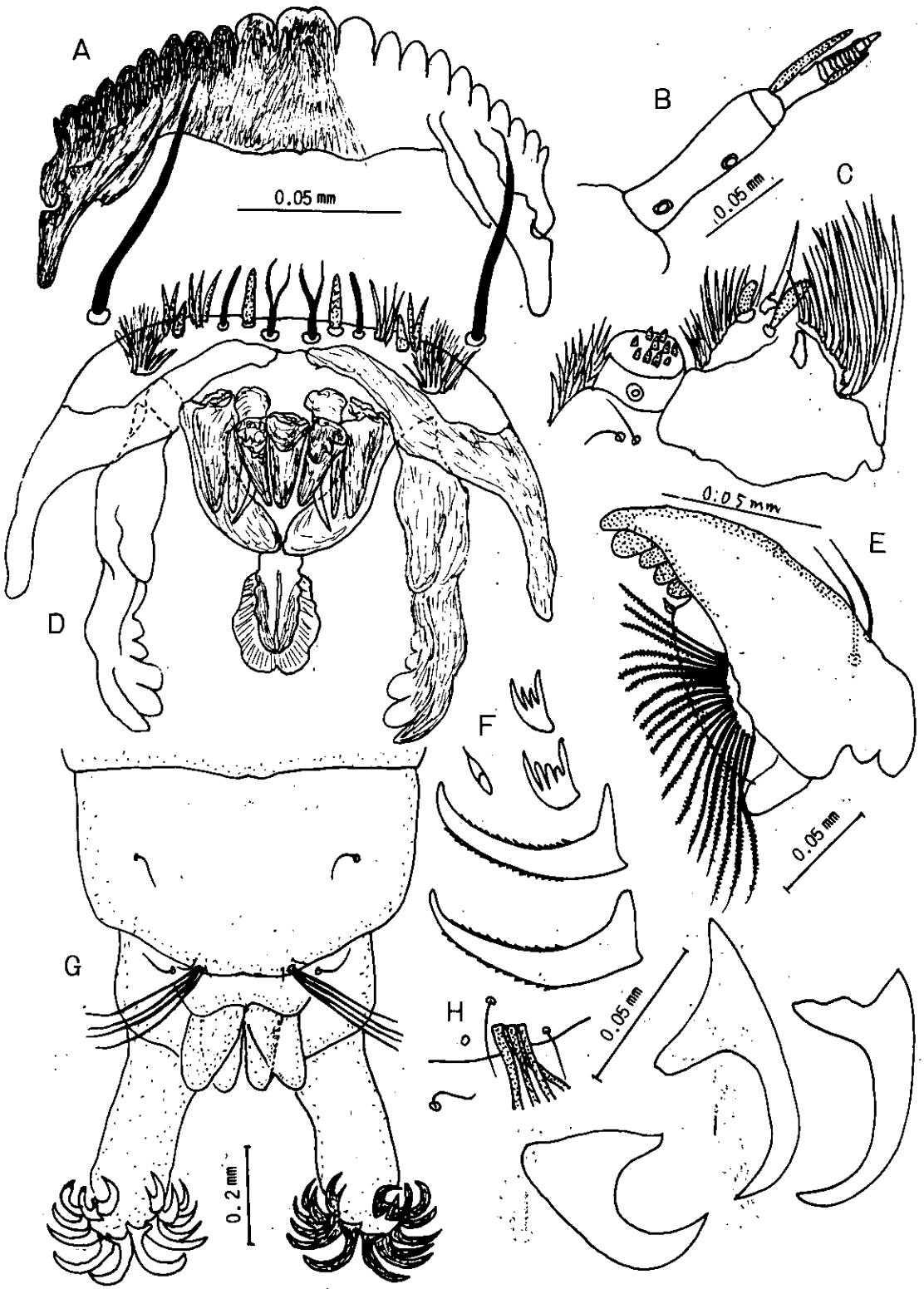

Fig. 75. *Diamesa tsukuba*, sp. nov. Larva.

APPENDIX

Tentative key for identification of genera or species quoted in this paper.

A. Adult males

1. Cross vein m-cu present (Fig. 72 A) 2
   Cross vein m-cu absent 3
2. Vein R 2+3 present and not forked. Wing membrane bare. Last antennal segment much longer than the preceding segments. . . . . Genus *Diamesa*, DIAMESINAE
   Vein R 2+3 present and forked, connected with R 1 with R 2. Last antennal segment short, much shorter than the preceding segment. Wing membrane usually densely covered with macrotrichiae . . . . . * TANYPODINAE
3. Front tarsus I shorter than front tibia. Tibial combs, if present, basally separated (Fig. 41 D). Gonostylus bent inwards and with a short and stout apical spine . . . . . ORTHOCLADIINAE 4
   Front tarsus I longer than front tibia. Tibial combs fused with each other (Figs. 1 D, 8 C). Gonostylus and gonocoxite on the same axis, directed backwards, apical spine absent . . . . . CHIRONOMINAE 14
4. Veins R 1 and R 4+5 fused with thickened costa (Fig. 69 D) 5
   Vein R 1 and R 4+5 separated from the costa, as usual 6
5. Hind tibia strongly expanded distally . . . . . *Corynoneura*
   Hind tibia cylindrical, as usual . . . . . *Thienemanniella*
6. Eyes pubescent (with numerous short hairs; Fig. 69 B) 7
   Eyes bare, as usual 10
7. Dorsocentral setae long and erect, arising from large pale pits, as usual (Fig. 53B) . . . . . *Paratrichocladius*
   Dorsocentral setae short and decumbent, arising from small pits (Figs. 57 A, 60 C) . . . . . *Cricotopus* 8
8. Body coloration almost entirely black, only hypopygium being white. Scutellum and abdominal tergites with numerous setae irregularly arranged (Fig. 65 A) . . . . . *C. yatabensis*
   Body with distinct pale bands on abdomen and legs. Setae on scutellum and abdominal tergites more reduced, those on scutellum on a single line (Figs. 57 A, 60 C) 9
9. Pulvilli absent (Fig. 56 E). Abdominal tergites I and IV yellow, other tergites black. Scutellum with about 12 setae (Fig. 57 A) . . . . . *C. bicinctus*
   Small pulvilli present (Fig. 60 D). Abdominal tergites I, IV and V entirely or largely pale (light form). Scutellum with about 8 setae (Fig. 60 C) . . . . . *C. sylvestris*
10. Anal point absent (Fig. 49 B). Vein R 2+3 fused with R 4+5. Anal lobe of wing flat (Fig. 48 A) . . . . . *Eukiefferiella yasunoi*
    Anal point present. Vein R 2+3 separated from both R 4+5 and R 1. Anal lobe of wing prominently produced (Fig. 40 A) 11
11. With large pulvilli (Fig. 45 F) . . . . . *Psectrocladius aquatronus*
    Pulvilli absent (Figs. 41 E, F) . . . . . Genus *Orthocladius* 12
12. Setae on scutellum on a single transverse line (Fig. 32 D). Anal point sharply pointed apically, with conspicuous lateral bristles (Fig. 33 C) . . . . . Subgenus *Orthocladius* 13
    Setae on scutellum irregularly arranged (Figs. 40 F, G). Anal point apically

rounded, lateral hairs shorter (Fig. 41 J) . . .*Orthocladius (Euorthocladius) kanii*

13. Antennal ratio about 1.6. Halteres black. Hypopygium as in Figs. 33 C-G . . . . . .*Orthocladius (O.) makabensis*

Antennal ratio about 2.6. Halteres yellow. Hypopygium as in Figs. 38 A-D . . . . . *Orthocladius (O.) yugashimaensis*

14. Wing membrane with macrotrichia. Cross vein r-m short and parallel to wing axis. Squama bare (Fig. 1 A). Both accessory ventral appendage (2a) and accessory dorsal appendage (1a) usually present (Figs. 5 C, E, F) . . . . .TANITARSINI 15

Wing membrane usually lacking macrotrichia (exception: genus *Pentapedilum*); if present, then squama is fringed with setae (Fig. 17 F). Cross vein r-m long and oblique (Fig. 8 A). Accessory appendages 2a and 1a absent . .CHIRONOMINI 16

15. Combs on middle and hind tibiae very broad, occupying more than half circumference of tibia, and confluent medially or only narrowly separated, spurs absent or very short (Figs. 1 D, E) . . . . . .*Paratanytarsus*

Tibial combs narrow and widely separated, bear long spur (Fig. 6 I) . . . *Tanytarsus*

16. Both combs of hind tibia with a short spur (Fig. 8 C). Ventral appendage of male hypopygium without a long apical hair directed backwards (Fig. 13 B) 17

One tibial comb bearing a long spur, the other without a spur (Fig. 16 E). Ventral appendage with a long apical hair directed backwards (Fig. 17 B) 18

17. Pronotum reduced medially, divided into two lobes in the middle . . . . . *Glyptotendipes*

Pronotum well developed, reaching to anterior margin of scutum, and not completely divided in the middle . . . . . *Chironomus*

18. Wing with macrotrichiae (Fig. 17 F) . . . . . .*Pentapedilum* 19

Wing without macrotrichiae 20

19. Anal point of male hypopygium narrow and slender (Figs. 17 A, D) . . . . . .*P. shirokanensis*

Anal point very wide and with rounded apex (Figs. 20 A, F) . . . . . .*P. kasumiensis*

20. Vein R 2+3 ending close to R 1 (Figs. 27 A, 29 A). Wing membrane unmarked . . . . . *Microtendipes* 21

R 2+3 ending well separated from R 1. Wing membrane usually with dark spots (Fig. 24 I) . . . . . .*Polypedilum*

21. Dorsal appendage of male hypopygium slender, with 3 long hairs but devoid of microtrichiae (Fig. 27 F) . . . . . .*M. tsukubaensis*

Dorsal appendage composed of a basal, setigerous part, and a distal bare and sickle-like part directed inwards (Fig. 29 J) . . . . . *M. ureshinoensis*

B. Pupae

1. Thoracic respiratory organ with seave plate . . . . . *TANIPODINAE

Thoracic respiratory organ, if present, without seave plate 2

2. Abdominal segments VIII with a pair of caudolateral scales (Fig. 6 T) . . . . . CHIRONOMINAE 3

Abdominal segment VIII without caudolateral scales 9

3. Thoracic respiratory organ absent, or if present, a simple tube (may be haired, Fig. 6 J). Abdominal tergites III to V with distinctive patterns of spine patches . . . . . .TANYTARSINI 4

Thoracic respiratory organ with at least 4 branches. Abdominal tergites with rather

evenly distributed spines or spinules . . . . . CHIRONOMINI 5

4. Thoracic respiratory organ absent. Abdominal tergites III to V with spine patches as in Fig. 2 A . . . . . *Paratanytarsus parthenogeneticus*

With a simple tube-like thoracic respiratory organ (Fig. 6 J). Abdominal tergites III to VI with spine patches as in Fig. 6 K . . . . . *Tanytarsus oyamai*

5. Abdominal tergites II to VI each with a palmate scale (Figs. 14 A-H) . . . . . *Glyptotendipes tokunagai*

Abdominal tergites without such scales 6

6. Thoracic respiratory organ divided into numerous long filamentous branches . . . 7

Thoracic respiratory organ divided into 4 or 7 short, simple tubes 8

7. Caudolateral scales on abdominal segment palmate, with about 10 finger-like spines defined proximal band of small spines (Fig. 10 A) . . . . . *Chironomus tainanus*

Caudolateral scales on abdominal segment VIII elongated, with several spines along the lateral margin (Fig. 24 I). Abdominal tergites II to V with a well defined proximal band of small spines (Fig. 25 A) . . . . . *Polypedilum octoguttatum*

8. Thoracic respiratory organ with 4 branches of about 0.2 mm in length (Fig. 28 I). Caudolateral scales on segment VIII rather sharply pointed apically (Fig. 28 H) . . . . . *Microtendipes tsukubaensis*

Thoracic respiratory organ with 7 longer branches of about 0.5 mm in length (Fig. 30 A). Caudolateral scales on segment VIII rather blunt apically (Fig. 30 F) . . . . . *Microtendipes ureshinoensis*

9. Abdominal tergites II to VIII as well as sternites III to VIII with a row of large, dark conical spines (Figs. 74 A, B, C) . . . . . DIAMESINAE: *Diamesa tsukuba*

Spines on abdominal segments much smaller and thinner . . . ORTHOCLADIINAE

10. Anal lobes with a fringe of numerous swimming hairs (Figs. 46 D, 70 A) 11

Anal lobes without a fringe of swimming hairs 12

11. Thoracic respiratory organ horn-like, 0.33-0.44 mm long (Fig. 46 E). With 2 swimming hairs on abdominal segment VI, 4 on VII, and 5 on VIII (Fig. 46 A) . . . . . *Psectrocladius aquatronus*

Thoracic respiratory organ absent. Abdominal segments III to VIII each with 4 pairs of swimming hairs (Figs. 70 C, D) . . . . . *Thienemanniella majuscula*

12. Anal lobe with 3 long and stout terminal bristles. Thoracic respiratory organ slender, longer than 0.1 mm 13

Anal lobe reduced, without terminal bristles, and with two short setae. Thoracic respiratory organ ovate, only about 0.05 mm long . . . . . *Orthocladius kanii*

13. Thoracic respiratory organ napiform, basally expanded and apically filamentous (Fig. 50 D). Middle two pairs of lateral hairs on abdominal segment VIII longer and stouter than the first and the fourth pairs . . . . . *Eukiefferiella yasunoi*

Thoracic respiratory organ horn-like. Lateral hairs on segment VIII subequal . . 14

14. Spinose areas on abdominal tergites III, IV and V are continuous from middle to the caudal margin of the segment (Fig. 35 A) 15

Spinose areas on abdominal segments III, IV and V are clearly divided into the middle and the caudal zones (Fig. 54) 16

15. Thoracic respiratory organ only sparsely spinulated (Fig. 34 F). Anal lobes without specialized spines at base of caudal bristles (Fig. 35 L) . . . . . *Orthocladius makabensis*

Thoracic respiratory organ with numerous spinules (Fig. 38 G). Anal lobe with several spines at base of caudal bristles (Fig. 38 J) . . . . . .

. . . . . *Orthocladius yugashimaensis*

16. Thoracic respiratory organ slender and tube-like, with smooth surface, 0.20-0.27 mm long. (Fig. 62 E). Of 3 apical bristles of anal lobes, the innermost one (0.15 mm) is significantly longer than the middle and the outer ones (0.11 mm) . . . . . *Cricotopus sylvestris*

Thoracic respiratory organ more or less fusiform, widest at about the middle, surface with spinules. Apical bristles of anal lobes almost equal in length 17

17. Length of abdomen 3.0-3.3 mm (3.10+0.10 mm in 12) specimens). Thoracic respiratory organ 0.18-0.25 mm, with numerous spinules on the surface (Fig. 54 A). With 4 pairs of lateral setae on abdominal segment VII, 5 pairs on segment VIII . . . . . *Paratrichocladius rufiventris*

Smaller species, length of abdomen less than 2.7 mm. Thoracic respiratory organ shorter than 0.17 mm. With 3 pairs of lateral setae on segment VII, 4 pairs on segment VIII 18

18. Length of abdomen 2.1-2.7 mm (2.41+0.18 mm in 12). Thoracic respiratory organ 0.06-0.14 mm long (0.102 mm in average of 10), with fewer spines (Fig. 58 F) . . . . . *Cricotopus bicinctus*

Length of abdomen 1.8-2.2 mm (2.03+0.10 mm in 15). Thoracic respiratory organ 0.13-0.17 mm (0.148 in average), with more numerous spines (Fig. 66 D) . . . . . *Cricotopus yatabensis*

C. Larvae

1. Antenna retractile into head. Bases of preanl hair tuft long and cylindrical . . . . . *TANYPODINAE

Antenna non-retractile. Bases of preanal hair tuft semiglobal or lower 2

2. Third antennal segment annulated (Fig. 75 B) . . . . . DIAMESINAE

None of the antennal segments annulated 3

3. With a pair of striated paralabial plates (plb in Fig. 3 B). Mandible with preapical comb (mnc in Fig. 4 D) . . . . . CHIRONOMINAE 4

Without striated paralabial plates. Mandible without preapical comb . . . . . ORTHOCLADIINAE 13

4. Paralabial plates very narrow and wide, almost touching in the middle (Figs. 4 C, 7 A). Antenna relatively long, the first segment curved and more than 1.6 times the combined length of segments II to V; antennal tubercle prominent, longer than wide; Lauterborn's organs paired and prominent (Figs. 4 F, 7 G) . . . . . TANYTARSINI 5

Paralabial plate fan-shaped, widely separated (Fig. 11 A). Antenna shorter, the first segment hardly longer than the combined length of segments II to V; antennal tubercle much shorter than wide; Lauterborn's organs inconspicuous (Figs. 11 C, 15 B) . . . . . CHIRONOMINI 6

5. Lauterborn's organs sessile on tip of antennal segment II . . . . . *Paratanytarsus parthenogeneticus*

Lauterborn's organs on a long petiole . . . . . *Tanytarsus oyamai*

6. Labial plate with an odd number of teeth, the middle tooth unpaired 7

Labial plate with an even number of teeth, the middle teeth paired 11

7. Abdominal segment VII with a pair of caudolateral processes, and VIII with two pairs of long blood gills . . . . . *Chironomus plumosus*-group (see Sasa, 1978)

Abdominal segment VII without caudolateral processes 8

8. Abdominal segment VIII with two pairs of long blood gills . . . . . *Chironomus yoshimatsui* (see Sasa, 1978)

Abdominal segment VIII with no or only one pair of blood gills 9

9. Abdominal segment VIII without blood gills . . . . . *Chironomus salinarius* (see Sasa, 1978)

Abdominal segment VIII with a pair of blood gills 10

10. Blood gills almost as long as or longer than abdominal segment VIII (Figs. 11 G, H). The first lateral pair of teeth of labial plate shorter and narrower than the second pair (Fig. 11 A) . . . . . *Chironomus tainanus*

Blood gills less than half the length of abdominal segment VIII (Figs. 15 F, G). The first lateral teeth of labial plate longer and wider than the second and the subsequent pairs . . . . . *Glyptotendipes tokunagai*

11. Body length 8 mm or longer when mature, color in life deep red. Anal gills short, about 1.5 times as long as wide . . . . . *Polypedilum octoguttatum*

Body smaller, less than 7 mm. Color in life pink or paler. Anal gills more than twice as long as wide, constricted in the middle (Figs. 19 H, 22 H, I, 31 H) 12

12. Antennal blade longer than combined length of antennal segments II to V. LAR = 1.5. Body length about 6 mm . . . . . *Microtendipes ureshinoensis*

Antennal blade as long as or shorter than combined length of antennal segments II to V. LAR = 1.1 . . . . . *Pentapedilum*

13. Antenna very long, about half as long as head and 2.2 times length of mandible, the second segment dark brown (Fig. 71 C) . . . . . *Thienemaniella majuscula*

Antenna less than 1/3 the length of head, and about as long as or shorter than mandible 14

14. Labial plate with 12 teeth, the middle teeth paired (Fig. 47 D). Antennal segment I more than 2.5 times the combined length of segments II to V . . . . . *Psectrocladius aquatronus*

Labial plate with odd number of teeth, the middle tooth unpaired. LAR less than 2 15

15. Labial plate with 11 teeth, the middle tooth flat and wide, about 3 times as wide as the first and the subsequent pairs of teeth . . . . . *Eukiefferiella yasunoi*

Labial plate with 13 or 11 teeth, the middle tooth at most twice as wide as the lateral teeth 16

16. Labial plate with 11 teeth, the first lateral pair notched laterally. Abdominal segments I to VI with hair pencils. Pecten epipharyngis a laterallly notched triangular plate (*pes* of Fig. 67 E) 17

Labial plate with 13 teeth. Abdominal segments without hair pencils. Pecten epipharyngis three spines (Fig. 59 E) 18

17. Middle and the first pair of teeth of labial plate sharply pointed (Fig. 67 C). Mandible crenulated as in Fig. 67 A . . . . . *Cricotopus yatabensis*

Middle and first pair of teeth apically rounded (Fig. 63 D). Mandible crenulated as in Fig. 63 E . . . . . *Cricotopus sylvestris*

18. Mandible with 4 cutting teeth; outer margin crenulated 19

Mandible with 5 cutting teeth; outer margin usually smooth 20

19. Inner margin of mandible serrulate (Fig. 59 D). Middle five teeth of labial plate paler than the more lateral teeth (Fig. 59 A) . . . . . *Cricotopus bicinctus*

Inner margin of mandible smooth (Fig. 55 D). Teeth of labial plate almost equally

dark brown (Fig. 55 A) . . . . . *Paratrichocladius rufiventris*

20. Outer margin of mandible with three notches. Lauterborn's organ globular, about 4 times as wide as antennal segment III. Middle tooth of labial plate wider and with horizontal anterior margin. Claws on anterior and posterior pseudopods and head capsule dark brown . . . . . *Orthocladius kanii*

Outer margin of mandible smooth (Fig. 36 C). Lauterborn's organ longer than wide (Fig. 36 B). Middle tooth of labial plate with convex anterior margin (Fig. 36 A). Claws on anterior and posterior pseudopods as well as head capsule yellowish brown . . . . . *Orthocladius makabensis*; *O. yugashimaensis*

* This subfamily is not quoted in this paper.

日本産ユスリカ科２０種の成虫，サナギ，幼虫の形態学的研究

国立公害研究所　佐々　学

この研究は当研究所で進められている陸水域の富栄養化に関する総合研究の一部として開始され，その昭和５３年度における成果をとりまとめたものである

ユスリカ類は双翅目 Diptera に属する昆虫で，ユスリカ科 Chironomidae という分類学上の一科をなしている。蚊に近い虫であるが，成虫は口器が退化して血液を吸ったり，植物を加害したりしない。その一生は，卵，幼虫，サナギ，成虫の４期より成り，卵は多くの場合水面や水辺にうみおとされ，これからかえった幼虫は水底で微小藻類や微生物，有機物を食べて生長し，サナギとなって水面から成虫が羽化する。成虫は空中ないし地表で雌雄が交尾し，やがて雌は産卵して死ぬ。

ユスリカ類はこのような生活史をくりかえしているため，医学，獣医学，農学上には害も益もほとんどなく，いわゆる応用昆虫学の分野からはほとんど顧みられなかった。しかし水環境においては，これに流入する栄養源をとって微生物や藻類が増殖すると，ミジンコ，ワムシなどの動物プランクトンが水中でこれを捕食し，水底ではユスリカ幼虫，イトミミズ類，貝類などがそれらを食べて生長し，さらにエビ，カニ，魚類，水鳥などの餌となり　さらに人の食物となるという食物連鎖をなしている。水におけるこのような栄養素の流れにおいてユスリカ類は一つの大きな役割をしていることが示されてきた。すなわち，水の富栄養化の機構解明と，その対策の樹立は　ユスリカ類を無視してはすすめることができないことを知り，この研究を開始したことになる。

霞が浦に一例をとっても，１０月末にその底泥をしらべてみると，１５cm平方あたり平均４５足，目方にして約0.９グラムのアカムシユスリカ幼虫がいた。それは１平方キロあたり４０t　全湖面については約8,000tという計算になる。この湖にはこのほかにオウユスリカはじめ数十種のユスリカがいて，春から冬にかけて大量に羽化してくる。おそらく年間には１万tをこえるユスリカが湖面から脱出し，あるいは魚の餌となっていると思われる。それだけ富栄養化の防止に役立っていることはたしかである。

ユスリカ類の幼虫は，あらゆる湖沼，河川，池，溝，水槽などの底に生息し，さらに海水にいるものや，陸棲の種類もある。その発生環境に応じて異なった種類が見出され，とくに湖沼や河川においてはその汚染の質や量がユスリカ幼虫の種類により判定できるものと推定される。

日本産ユスリカ類については，佐々・山本（1977）がとりまとめたところでは，主として徳永雅明博士により１６０種類あまりが記録されているが，その幼虫についてはほとんど分かっていない。また，北川禮澄氏らは幼虫で分類を試みておられるが，幼虫で固定してしまったのでは，種はおろか，属さえも分からない場合がある。ユスリカ類の分類には雄の形質，

とくにその交尾器の構造が最も重要なよりどころになっているからである。

日本のどこに，いつ，どんな種類のユスリカが発生しているかをてっとり早く知るためには，空中に群飛中や草むらなどに休息中の成虫を捕虫網でとって調べればよい。しかし，私どもの研究目的は主として水環境中に現存しているユスリカ幼虫の動態を解明することであるから，幼虫で種を分類し，それぞれの種についての定量的な観察をする必要がある。そのためには，野外で採集した幼虫を生きたまま，あるいはその一部を固定して形態をしらべ，さらに，実験室内でサナギ，成虫に育てて，雄成虫で正確に種を同定するという手順を必要とする。野外で集めた材料には何種類ものユスリカがまじっていることが多いので，幼虫やサナギを1匹づつ個別の容器で飼育し，成虫が出たあと，サナギ，幼虫の抜殻を標本にするという方法がこの3代の形態をたしかめる上で最も信頼できる。サナギのとき，成熟幼虫の抜殻を腹にひっかけているものがあり，それから雄が出ると1匹で目的をはたせる。

このような方法で，茨城，東京，静岡，長崎などの調査場所で普通に見出されたユスリカのうち，今回は２０種類についてこの研究をまとめた。そのうち１２種は既知種の記載といづれかの点で基本的な差を認めたので，新種とせざるをえなかった。残り８種のうち3種は外国では既知種で日本未記録種であり，５種の日本既知種のうち成虫，サナギ，幼虫のいづれもが分かっているのは１種にすぎなかった。これをみてもいかに日本産ユスリカ類の分類学には未知の領域が多いかを痛感した。

この研究における標本作製は次の方法によった。

ガム・クロラール液封入法：成虫はまず１０％苛性ソーダ液中で加熱してから水洗し，スライドにとり，ガム・クロラール液をかけて実体顕微鏡下で解剖針を用い頭，交尾器などを外し，位置をととのえてからカバーグラスをかけ，下からガスライターの炎で熱して気泡を追い出す。ハネの標本は，成虫を加熱前に細いピンセットでハネの根本から切断し，乾いたままの標本に小さく切ったカバーグラスをかぶせ，その両端をマニキュア糊で固定する。幼虫，サナギの抜殻は水洗後スライドグラスにとり，針で幼虫は頭部を分解し，サナギは頭胸部と腹部を切りはなして位置をととのえ，ガム・クロラール液を加え同様にカバーグラスで封入する。生きた幼虫はそのままスライドにのせ，ガム・クロラール液をかけ，頭と尾部を切断し，形をととのえてカバーグラスをかける。ガム・クロラール液は，アラビアゴム８g抱水クロラール３０g，氷醋酸１mℓ，グリセリン３mℓ，水１０mℓの割に乳鉢にとり，乳棒でよく砕いて溶解させ，ガラスびん中に静置してごみの沈んだあとの上澄を使用する。

成虫の乾燥標本：成虫は乾燥のまま三角紙か小さい容器に入れ，パラヂクロルベンゼンの入った箱に密封する。また，名刺の紙を長さ１２mm，幅５mmほどの直角三角形に切り，これを昆虫ピンの中ほどに刺し，紙のとがった先にマニキュア糊を少量つけ，成虫の胸部側面をこれに固定する。昆虫針標本は体色やハネの脈の観察に便である。

アルコール液漬標本：成虫，サナギ，幼虫のいずれもエチルアルコール７０，水３０，グリセリン１０の割合の液につけ保存することができる。検鏡はホールグラスに水を入れた中でおこない，再び７０％アルコールにもどす。

A morphological study of adults and immature stages of 20 Japanese species of the family Chironomidae (Diptera)

Manabu Sasa

RESEARCH REPORT FROM
THE NATIONAL INSTITUTE FOR ENVIRONMENTAL STUDIES
No. 7
国立公害研究所研究報告第7号
(R — 7 — '79)

昭和54年3月31日発行

編集・発行 国立公害研究所
茨城県筑波郡谷田部町大字館野

印 刷 フクダ工芸株式会社
東京都中央区新川1丁目3番3号

Published by the National Institute for Environmental Studies
P.O. Yatabe, Ibaraki 300-21, Japan.
March, 1979