

### Materials and Methods

Collections and rearings. Procedures for collecting and rearing were basically those of Belkin et al (1965). Preservation of adult mosquitoes was done by pinning method.

Slide mounts. All slide mounts used in identification were prepared from the following media :

1. Hoyer's media.
2. Canada balsam.
3. Grade A Canada balsam.
4. Euparal.
5. Gater's media.



Preparations of specimens before slide mounts. Whole larvae, whole <sup>and male</sup> pupae, larval and pupal skins, genitalia were prepared as outlined by Belkin et al (1965).

The system of chaetotaxy and terminology of structural parts of the adults, male genitalia, pupae and larvae used in this thesis are mainly those of Belkin (1962, vols. I & II) and of Bram (1967, vol . II, No. 1).

DISTINCTIVE CHARACTERS OF THE GENUS CULEX:

Adults :

The obvious features of adults of the genus *Culex* are as follows : Apical half of labium does not curve downward; Posterior margin of scutellum is distinctly trilobed with separated marginal setae. Squamae are fringed with long hairs. Spiracular and postspiracular bristles are absent; cell  $R_2$  is always at least as long as vein  $R_{2+3}$ . Pleural scales reduced or absent. Pulvillus develops below each claw of pretarsi.

Pupae :

Pupal respiratory trumpet is always with distinctive tracheoid and pinna. Abdominal hair 9 on segment VII and VIII are well developed, far removed from caudolateral angle of tergite. Both hair 1, 2 - P are present at apex of midrib of paddle.

Larvae :

Head hair 3 - C always dorsal in position; prothoracic hairs 13 - P absent. No abdominal palmate hair is seen. Siphon is distinctive with an obvious attached acus at base laterally. Accessory ventrolateral or ventral hairs are present.

Male genitalia :

Proctiger strongly developed, paraproct with a conspicuous transverse crown of numerous apical spines, denticles or spicules; sidepiece with subapical lobe bearing specialized setae; clasper or basimere inserted in a vertical plane; phallosome usually complex.

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DISTINCTIVE CHARACTERS OF THE SUBGENERA

Subgenus Culex Linnaeus 1758

For synonymy see appendix



Female :

Medium to large sized species. Head. Proboscis with or without pale dorsal band. Thorax. Scutum covered with very dense scales, with or without distinct ornamental pattern; bristles well developed on acrosticha, anterior dorso centra, posterior dorso-centra, supraalar, prescutellar and scutellar areas; pleuron with distinct scale patches. Wings with or without distinct patches of light scales. Legs with or without pale bands. Abdomen. Terga with or without band of pale scales.

Male :

Palpus with 5 segments and usually longer than the proboscis, without specialized or modified tufts of scales or setae, approximately as long as the proboscis. Genitalia. Sidepiece with well developed subapical lobe, at least 1 leaflike seta present; phallosome complex, the lateral plate with both inner and outer division, spiculate or denticulate; paraproct crowned with a dense tuft of spicules, cercal setae variable in number, basal sternal process well developed.

Pupae :

Metanotal hairs 10 - C usually multiple; paddle smooth, without distinct fringe of spicules on outer margin, apex rounded.

Larvae :

Hair 1 - C variable in shape and sclerotization; 5, 6 - C

strongly developed, branched and pectinate; 16, 17 - C absent.

Thorax. Hair 1, 2 - 3P single, pectinate, usually of the same order and thickness. Abdomen. Pecten restricted within the basal third of the siphon, ventral brush consisting of at least 10 tufts inserted on the grid.

Distribution :

The representatives of the subgenus are known from every zoogeographic region. Members of the subgenus are found throughout Thailand.

The subgenus Culex may be divided into 2 main groups, pipiens - group and sitiens group.

PIPIENS - GROUP

Adult :

Head: Proboscis entirely covered with dark scales. Thorax. At least 1 bristle present on lower mesepimeron; tarsomeres without distinct pale rings. Abdomen Terga with or without distinct transverse pale bands.

Larva :

Head : Hair 1- C usually fine and filamentous, slightly pigmented, if do not so some characters are distinguish.

SITIENS - GROUP

Adult :

Head : Proboscis with a median pale band. Thorax. Lower mesepimeron bristles absent; tarsi with distinct or indistinct pale rings. Abdomen. Terga always with transverse pale bands.

Larva :

Head : Hair 1 - C always distinct, usually moderately or strongly pigmented.

Subgenus Culicionya Theobald 1907

For synonymy see appendix

Female :

Usually small to medium sized species. Head. Proboscis unbanded; Thorax. Scaling pattern of the scutum very dense, smooth in appearance; acrostichal bristles not developed except at extreme anterior end and rarely weakly near prescutellar space, pleuron without distinct scale patches; usually 1 or 2 strong lower mesepimeral bristles present; wings with the dorsal plume scales short and rather broad; legs without pale bands on the femur, tibia or tarsus.

Male :

Proboscis with a median tuft of several long, ventral hairs; palpus longer than the proboscis, with a single row of long hairlike scales obviously flattened and widened<sup>ed</sup> near middle on the ventral surface of segment III; antenna plumose, slightly shorter than the proboscis. Genitalia. Subapical lobe of the side piece with strongly developed setae and with or without a leaf-like seta; clasper variable in shape; phallosome simple, the lateral plate with a strong basal tooth and usually with a series of distinct denticles on the lateral margin; proctiger with a dense tuft of fine spines, cercal setae short, varied in number; basal sternal process long, slender.

Larva :

Head: Hair 1 - C either fine and filamentous or robust; 16, 17 - C present, represented by minute spicules. Thorax. hair 1 - P single or bifid; 2 - P always single; 3 - P single or branched, the branches

always much thinner than, and usually about half the length of 1 - P. Abdomen with from 3 to 6 pairs of subventral tufts inserted in a line beyond the pecten; ventral brush consisting of 8 hair tufts inserted on the grid; anal gills always longer than the saddle.

Pupa :

Not study in detail.

Distribution :

The subgenus Culiciomyia is represented principally in the Old World tropics, although a few species extend to Japan and 3 species are found in the South Pacific. Collections to date indicate that members of the subgenus are distributed throughout Thailand. (Bram 1967).

Biology :

The immature stages of species of Culiciomyia in Thailand are found in a variety of habitats ranging from treeholes to running creeks and swamps in tropical rain forests; however, the larvae are found most frequently in temporary<sup>ry</sup> accumulation of water, usually with high organic content. Host preferences and bionomics of the adult females are virtually unknown, but species of this subgenus have rarely been collected feeding on humans, even in area where the mosquitoes are quite numerous. Two species, pallidothora and spathifurca, have been experimentally fed on human infected with *Wuchereria bancrofti* with subsequent isolation of infective larvae from the mosquito. It is felt, however, that these species play little in any part in the transmission of the disease in nature. (Bram 1967).

Subgenus Lutzia Theobald 1903

For synonymy see appendix

The following description of female, male, pupa and larva are coded from Bram (1967).

Female :

Very large species for the genus with conspicuous ornamentation  
Head. Proboscis with a pale median band of scales on the ventral surface and frequently encompassing the proboscis; antenna longer than the proboscis; torus with a number of broad scales on the inner margin. Thorax. Scutum with very dense scaling, usually with distinct but variable patches of light scales; acrostichal bristles well developed; but rather short, distinct pleural scale patches present; 4 or more strong, lower mesepimeron bristles present.

Male :

Head: Palpus and antenna longer than the proboscis, palpal segments IV and V upturned. Genitalia Subapical lobe of the basimere with strongly developed setae, but without a leaflike seta; distimere normal for the genus; phallosome simple; proctiger crowned with a dense tuft of rather slender, short spicules; usually 5 or more short cercal setae present.

Larva :

Head: Head capsule elongate; antenna glabrous, gradually tapering to a truncate apex, and not constricted beyond the insertion of hair 1 - A which is short, single, simple and inserted on the proximal half of the shaft; head hair 1 - C single, simple; 4 - C dendritic with about 4 or 5 branches; 5, 6 - C single, simple, very strong and long

16, 17 - C absent; mentum with very strong teeth; mouth parts adapted for predation and mouth brushes very broad and lamellate; integument of the head covered with a conspicuous pattern of minute spicules. Thorax, Integument covered with a conspicuous pattern of very dense, small, sharply pointed spicules; prothoracic hairs relatively short. Abdomen. Integument covered with spicules which are not nearly as apparent as those of the thorax; comb consisting of a broadly triangular patch of fan-shaped scales; siphon variable, index approaching 1 : 1, covered with a dense conspicuous pattern of sharply pointed spicules which seem to be modified in the form of reticulose platelets; approximately 10 subventral tufts inserted on the siphon, pecten extending almost to the apex; saddle completely ringing the anal segment; ventral brush consisting of approximately 15 individual tufts inserted within the grid.

Pupa :

Very large, but similar in chaetotaxy to those of the subgenus Culex. Paddle broad.



Subgenus Lophoceraomyia

Female :

Small to medium size species with proboscis and palpus completely dark; length of antenna slightly greater than that of the probosis. Scutum sparsely covered with narrow dark scales, rough in appearance; acrostichal bristles absent, if present weakly developed at extreme anterior margin of scutum or sometimes near the prescutellar space; dorsocentral bristles well developed; pleuron normally without distinct scale patches.

Male :

The most distinction is the bearing of specialized or modified tufts of scales and setae on at least 2 antennal segments, in between flagellomeres 5 - 10. Genitalia sidepiece usually with a row of strongly developed submarginal setae; at least a leaflike seta appears on subapical lobe; phallosome simple, consisting of 1 or 2 parts of lateral plate; proctiger well developed, crowned with a tuft of several rather strong, short bristles, 2 to 3 cercal setae always present; basal sternal process not developed.

Larva :

Head : Head hair 1 - C strongly sclerotized; 5, 6 - C strong, long, more or less pectinate, subequal in length; 14 - C weak, with from 2 - 3 branches, at least 2 of them strongly divergent. Thorax hair 1, 2, 3 - P always single; 3 - P very fine, considerably shorter than 1, 2 - P occasionally branched. Abdomen comb scales with at least a well developed fan-shaped scales type; siphon well developed,

with 3 or 4 pairs of subventral tufts, usually inserted in a line; pecten always present; ventral brush consisting of 10 or more tufts; saddle completely ringing segment X.

Distribution :

The subgenus Lophoceraomyia is restricted predominantly to the Oriental, Indomalayan, and Australasian regions of the Old World. In Thailand, representatives of the subgenus are found throughout the country. Colless (1965) has postulated that the subgenus originated in Southeast Asia as a derivation of the stem that includes, Neoculex, Mochthogenes, and Guliciomyia. (Bram 1967).

Habitat and Disease relation :

Larvae of the subgenus Lophoceraomyia have been collected from various ground water habitats; natural containers such as treeholes, bamboo internodes, rockholes etc., and pitcher plants. Very little is known about the biting habits of females. Adults of some species are known to attack man in the forest. Females may feed on frog and wild birds or other vertebrates.

Three arthropod-borne viruses (Bakau, Ketapang, and Bebaru viruses) have been isolated from species of the subgenus Lophoceraomyia in Malaya but the mosquito species were not determined, nor were host relationships fully investigated; however, antibodies to these viruses have been identified from humans in Malaya (Bram 1967).

The subgenus was subdivided into fraudatrix group and mammilifer group. Characters of the two groups which is based only on the male antenna and palpus are as follows :

The fraudatrix group: Male antenna with plain torus; palpus with basal fingerlike process.

The mammilifer group : Male antenna with prominence on inner side of torus; palpus without basal fingerlike process.

Subgenus Neoculex Dyar 1905

For complete synonymy see appendix

Female :

Head: Small, dark species Head. Proboscis unbanded, palpus uniformly dark. Thorax. Dorsocentral bristles well developed; acrostichal bristles weakly developed, present only on the extreme anterior edge of the scutum; pleura without any ornamentation; legs uniformly dark. Abdomen. Terga with indistinct narrow, pale, basal bands.

Male :

General appearance like female. Head. Palpus  $\frac{2}{3}$  the length of the proboscis; antenna without specialized scales or setae. Genitalia. Sidepiece without scales and without prominent submarginal setae; clasper normal; phallosome simple, ovoid and covered with many strong denticles, particularly on the inner margin; proctiger crowned with a tuft of short, stout spicules; basal sternal process not developed.

Larva.

Head : Usually dendritic beyond the basal half. Thorax. Hair 1, 2, 3 - P single, but 3 - P about half the length and width of 1, 2 - P. Abdomen siphon very long and narrow, with 5 pairs of subventral tufts; pecten restricted within the basal third of the siphon; saddle completely ringing segment X; ventral brush consisting of approximately 10 individual tufts of setae.

Distribution.

The subgenus Neoculex is predominantly Ethiopians, but

representatives are known from all major zoogeographical regions. In Thailand, species of the subgenus, primarily *brevipalpis*, are distributed throughout the country. (Bram 1967).

Biology :

Little is known of the biology of Oriental species of this subgenus. Larvae are usually found in container habitats such as tree holes, bamboo internodes, and restricted ground waters. Host preferences of the females are poorly understood, but man is rarely, if ever, attached. It is possible that the females feed to some degree on amphibian and reptilian hosts. Although there is presently no indication that species of the subgenus Neoculex play any role in the transmission of arthropod borne viruses in Thailand, viruses for which neutralizing antibodies have been found in the human population, have been isolated from species of the subgenus in Mocambique and South Africa (see for example, Worth and de Meillon 1960). Coded from Bram (1967).

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Subgenus Mochthogenes Edward 1930

1930 Culex (Mochthogenes) Edwards, Bull. ent Res. 21 : 305

Type species : Culex malayi Leicester.

Female : Very small species without distinctive ornamentation.

Head. Proboscis and palpus completely dark; antenna longer than the proboscis. Thorax. Acrostichal, anterior dorsocentral, posterior dorsocentral, supraalar, and prescutellar bristles well developed; pleuron without distinct scale patches; 1 strong, lower mesepimeron bristle present; legs completely dark.

Male.

Head; Palpus less than  $\frac{1}{4}$  the length of the proboscis; antenna plumose without specialized or modified scales or setae. Genitalia. Sidepiece without scales or distinctive submarginal setae; subapical lobe having strongly developed setae; clasper irregular in shape; phallosome simple, elongate with denticles; proctiger crowned with a tuft of rather short spines; 2 or 3 cercal setae present; basal sternal process not developed.

Larva :

Head : Head hair 5, 6 - C short, weak, 5 - C about half the length of 6 - C; 14 - C bifid, the branches strongly divergent; 16, 17 - C present, distinct. Thorax. Hair 1, 2, 3 - P single, 3 - P approximately half the length and width of 1, 2 - P. Abdomen. Recten restricted to the basal fourth of the siphon; individual pecten tooth with several broad basal barbs and a distal lateral series of fine, parallel spines.

Distribution :

The subgenus Mochthogenes is restricted to the Old World tropics. Species of the subgenus are found throughout Thailand. (Bram 1967).

Biology :

Bionomics of the adults of this subgenus are virtually unknown; however, females have never been reported feeding on man. Larvae have been collected from a wide variety of habitat in Thailand, ranging from stream margins to rock pools, wells, and ponds. (Bram 1967).

DISTINCTIVE CHARACTERS OF THE SPECIESSITIENS GROUPCulex (Culex) mimulus Edwards 1915

For synonymy see appendix

MATERIAL EXAMINED : 15 ♂♂, 15 ♀♀; 5 associated pupae and larvae skins;  
30 larvae.Female :

Head : Proboscis with broad pale band; palpus with several scattered pale scales. Thorax. Scutum covered with golden brown scales, possessing of indistinct dark and pale areas; dark in the fossal area, posterior dorsocentral and around the lighter scales of prescutellar space; lighter with scattered pale scales on the anterior promontory, posterior fossal area, supraalar area and around the prescutellar space; occasionally pale scales form borderlike on the humeral and posterior fossal area; integument of the pleuron light brown, no lower mesepimeral bristle, and with indistinct darker area present particularly on the sternopleuron and mesepimeron, dense patches of pale scales on the upper sternopleuron, posterior sternopleuron and several scales on the mesepimeron. Wings. Patches with light scales are as follows : first patch begins from costa through subcosta to  $R_1$  (occasionally costa and  $R_1$  indistinct); second spot obviously seen in each specimen from costa through subcosta and  $R_1$  and sometimes through the distal third of  $R_{2+3}$  and base of fork  $R_2$ ,  $R_3$ , the apical spot quite variable, usually of  $R_{4+5}$ ;  $Cu_1$  and proximal half of anal vein pale, (occasionally fringe spot appears between the tip of  $Cu_1$  and  $Cu_2$ ). Legs. Tarsomere



I - IV with narrow basal pale band. Abdomen. Terga dark, with narrow basal pale band.

Male :

Head : Palpus with a broad, median pale band on segment III. Genitalia (figure 3 ). Sidepiece with well developed subapical lobe, 3 setae in (a-c) group, seta a is blunt, shorter than setae b and c which hooked apically, 3 setae in (d - f) group, subequal in length, a leaflike seta g rather broad, and a slender gently curved seta h; clasper normal in shape, with 2 subterminal setae, inner division of the lateral plate possess 6 sharp denticles, the spiculate portion also bears toothlike apically; proctiger crowned with a strong tuft of spines, with a terminal spines on convex and concave surface; basal sternal process well developed and strongly curved.

Pupae : Chaetotaxy see figure 2 .

Larvae : (Figure 4 ).

Head : Head hair 1 - c strongly pigmented, stout, gradually tapering to a sharp point, its length approximately at least half the distance between the base of the pair; 4 - C usually single and simple but occasionally bifid; 5 - C which from 3 to 5 branches, pectinate, 6 - C usually bifid, pectinate (rarely 3 branches); 14 - C single (occasionally bifid). Thorax. Integument glabrous; hair 1, 2, 3 - P single, pectinate; 4, 5, 6 - P single, pectinate; 7 - P usually 2 branches, pectinate; 8 - P 2 branches, pectinate; occasionally 3 branches, 14 - P single and simple (rarely bifid and trifid). Abdomen. Integument glabrous; comb variable ranging from 30 to 42 scales;

siphon variable ranging from 4 : 1 to 8 : 1 ; 4 - 6 pairs of subventral tuft, 1 inserted out of line, the length less than the width of the siphon at the point of insertion; pecten approximately from 8 - 12 teeth; saddle ringing segment X.

Habitats and disease relation :

This species had been collected from rockholes, ground pool and artificial containers, at the elevation of 800 - 1200 meters, from stagnant clear water to milky; larvae collected from rock holes frequently in association with Culex (Lutzia) halifaxii and Culex (Lophoceraomyia) minor. Median distal spine of comb scales of specimens collected at the elevation of 1200 meters is obviously broader and longer than the lateral spines.

The females biting habit is unknown, though adults have been found in houses.

Fig. 1

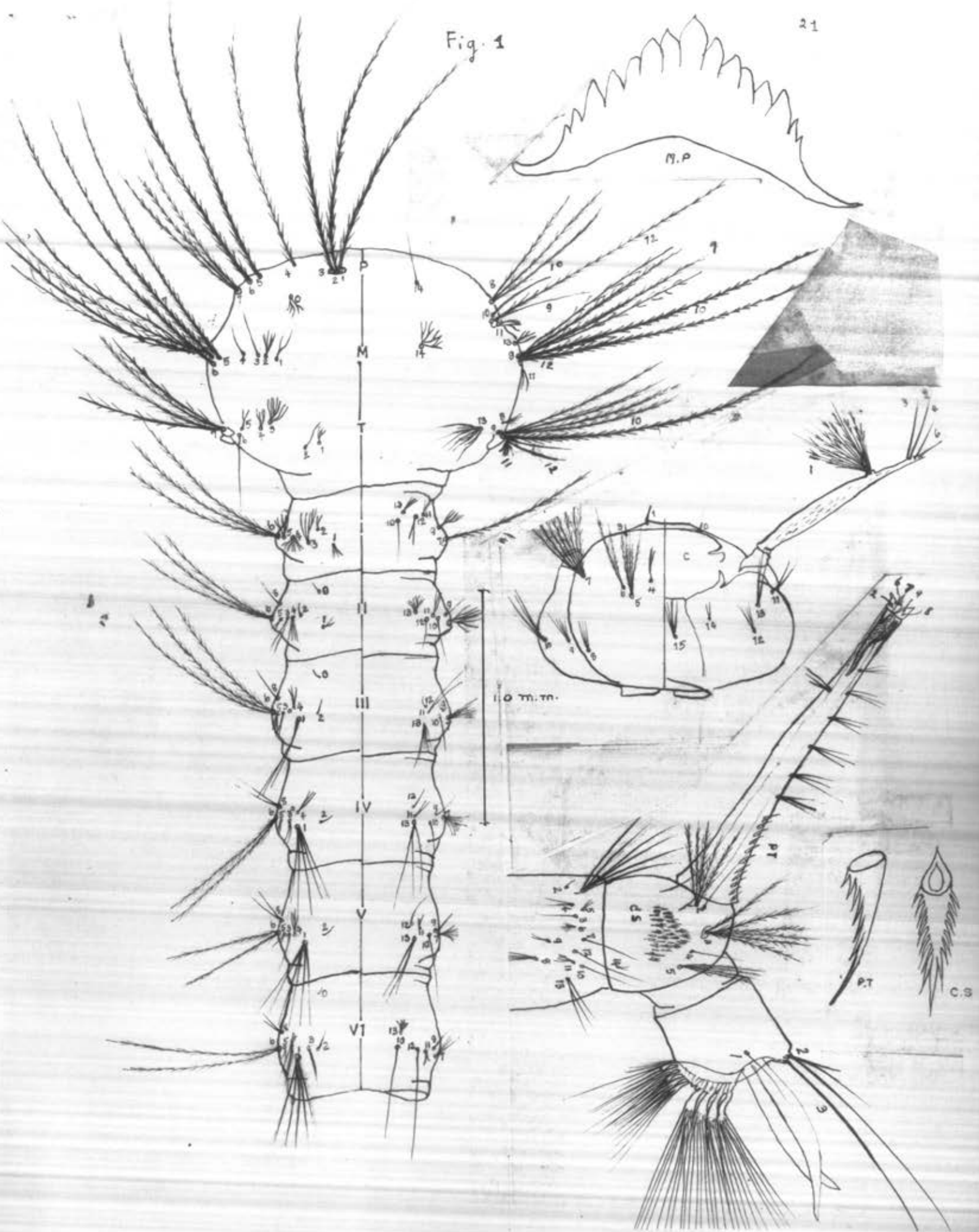


Fig. 2

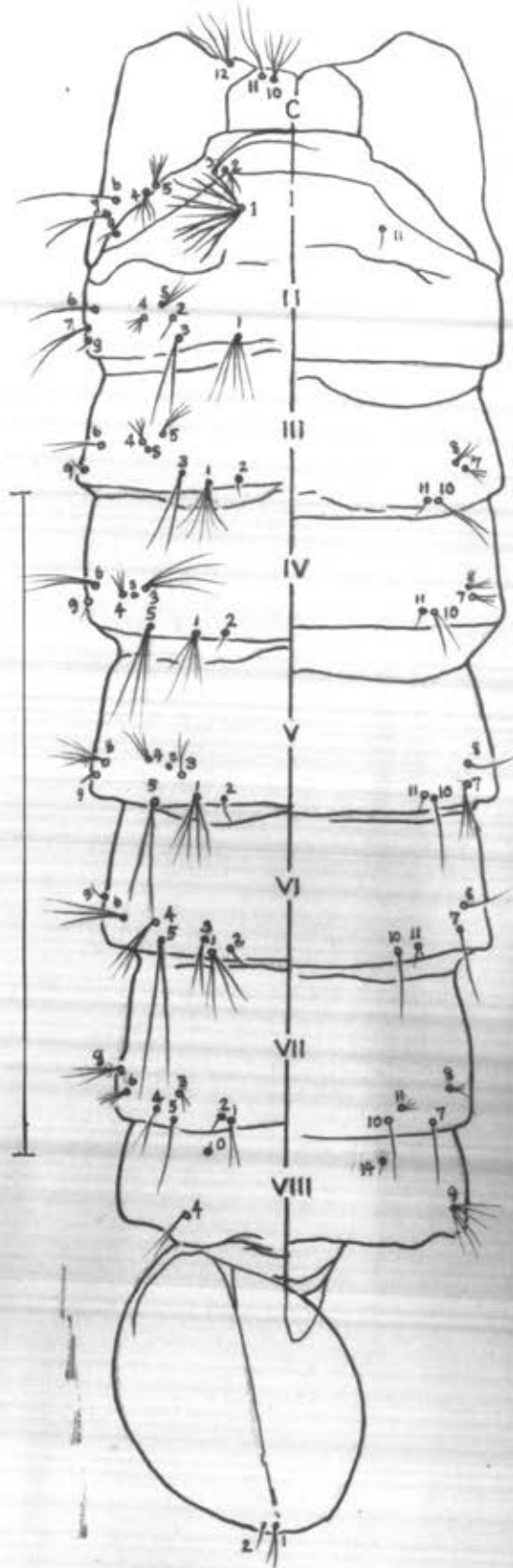
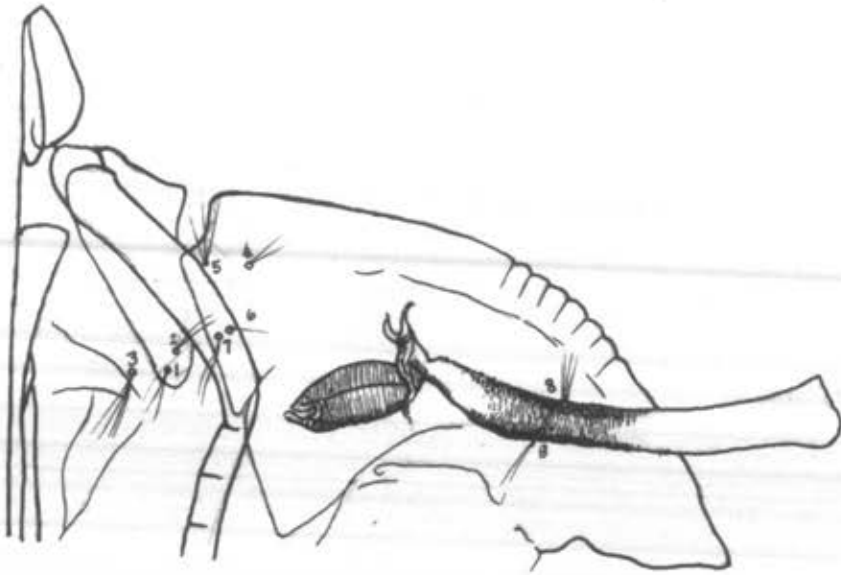
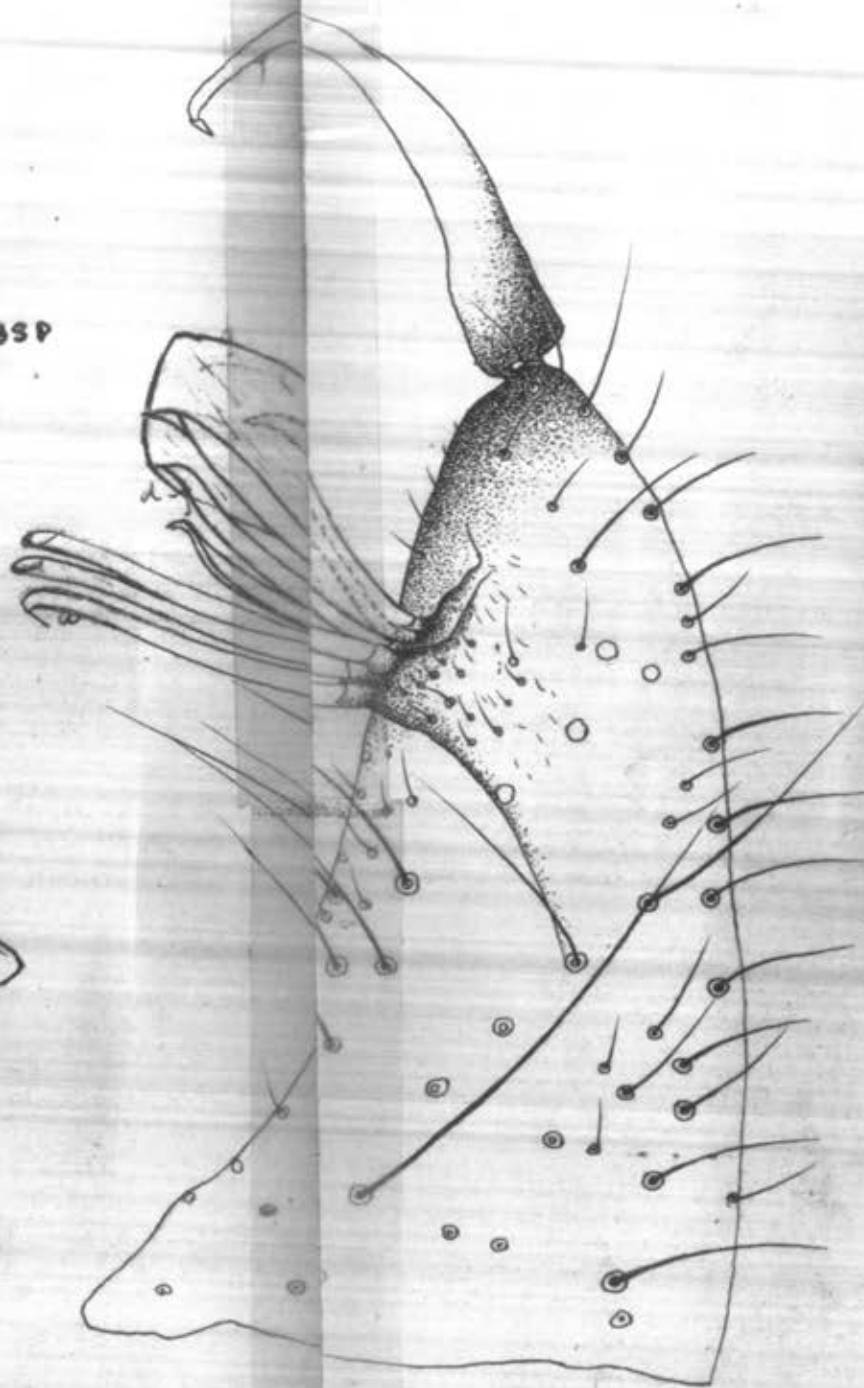


Fig. 3

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Culex (Culex) sinensis Theobald 1903

For synonymy see appendix

MATERIAL EXAMINED : 3 ♀♀, (abdominal segment missing) 3 ♂♂, 2 associated pupal and larval skin and 8 larvae.

Female :

Head : Labium with broad median pale band; palpus dark brown with scattered pale scales at apex. Thorax. Scutum covered with light brown scales from anterior promontory to the supraalar area, but indistinct around prescutellar space, darker scales located around prescutellar area; scutellum with pale scales on midlobe; pleuron dark brown, with patches of white scales present on the upper and posterior sternopleuron, indistinct on upper mesepimeron; dark brown patches appears at subspiracular area and between scale patches of upper and posterior sternopleuron. Wing uniformly dark brown. Legs. Tarsomere I - IV with narrow basal pale band. Abdomen. Abdominal segment missing.

Male :

Head: Labium with broad pale band; palpus dark, with basal and median pale bands on segment III, only a narrow basal pale band on IV, and narrow basal and narrow basal and apical pale bands on V. Genitalia. (Figure 4). Subapical lobe of the sidepiece or basimere well developed, setae (a-c) hooked apically, setae slenderer than setae a and b which located close together; subequal 4 accessory setae (d-f), followed by a slender leaflike seta g and a curved seta h; clasper normal in shape, smooth, with 2 subterminal spines,

on concave and convex surfaces; phallosome simple, inner division gradually tapering, slightly curved and spiculate, the arm parallel, outer division greatly reduced, represented by a small slightly curved prominence at the base of inner division; proctiger crowned with a tuft of spine and with 2 cercal setae; basal sternal process darkly pigmented and strongly curved.

Pupa: Chaetotaxy see figure 5

Larvae: (Figure 4 )

Head: Antenna with a dark basal ring, rather straight, 1 - A branched, simple, inserted at the middle of the shaft, spicules on the shaft reduced in number, scattered particularly on the inner surface below the insertion of 1 - A; head hair 1 - C lightly to moderately pigmented, its length approximately half the distance between the point of insertion; 4 - C weak, long and single; 5, 6 - C rather strong, bifid and pectinate; 5 - C rarely trifid 14 - C single; mentum triangular, strongly pigmented, with approximately 15 - 19 lateral teeth on each side, only 7 - 8 teeth robust and distinct.

Thorax. Integument glabrous; hair 1, 2, 3 - P single, pectinate, subequal in length; 4 - P very weak, short, with from 3 to 4 simple branches; 5, 6 - P single, sparsely pectinate, 6 - P shorter and thinner than 5 - P; 7 - P 2 - 3 branches, pectinate; 8 - P single, pectinate, 14 - P single, simple. Abdomen. Hair 6 - I - II trifid, pectinate, 6 - III usually trifid (rarely 4), 6 - V - VI bifid; 7 - I single, pectinate. Integument glabrous, combs consisting of from 3 to 5 scales, each scale with prominent median distal spine.



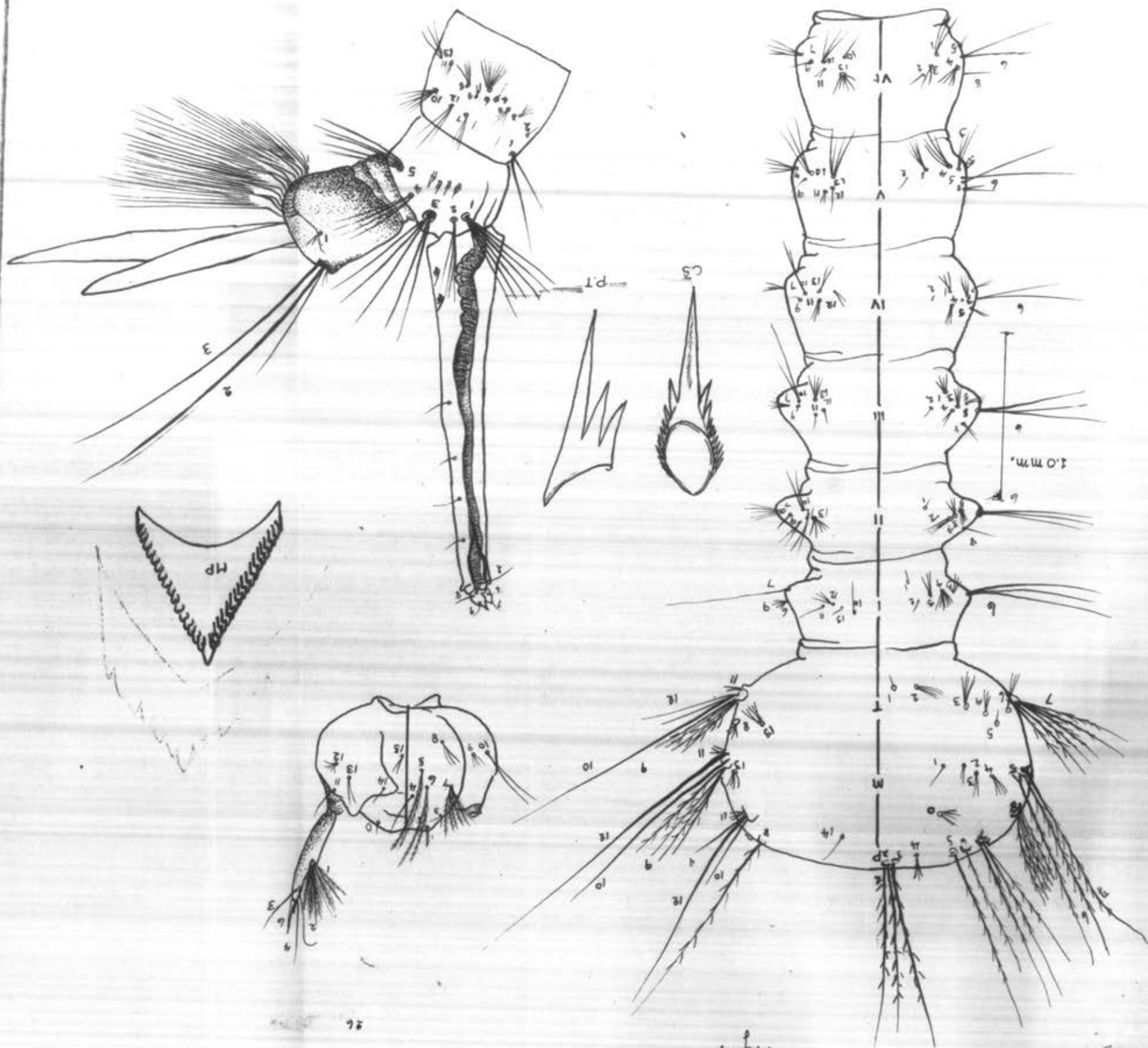


Fig. 4



Fig. 5



10 mm.

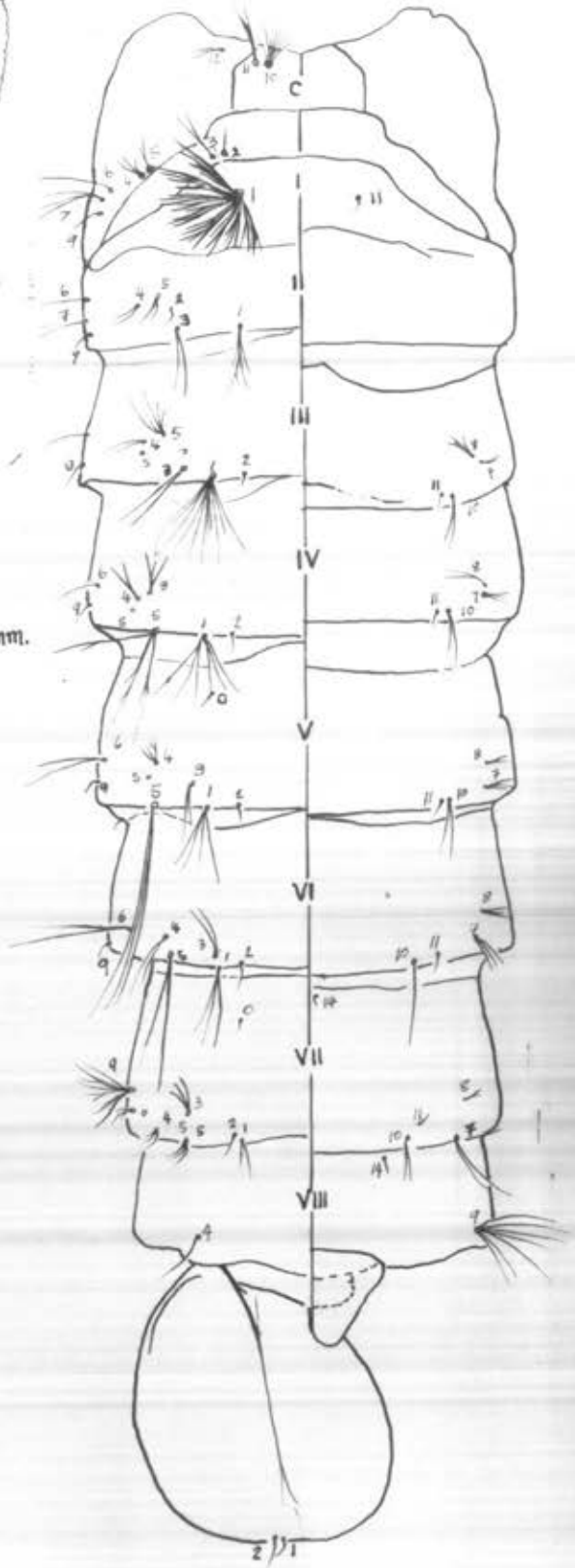
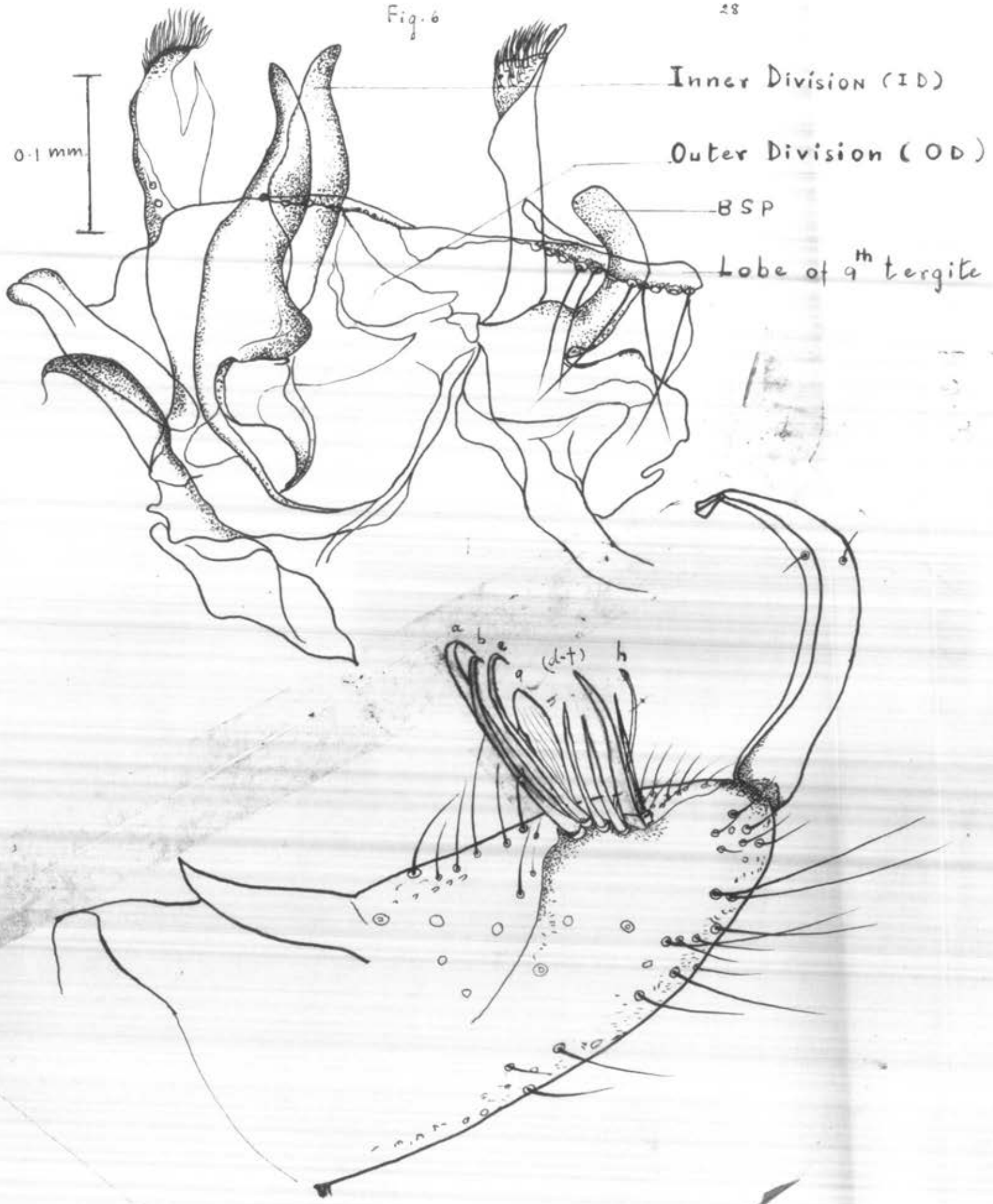


Fig. 6



Culex (Culex) pseudovishnui Colless 1957

1957: Culex pseudovishnui Colless, Ann. trop. Med. Parasit. 51 : 88

(♂, ♀, L\*)

MATERIAL EXAMINED : 5♀♀, 2♂; 9 larvae with 2 associated larval and pupal skins.

Female :

Head: Proboscis dark brown with a rather narrow median band of light scales which broader on ventral surface; palpus also dark brown; decumbent scales of the vertex light golden brown, white broader scales arrange at the border of orbital line, erect scales with dark and light colour. Thorax. Scutum dark brown, with golden brown scales along the borders, darker scales appear at the fossa and along the acrostichal and posterior dorsocentral areas, lighter on the lateral prescutal and supraalar areas; scutum with golden brown scales; integument of the pleuron uniformly dark brown, with patches of dull white scales on the upper sternopleuron, posterior sternopleuron, and anterior mesepimeron, dark bands appear between patches of upper and posterior sternopleuron, prealar, below upper mesepimeron, subspiracular, posterior pronotal lobe. Wing usually dark brown. Legs. Anterior surface of hind femur pale, with an indistinct broad dark band apically, narrow pale band present between joints of all legs. Abdomen. Terga dark, with narrow basal band, segment II the band slightly convex.

Male :

Head: Palpus with a broad median pale band and a narrow basal pale

band on segment III, a basal white band on segment IV, and basal and apical pale bands on segment V. Genitalia. (Figure 9 ). Subapical lobe of the sidepiece with 3 setae in (a- C) group, seta a blunt, b and C hooked apically; 4 accessory setae in (d - f) group which one is leafletlike, broader than the 3; a broad, striated leaflike seta g; and a slender, slightly curved seta h; clasper normal in shape, with 2 subterminal spines; inner division of the phallosome with 3 or 4 strong denticle, the spiculate portion with strong teeth apically; proctiger crowned with a strong tuft of spines; basal sternal process well developed, strongly curved and pigmented.

Pupa : Chaetotaxy as figure 8

Larvae : (Figure 7 )

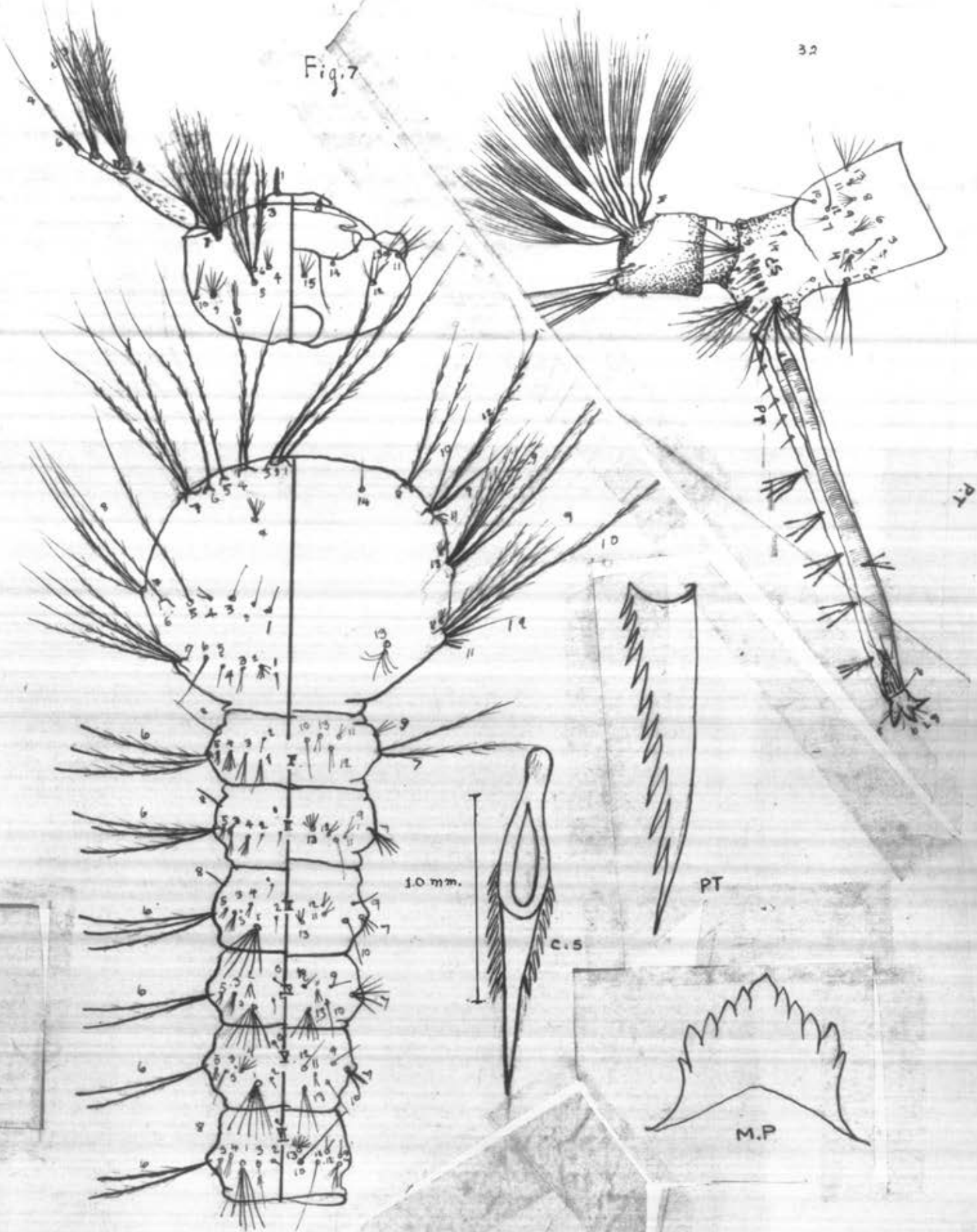
Head : Head hair 1 - C strongly pigmented, stout, progressively tapering to a sharp point frequently asymmetrical; 4 - C single or bifid, simple; 5 C with 3 to 4 branches, pectinate; 6 - C with 2 or 3 branches, pectinate. Thorax. Integument usually glabrous; hair 1, 2, 3 - P single, pectinate, subequal in length; 4 - P 2 or 3 branches, pectinate; 5, 6 - P single, pectinate, 7 - P with 3 branches, pectinate 8 - P bifid, pectinate; 14 - P single, simple. Abdomen. Abdominal hair 6 - I trifid; 6 - II usually trifid (rarely 4); 6 - III from 2 - 5 branches; 6 - IV usually 4 (rarely 3); 6 - V-VI usually 3 (rarely 4); 7 - I single pectinate; comb consisting of 5 or 6 scales arranged in an irregular line; individual comb scale elongate, with a median prominent distal spine and very fine lateral spicules; siphon index variable ranging from 4 : 1 to 6 : 1, 5 to 6 irregular pairs of

subventral tufts, with from 2 to 6 simple branches, their length greater than the width of the siphon at the point of insertion, pecten consisting of 8 to 11 teeth restricted to the basal third of the siphon.

Habitats and disease relation :

The larvae had been collected from Khao Yai at the altitude 800 - 900 meters. They have been found in swamp margin covered with grass and green algae, in associated with Culex (Culex) sinensis, and from a ground pool with Culex (Mochthogenes) malayi. Bram (1967) referred that Colless (1959h) reported that the adult females feed primarily on birds and pig, and to a lesser degree on ox, dog, horse and man; and Scanlon and Esak (1965) collected females biting man at elevation greater than 4,500 feet on Doi Pui, Chiangmai, Thailand. No report on disease relation.

Fig. 7



10 mm.

C.5

PT

M.P

Fig. 8

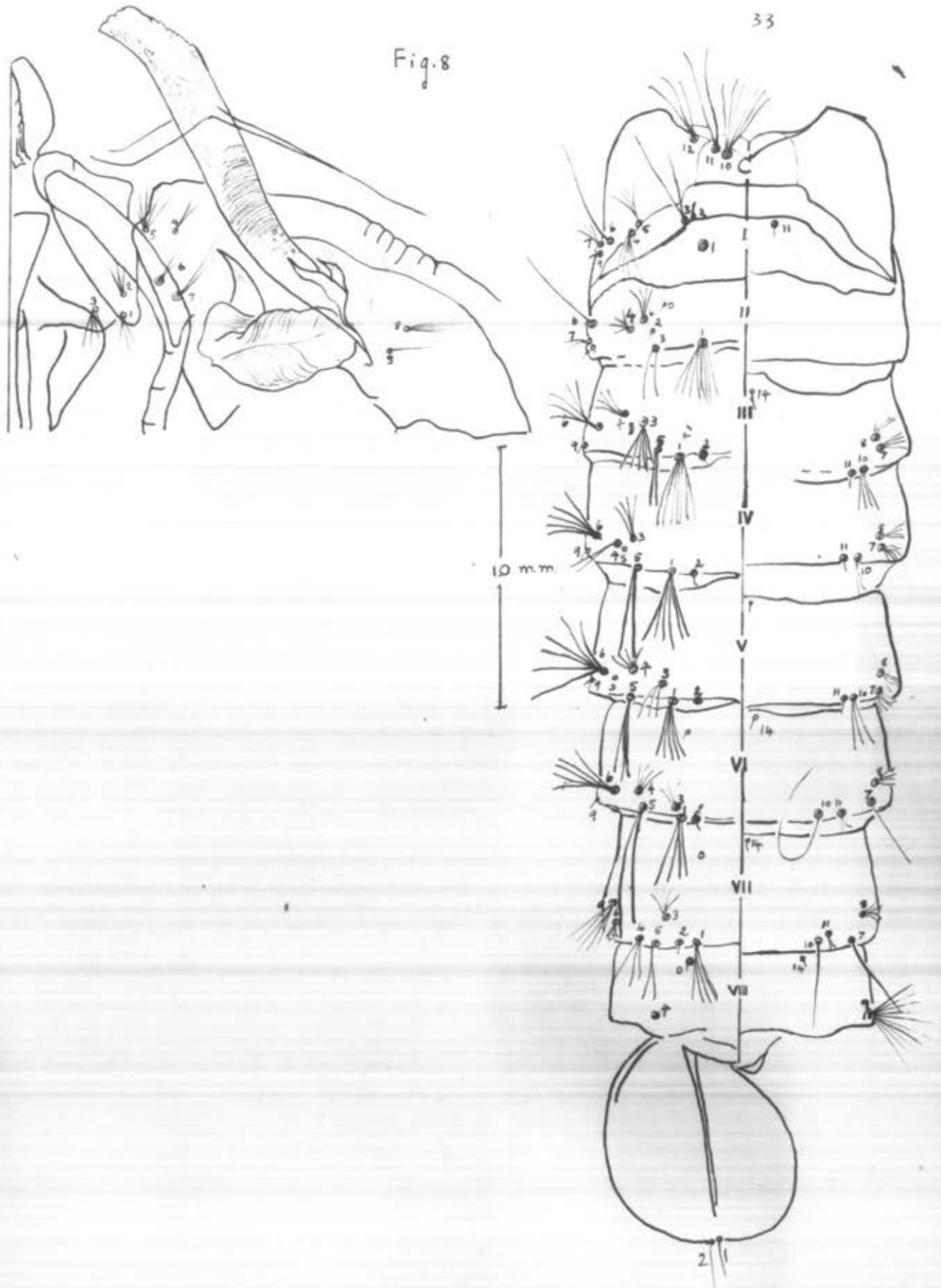




Fig. 9





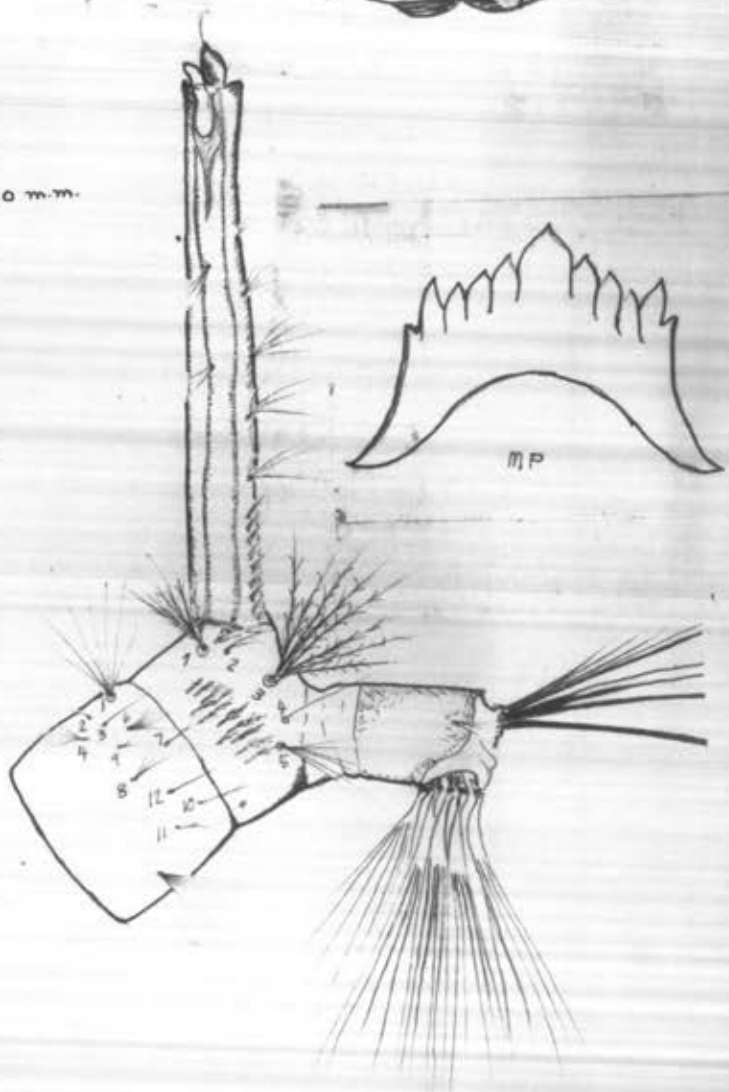
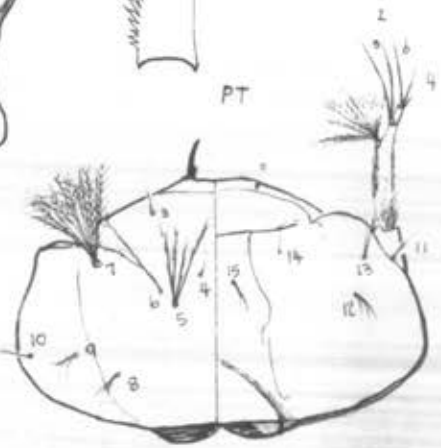
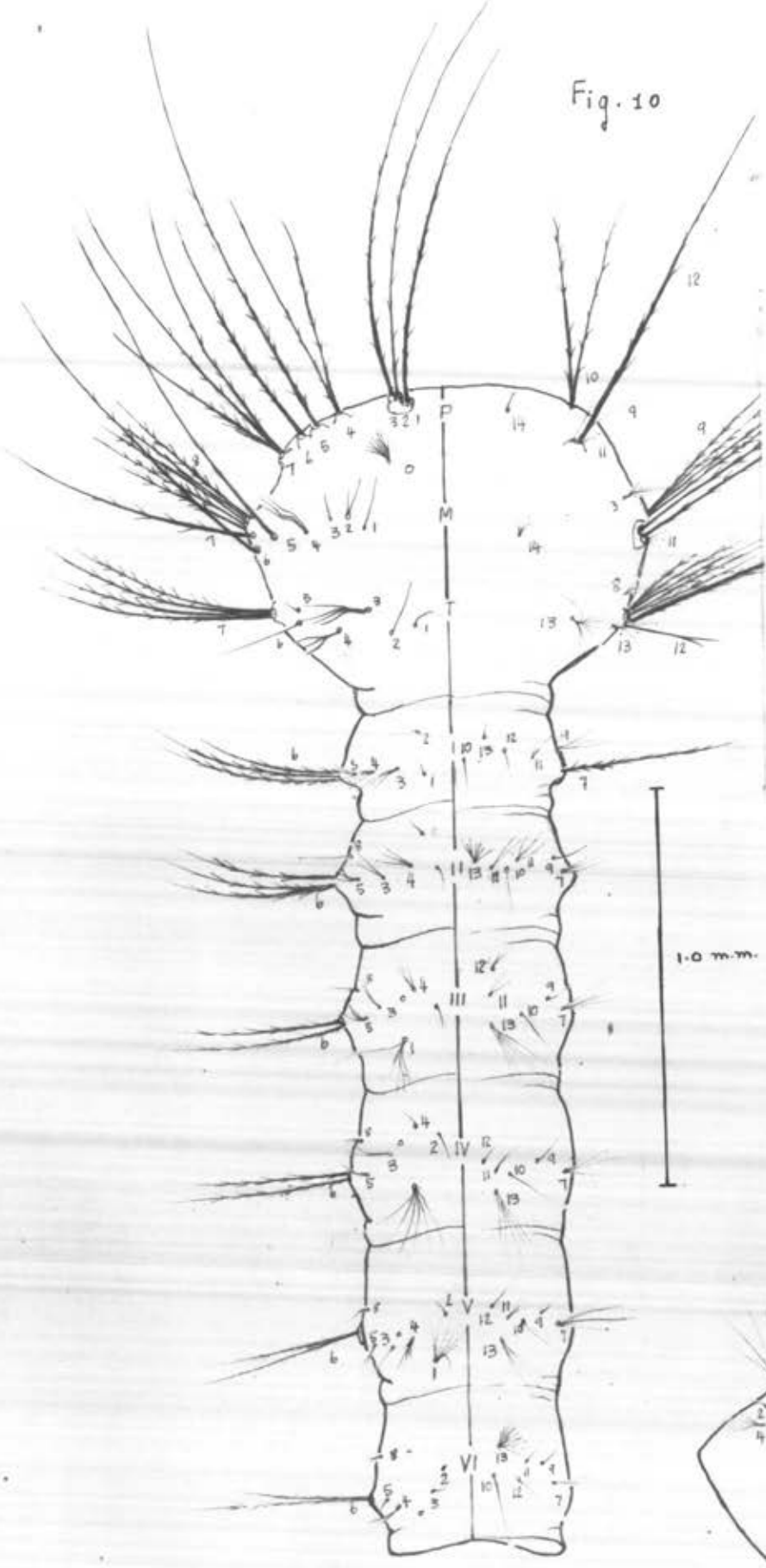
Culex (Culex) perplexus Leicester 1908

1908. Culex perplexus Leicester, Cul. Malaya : 150 (♂, ♀);

Edwards 1917, Bull. ent. Res. 7 : 225 (placed in synonymy with vishnui); Colless 1957, Ann. trop. Med. Parasit. 51 : 95 (♂, ♀, L\*, revalidated)

Only one larva had been collected from a rockhole in association with C. (C) mimulus. The most distinctive character of larva was head hair 1 - C with accessory lateral spicules. Larval chaetotaxy see figure 10 .

Fig. 10





PIPIENS GROUP

Culex (Culex) pipiens quinquefasciatus Say 1823

For synonymy see appendix

MATERIAL EXAMINED : 15 ♀♀; 15 ♂♂, 15 associated pupal and larval skins; 15 larvae.

Female :

Head : Proboscis and palpus entirely dark brown. Thorax. Scutum and scutellum uniformly brown with golden bronze scales; pleuron lighter and without any striking dark area; 1 or 2 strong lower mesepimeron present, patches of distinct whitish scales appears on upper sternopleuron, posterior sternopleuron, upper mesepimeron and anterior mesepimeron. Legs. Anterior surface of all legs covered with pale scales on the ventral half, completely pale at base and entirely dark at apex, remainders of the legs with dark scales. Wings. Dorsal scales all dark. Abdomen. Terga uniformly dark, with distinct convex basal pale band, basolateral white patches indistinct; sterna with variable patches of dark scales.

(In some specimens integument of pleuron is darker than others at postspiracular area, around anterior spiracular area and anterior of posterior pronotal lobe.)

Male :

Head : Antenna normal, shorter than the proboscis; palpus dark, with a somewhat paler area at the base of segment III, with a ventral line of white scales on segment V. Genitalia (figure 13). Subapical lobe

of the sidepiece well developed, with 3 setae in (a-c) group, followed by 3 accessory setae (d-f), which one is blunt, broader than the two, a broad leaflike seta g and a long curved seta h; clasper normal in shape, without crest or annulations; lateral plate of the phallosome distinctive and fairly simple, outer division of the lateral plate rather straight, tapering to a sharp point, nearly parallel in dorsal aspect, inner division with rather large, divergent arms; proctiger crowned with a strong tuft of spines, with 4 cercal setae present, basal sternal process poorly developed, very short and straight.

Pupa : Chaetotaxy see figure. 12

Larva : (Figure 11 ).

Head: Head hair 1 - C filamentous, slightly pigmented; 4 - C single, simple; 5 - C with 3 to 5 branches, pectinate; 6 - C with 4 - 6 branches, pectinate; 14 - C single, simple. Thorax. Integument glabrous; hair 1, 2, 3 - P single, pectinate, subequal in length

4 - P bifid, pectinate; 5, 6 - P single, pectinate; 7, 8 - P bifid, pectinate; 14 - P single, simple. Abdomen. Integument glabrous; comb scales fan-shaped; siphon varied in length and shape, usually stout and expanded medially, greatly narrowed distally, siphon index do not reach 5 : 1; 4 pairs of subventral tufts, with from 2 to 7 branches; pecten variable, from 6 - 12 teeth; saddle encircling segment X.

Habitats and disease relation :

The numbers of this species had been collected from rockholes, artificial containers and swamp margin, in association with Culex (Mochthogenes) foliatus, the species is domestic mosquito and world wide distribution.

Females bite man predominantly at night, both indoor and outdoor.

C. (C.) pipiens quinquefasciatus is an important vector of periodic filariasis caused by Wucheneria bancrofti in some parts of the world, the disease rarely found in Thailand, but very common in Burma and many countries in South East Asia. Studies have been being done on the possibility of virus transmission of encephalitis with pipiens quinquefasciatus but the record is still doubtful.

Fig. 12

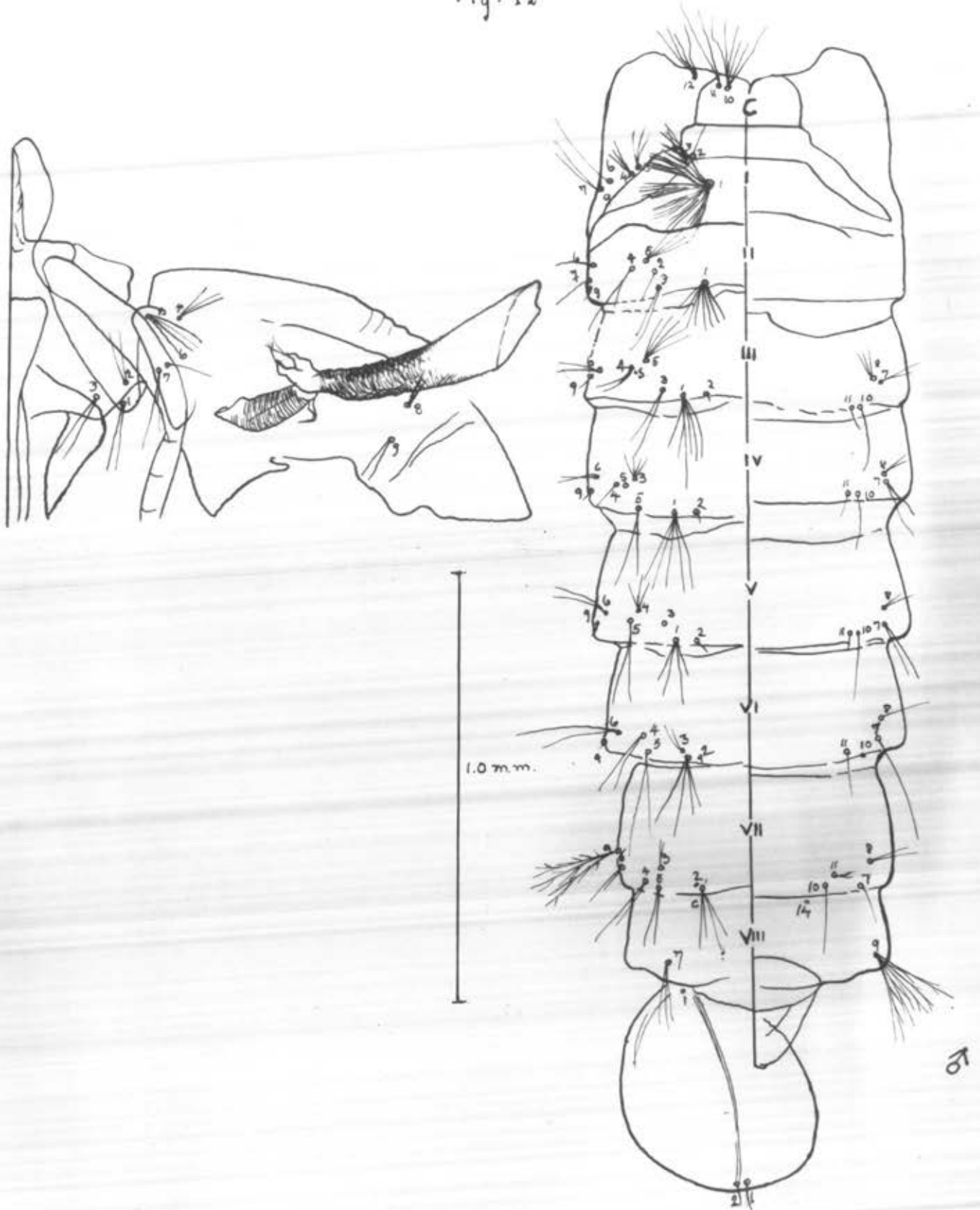
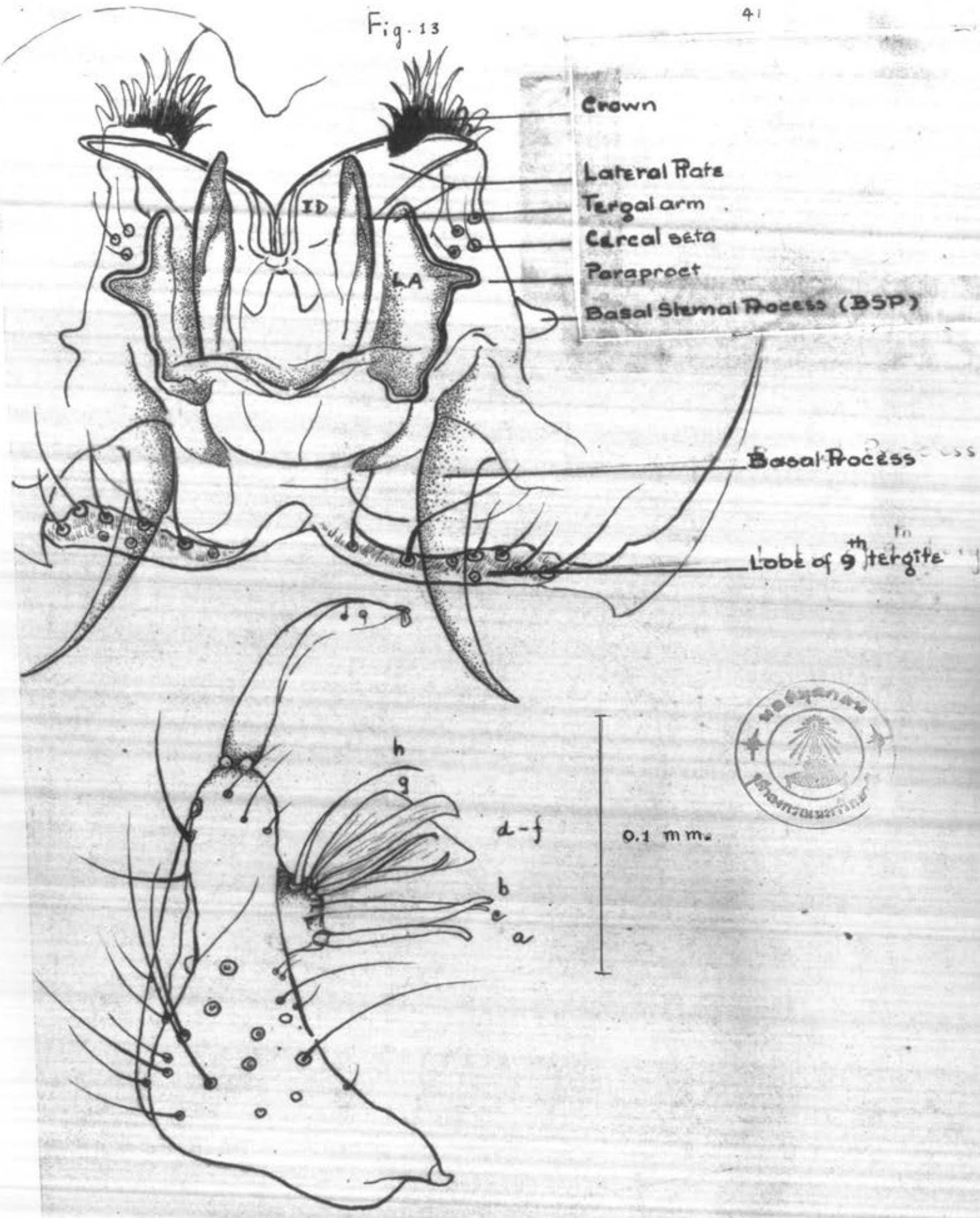
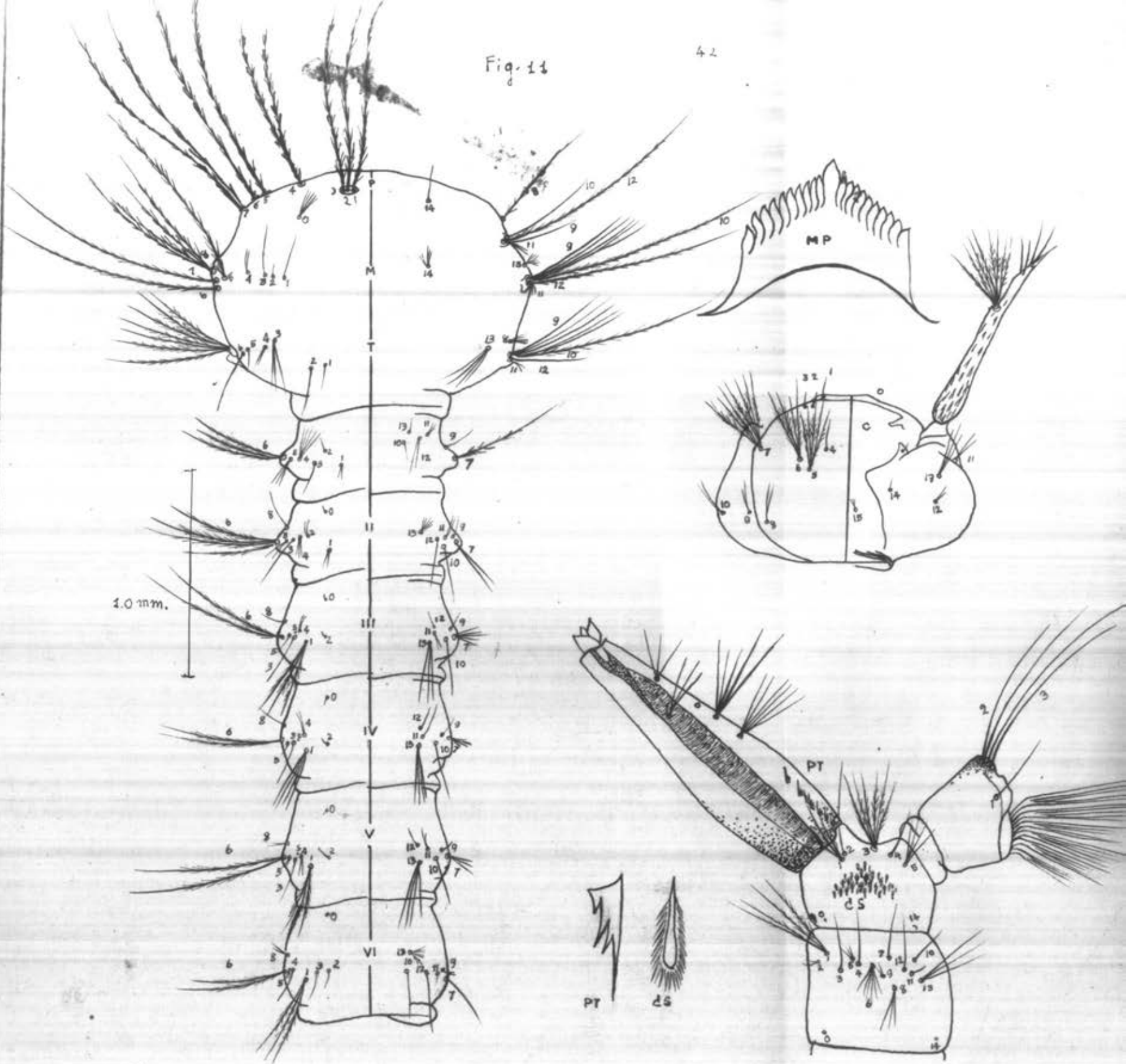


Fig. 13



quin.





Culex (Culicomyia) pallidothorax Theobald 1905

For synonymy see appendix

MATERIAL EXAMINED : 15 ♀♀ ; 10 ♂♂ ; 30 larvae with 4 associated larval and pupal skins.

Female :

Medium sized species. Head. Proboscis and palpus covered with uniformly dark scale; Thorax. scutum and scutellum are quite plain without any ornamentation; pleuron frequently tinged with green, with an obviously dark brown pattern, stretch from the posterior pronotal lobe through preepisacular area across the prealar area and terminated at the upper mesepimeron; another dark brown pattern appeared at the upper sternopleuron; (heavily comma like patches present on anterior of post spiracular and subspiracular areas in some species); 1 or 2 lower mesepimeral bristles present. Wings : covered with dark scales. Legs. All legs uniformly dark brown with pale scales on the anterior surface of the hind femur. Abdomen. Terga with narrow pale basal bands; sternum usually with broad pale scales.

Male :

Labium with a median tuft of bristlelike setae on the ventral side; lower mesepimeron usually with 1 or 2 bristles, (but occasionally absent). Genitalia. (figure 16 ). Subapical lobe of the sidepiece well developed, setae (a-c) closed together; seta a blunt, shorter and narrower than seta b and c which hooked apically; approximately 9 setae in (d-f)group a leaflike seta g slender, seta h shorter than seta g, curved up apically; beyond the subapical lobe covered with numerous

long fine hairs; clasper with 2 subterminal spines. The convex surface with a distinct crest of more than 10 recurved spines; lateral plate of the phallosome with a prominent basal teeth and approximately 7 denticles; basal sernal process narrow, long and straight.

Pupa : Chaetotaxy see figure 15.

Larvae : (Figure 14 ).

Head : Head hair 1 - C filamentous, lightly pigmented; its length at least half the distance between the base of the pair; 4 - C single and simple; 5, 6 - C with 2 - 3 branches, pectinate; 14 - C single.

Thorax. Integument with minute spicules; hair 1, 3 - P bifid, pectinate, (1 - P rarely trifid); 2 - P single, pectinate; 5, 6 - P single, pectinate; 7, 8 - P bifid, pectinate; 14-P single, simple; comb consisting of from 30 to 42 scales, fan-shaped; siphon swollen medially, with 4 pairs of subventral tufts; pecten variable in number, ranging from 7 to 13 teeth; saddle ringing segment X.

Habitats and disease relation :

The members of this species have been collected from rockholes and artificial containers in associated with Culex (Culex) halifaxii and Culex (Lophoceraomyia) minor at the elevation of 800 - 900 meters.

Female biting habit is unknown, but usually they do not feed on man. Bram (1967) had refered to Scanlon and Esah (1965)'s report that adults had been collected from Doi Pui Mountain at the elevation of 2,500 to 4,500 feet, biting on man; and Iyengar (1938) had reported pallidothorax as a carrier of Wuchereria malayi.

Fig. 14

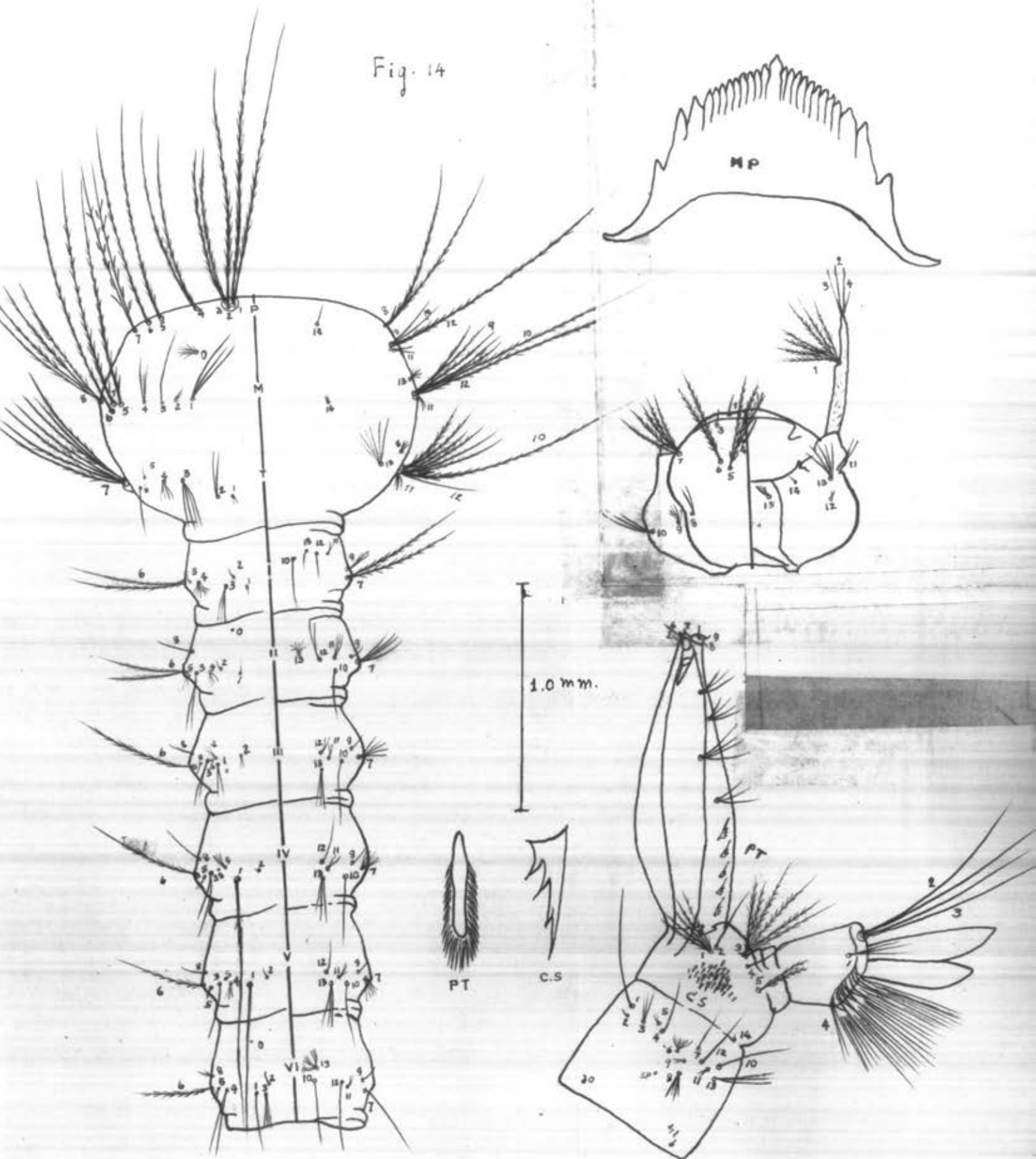


Fig. 15

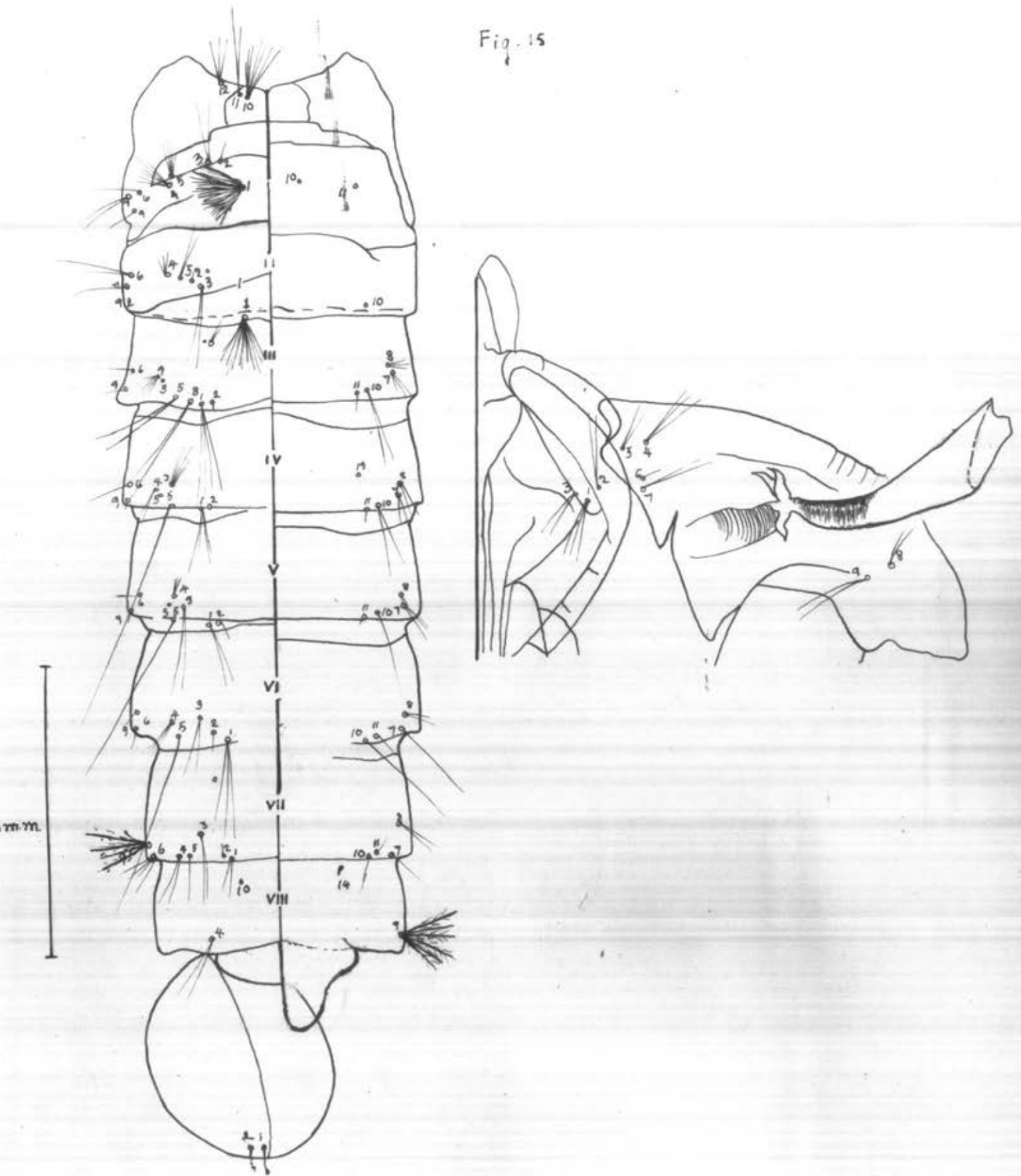
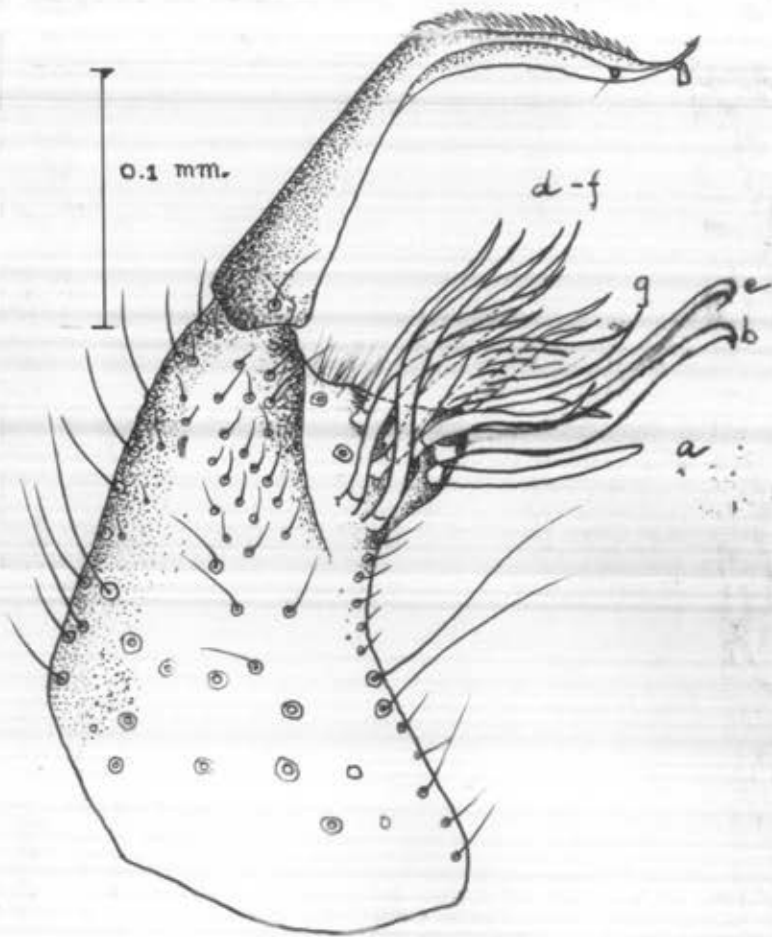


Fig. 16





Culex (Lutzia) halifaxii Theobald 1903

For complete synonymy see appendix

MATERIAL EXAMINED : 5 ♂♂, 4 ♀♀, 15 larvae with 2 associated pupal and larval skins.

Female :

A large sized species for the subgenus Culex with distinctive ornamentation on the legs, pleuron and abdomen. Head. Labium dark brown with a narrow distinct pale band on the ventral surface, indistinct in dorsal aspect but occasionally ring the proboscis; palpus also dark brown with small patches or scattered pale scales; Thorax. Scutum covered with bronze brown scales, but with a variable pattern of yellowish scales on the anterior promontory, the humeral area, posterior fossal area (in some specimens spotlike appear at this area), scattered in and around the prescutellar space (occasionally without scattered scales in the space), scutellar lobes also covered with the yellowish scales; acrostichal bristles distinct at the proximal part; integument of the pleuron light brown, with distinct scale patches and bristles on the prealar area, the upper sternopleuron, the posterior sternopleuron, the upper mesepimeron and the anterior mesepimeron, Legs. Femur and tibia of all legs speckled, all tarsomere dark. Abdomen. Terga II-V with distinct narrow apical pale bands, segment VI - VIII with broader pale bands.

Male :

Scaling and colouring as in female, but usually the labium with narrower pale band or dark on dorsal aspect. Genitalia. (Figure 19 ).

Subapical lobe of the sidepiece with 3 setae in (a-c) group, hooked apically, followed by 1 short seta; clasper with 3 subterminal setae; phallosome simple, consisting of a group of approximately 10 distinct denticles; paraproct with 7 cercal setae.

Pupa : (Figure 18 ).

Respiratory trumpet without slit widening distally; paddle strongly emarginate on apex. Chaetotoxy as figure .

Larva : (Figure 17 ).

Head ; Antenna small, slightly widened near the base, without spicules, uniformly lightly sclerotized, 1 - A developed like simple seta, inserted close to base. Mental plate strongly sclerotized with 4 robust teeth on each side of median tooth. Integument with dense heartbeat patterns of spicules. Head hair 1 - C arising on small, distinct protuberance; 4 - C with 4 to 5 branches; 5, 6 - C single, simple, usually with dark pigment around the insertions. Thorax. Integument with small sharply pointed spicules; thoracic hair 1- 7 - P all single, simple (except 1 - P very sparsely pectinate); 8 - P branched, pectinate; 14 - P single, simple. Abdomen. Integument finely spiculose; comb consisting of fan-shaped scales, siphon index variable but not more than 1 : 1.5; siphon with pectinate subventral tufts arranged in a line and a pair of small, bifid, simple tuft near distal end of the pecten; pecten appeared along the line of subventral tufts; ventral brush within the grid usually with 8 pairs of tufts; anal saddle complete, spicule conspicuous, anal gill very short.

Habitats and disease relation :

This species had been collected from rockholes and artificial containers, frequently with larvae Culex (Culex) pipiens quinquefasciatus

Culex (Culex) mimulus and Culex (Lophoceraomyia) minor, at the elevation of 800 - 900 meters. The larvae feed on other mosquito larvae and arthropods. Biting habits of the adult females are unknown, probably feed largely on avian host and seldom attack man.



Fig. 17

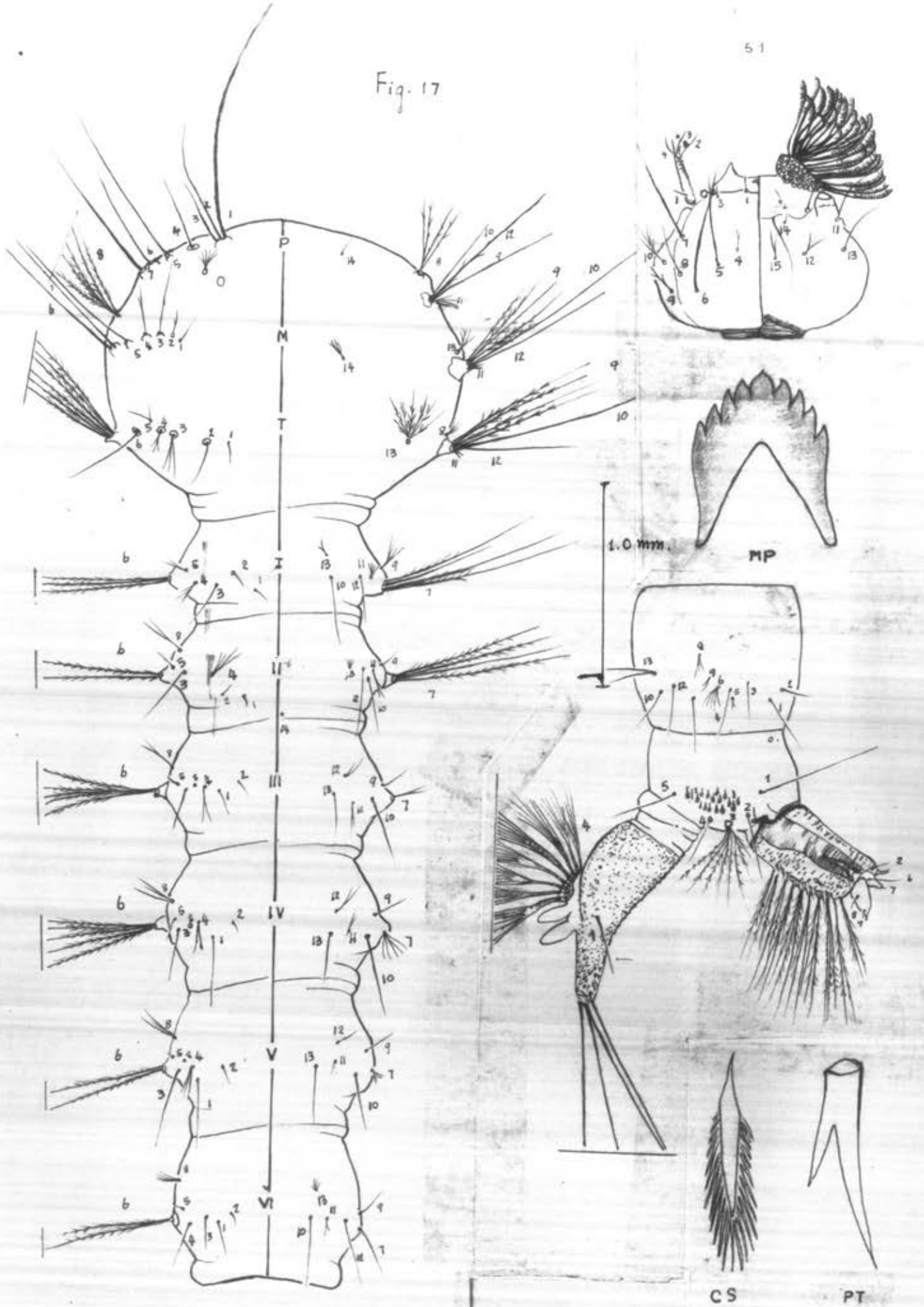
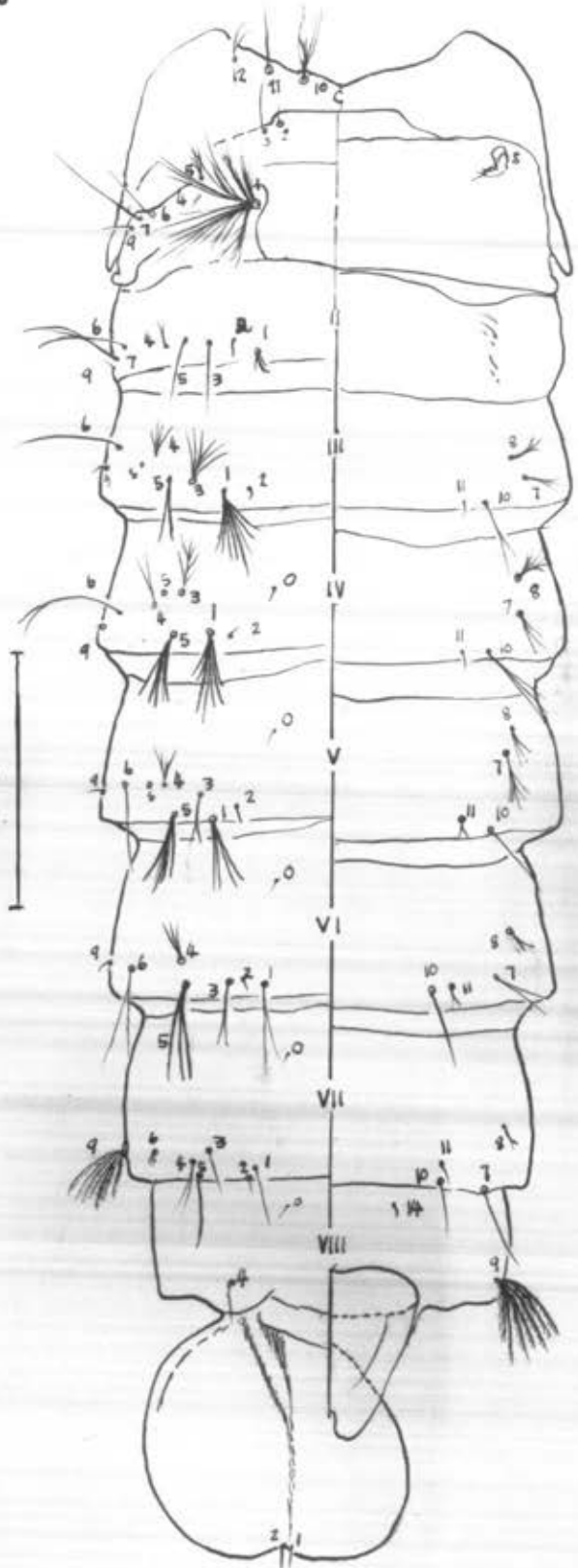
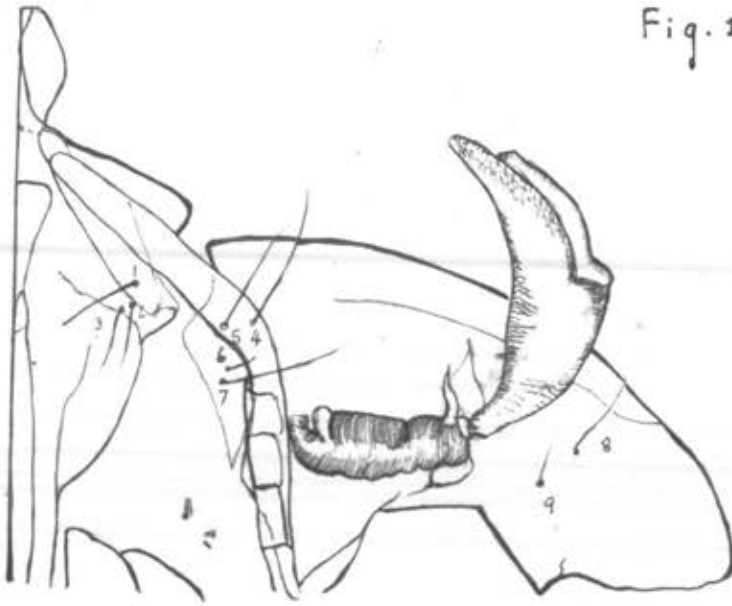


Fig. 18



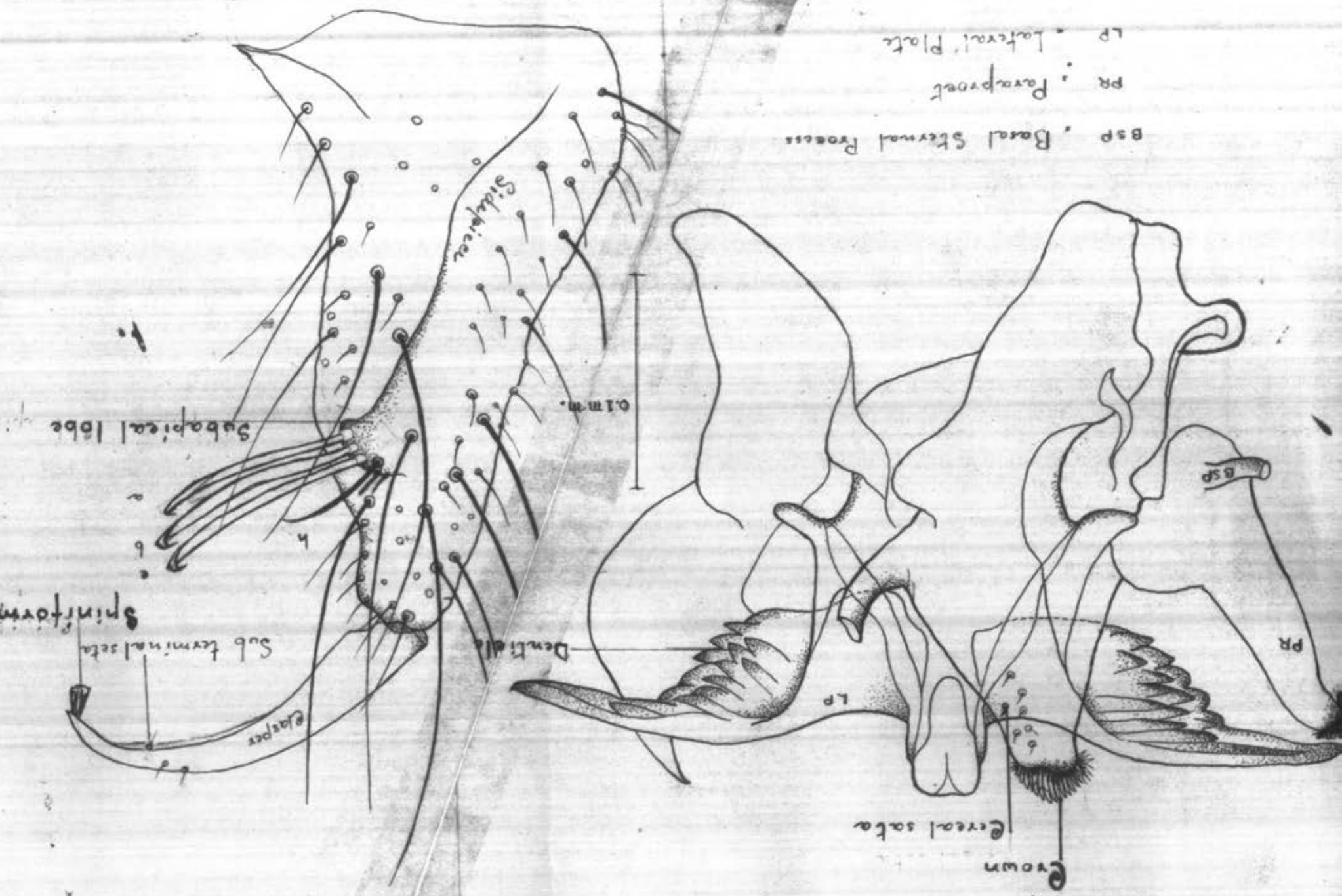


Fig. 19

DISTINCTIVE CHARACTERS OF THE SPECIESMAMMILIFER GROUPCulex (Lophoceraomyia) ganapathi Colless 1965

1965. Culex (Lophoceraomyia) ganapathi Colless, J. med. Ent. 2 : 294

(♂<sup>\*</sup> ♀, L<sup>\*</sup>)

Female : Lack associated pupal and larval skin to confirm.

Male : Specimen is not available to study other morphological characters except those of antenna and terminalia. Antenna. (Figure 20A) F<sub>5</sub> with a tuft of from 3 to 5 yellowish, narrow, pointed scales, subequal in length, and several additional setae; F<sub>6</sub> with a row of more than 10 pigmented, gently curved and filamentous apically scales, and additional filamentouslike setae; F<sub>7</sub> with a row of at least 8 scales like F<sub>6</sub> but slightly shorter, at least 4 kinked scales and additional filamentouslike setae; F<sub>8</sub> with a distinct tuft of from 5 to 7 pigmented, long and gradually curved up distally, 5 or more petallike scales and additional filamentouslike setae from 3 to 5; F<sub>9</sub> without any modified scales or setae. Genitalia (Figure 21). Subapical lobe of sidepiece with 3 setae in (a-c) group, one shorter, filamentous and hooked distally, another two gradually slender towards apex and hooked; 4 setae in (d-f) group, one leafletlike, striated and longer than the 3, a leaflike seta g and a long spinelike seta h; 4 submarginal setae present, inserted in a line; clasper normal in shape with 1 subterminal spine or seta; lateral plate of the phallosome with the internal process curved laterally, not longer than the apical knob of dorsal process; dorsal process with a spinose apical knob and with at least 7 distinct denticles on the lateral margin.

Pupa : Chaetotaxy see figure 22.

Larva : (Figure 23).

Head : Head hair 1 - C strongly pigmented, usually swollen on the basal half; 4 - C single, distinctly longer than the distance between the pairs; 5, 6 - C bifid, pectinate; 14 - C usually bifid. Thorax. Integument finely spiculose; 1, 2, 3 - P single, pectinate, 3 - P shorter and smaller than 1, 2 - P; 4 - P bifid, pectinate; 5, 6 - P single, pectinate; 7 - P bifid, pectinate; 8 - P single, pectinate; 14 - P bifid. Abdomen. Integument glabrous; comb consisting of from 30 to 45 fan - shaped scales; 4 pairs of subventral tufts; pecten with 8 to 13 teeth; saddle completely ringing segment X.

Habitat and disease relation :

Larvae of this species had been collected from treeholes, in association with Culex (Neoculex) brevipalpis and Culex (Lophoceraomyia) minor. Biology of adults is unknown.

Fig. 20

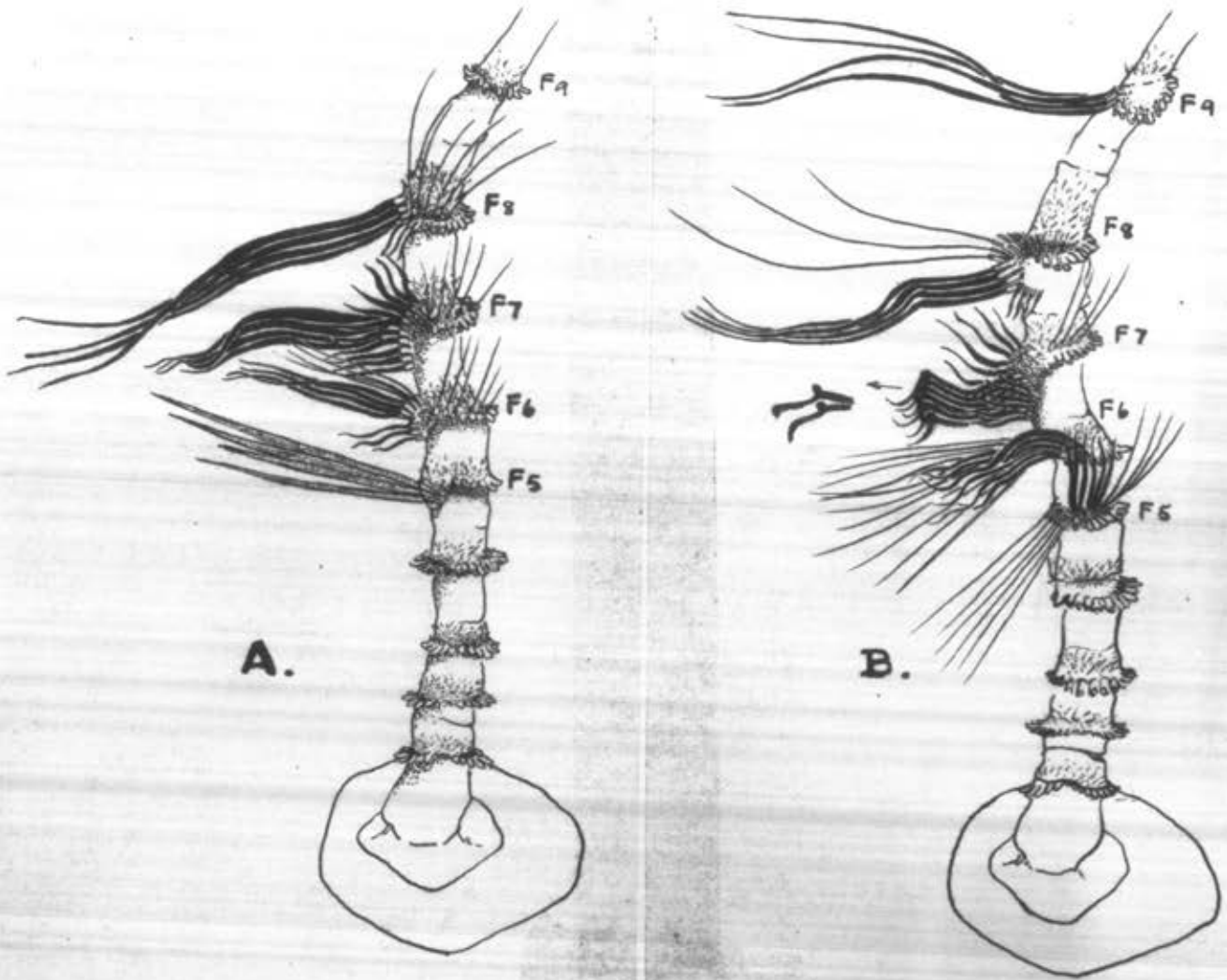




Fig. 21

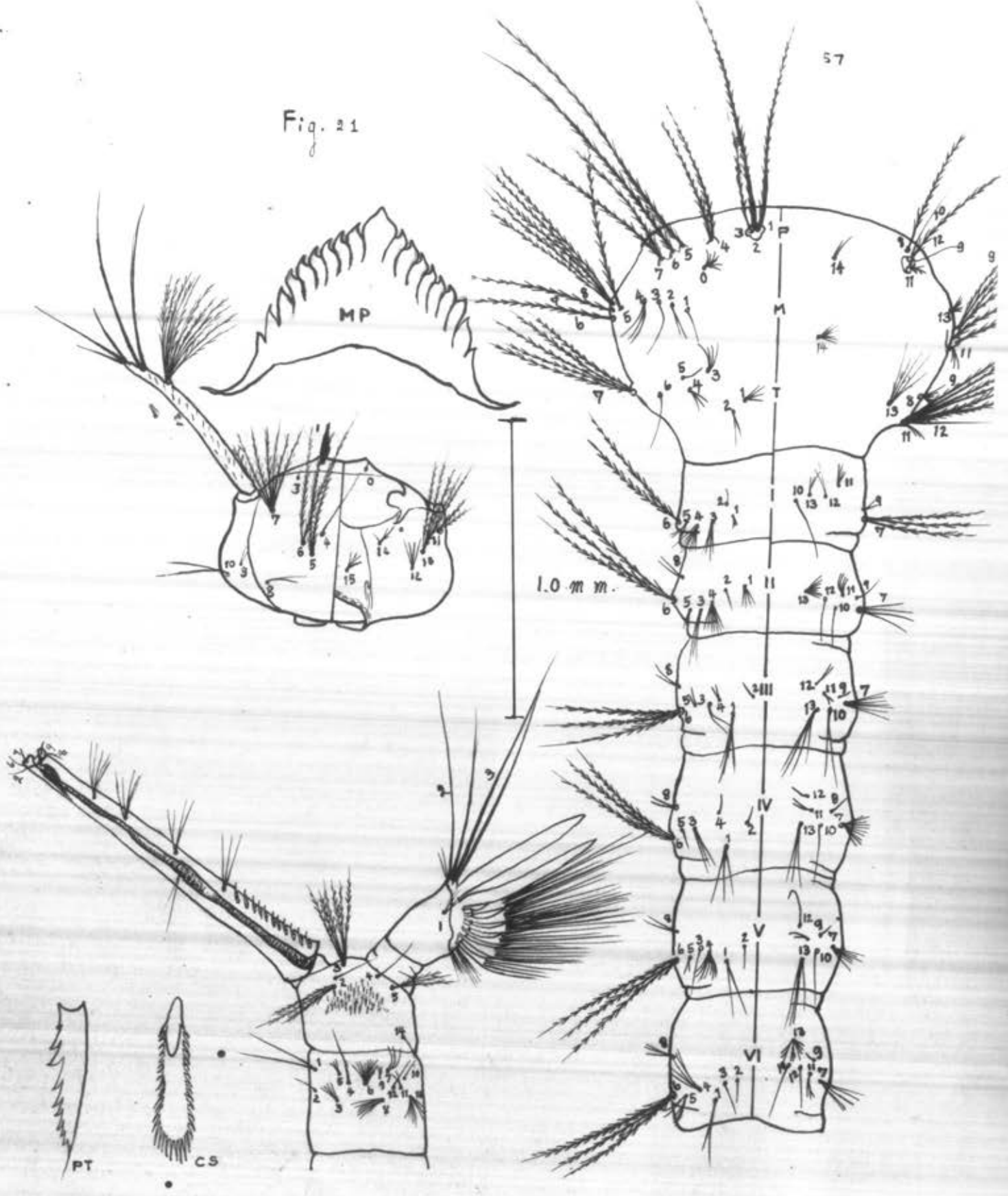


Fig. 22

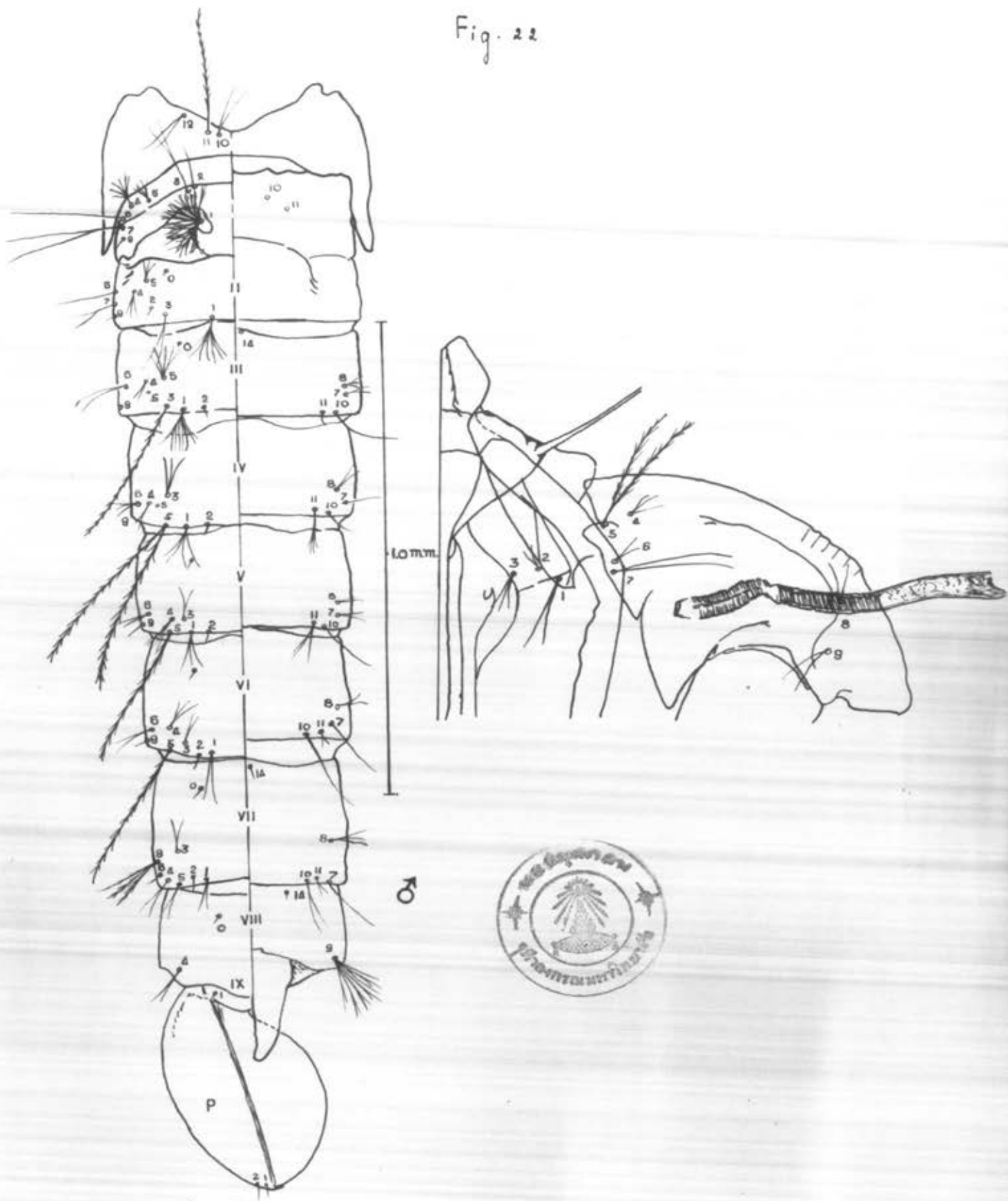
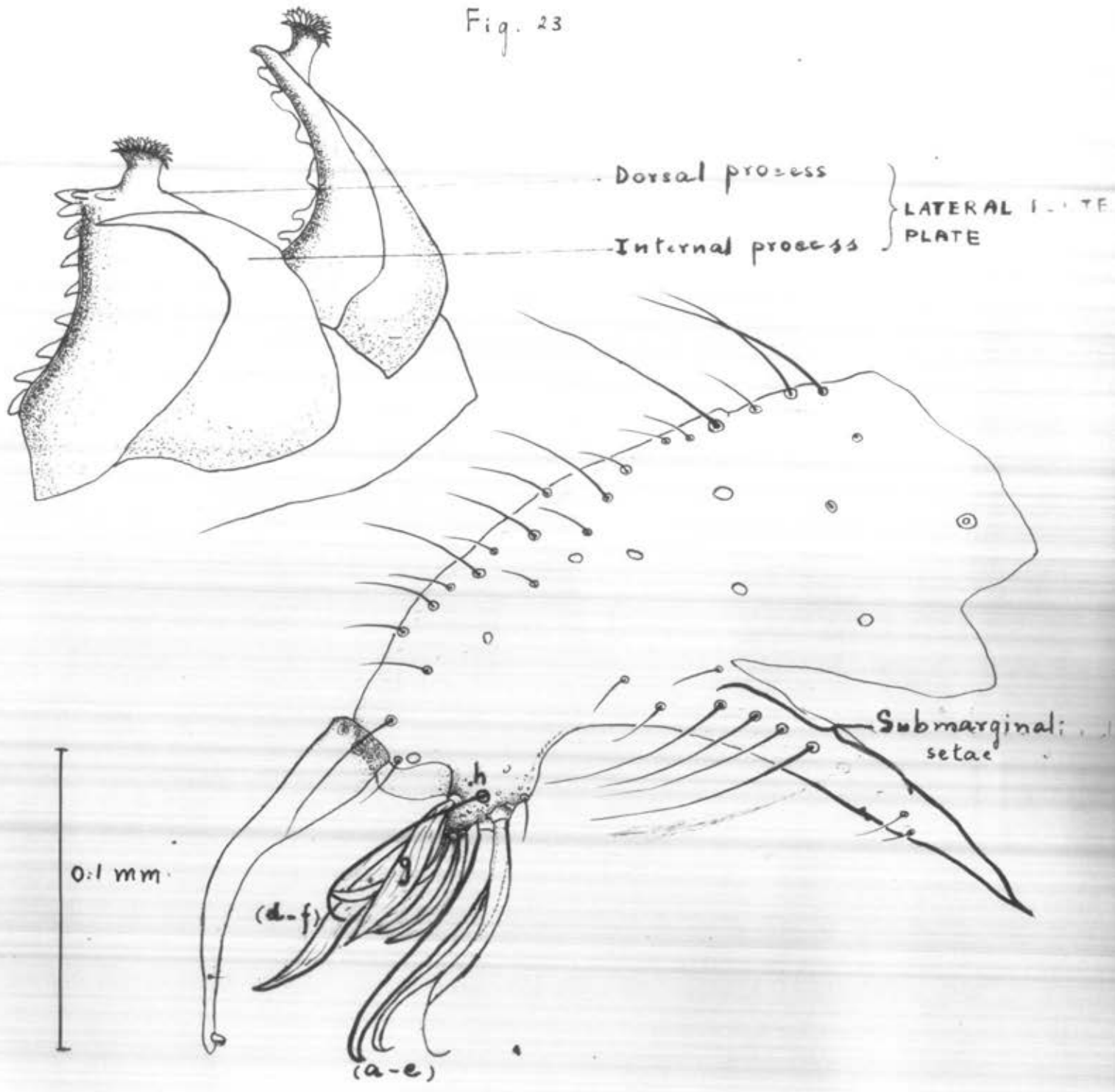




Fig. 23



Culex (Lophoceraomyia) minor (Leicester) 1908

For synonymy see appendix

Female : No specimen available to study.

Male : Antenna (Figure 208).

Specialized or modified scales or setae appear from  $F_5$  to  $F_9$ ;  $F_5$  with from 3 to 6 narrow, yellowish pointed scales between 2 groups of several additional fine setae;  $F_6$  with wavelike scales not more than 10, and several additional rather long and straight setae;  $F_7$  with 4 types of modified scales and setae, 5 or more sigmoid scales between 2 rows of petallike setae and at least 4 additional fine setae;  $F_8$  with long wavelike setae similar to  $F_6$ , atleast 4 short petallike setae and 3 or more long additional setae;  $F_9$  with 4 or more strongly pigmented, rather straight scales.

Most diagnostic characters of this species were agreeable to be Culex (L) minor except features of the phallosome. Genitalia. (Figure 16 ). Subapical lobe of sidepiece with 3 setae in (a-c) group, seta c separated from setae a and b, slightly expanded apically, then bent and becoming narrow and terminating in a pointed end; a and b similar, almost of the same length and strength, bent apically; 4 setae in (d-f) group, none of them striated, but one setae is distinctly longer than others; a symmetrical leaflike seta g; and a long hairlike seta h; 5 to 6 submarginal setae inserted in a straight line, the setae strong and prominently bent; clasper normal in shape with 2 subterminal setae; lateral plate of the phallosome with the internal process straight, curved down apically, not longer than the apex of the dorsal process;

the dorsal process with a spiculate apical knob and with 10 or more teeth in dorsal aspect.

Pupa : Chaetotaxy see figure 25

Larva : (Figure 24 )

The most distinctive character is bearing two types of comb teeth. Chaetotaxy as figure

Fig. 24

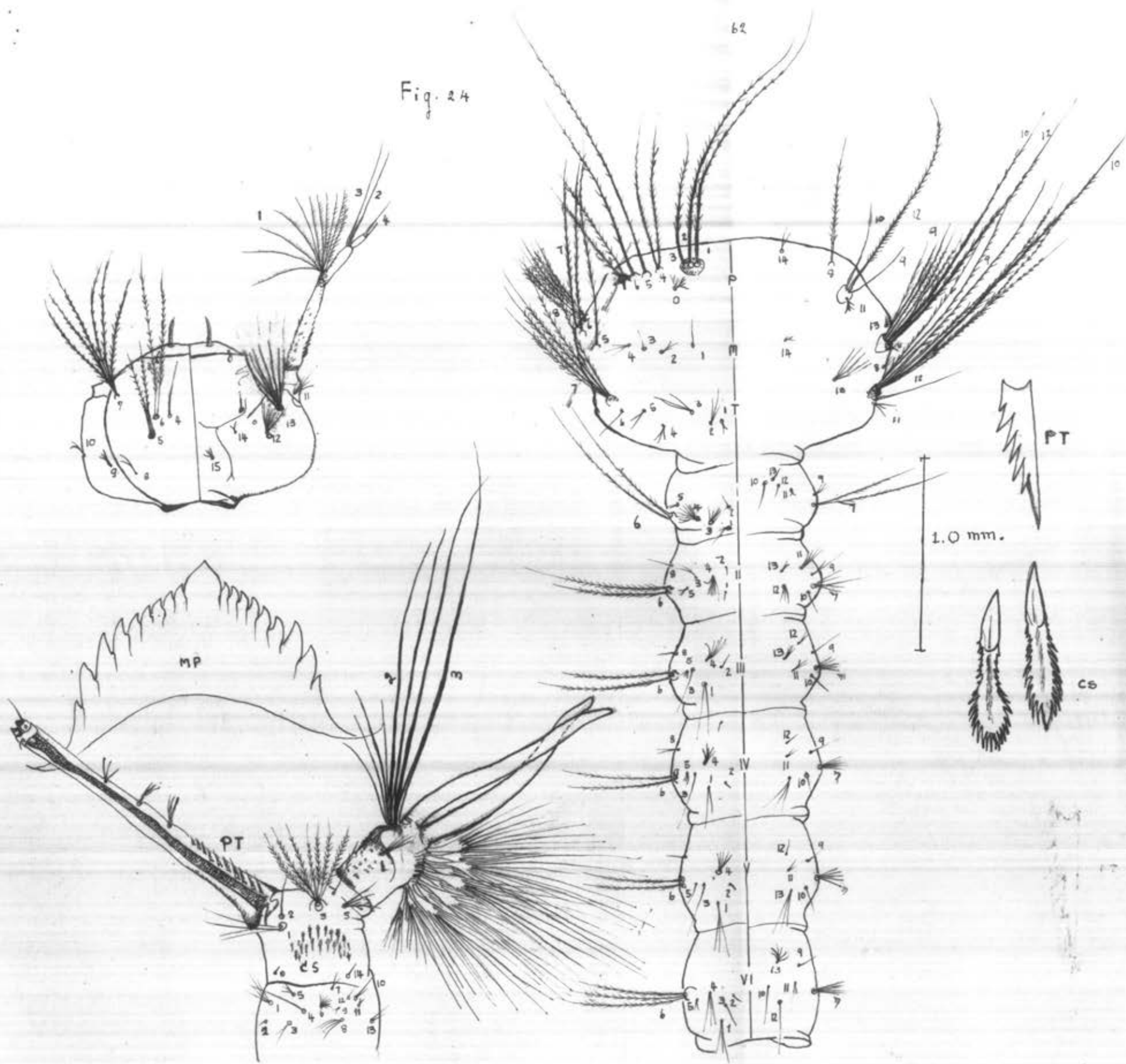


Fig. 15

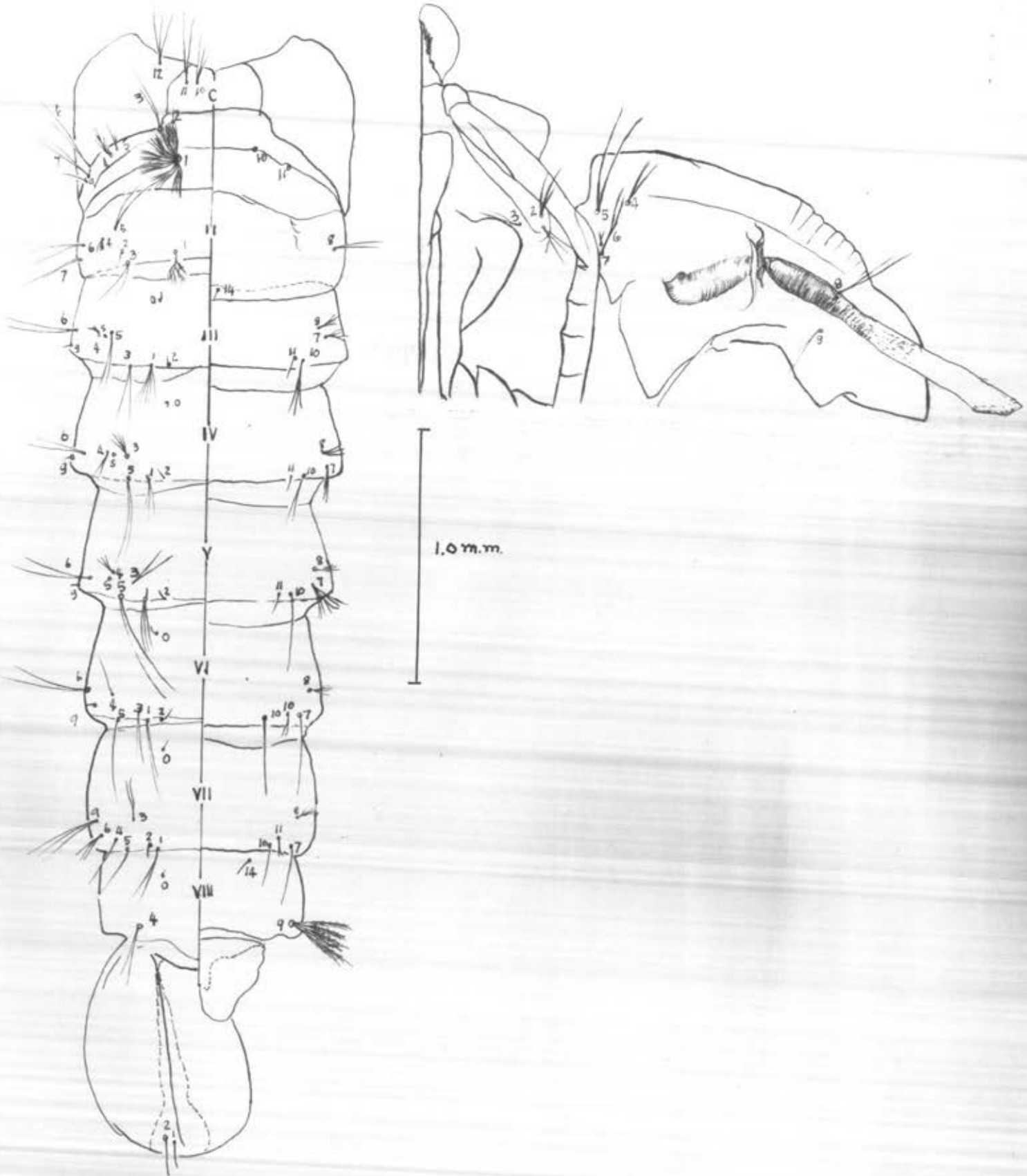


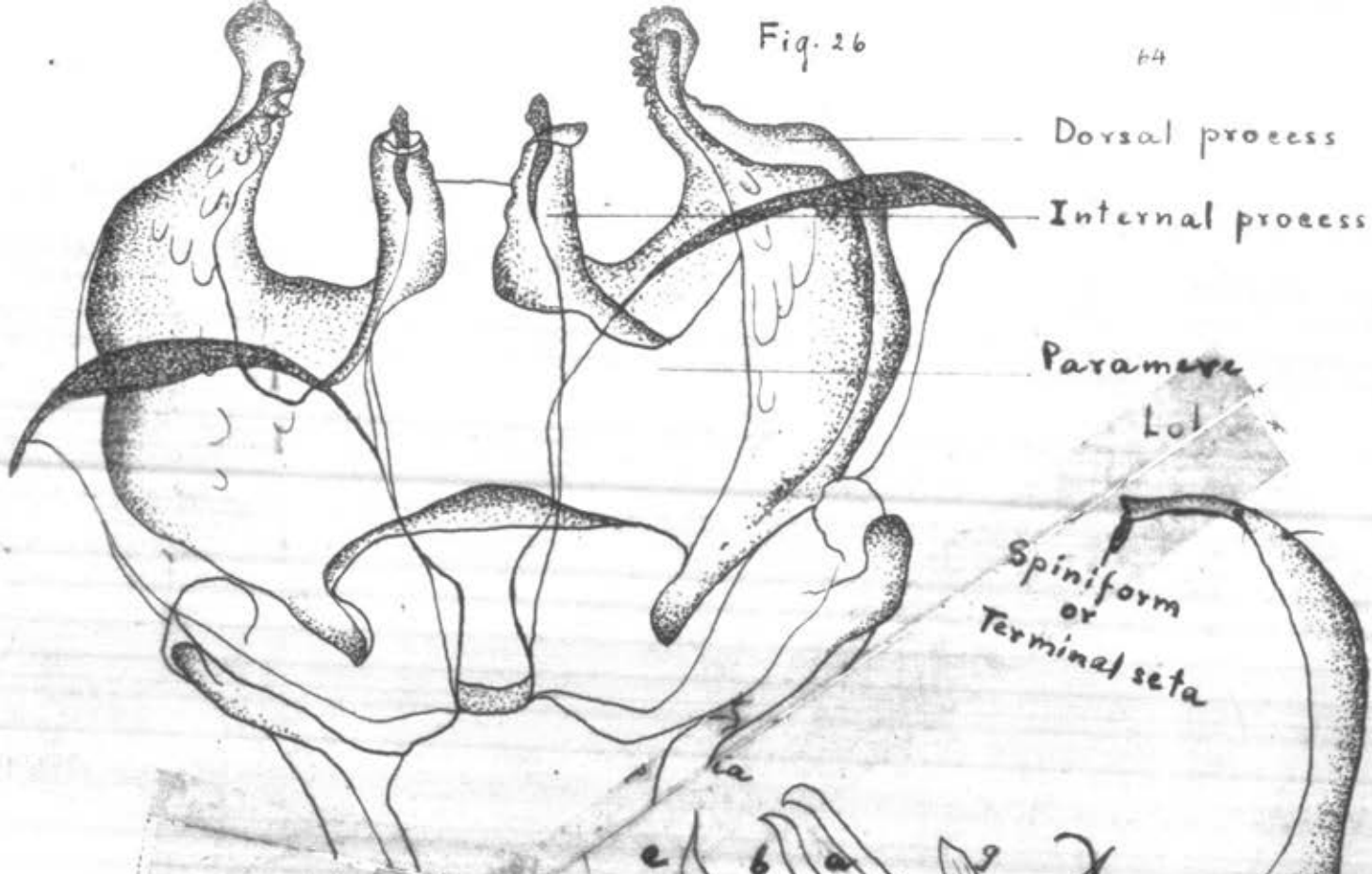
Fig. 26

Dorsal process

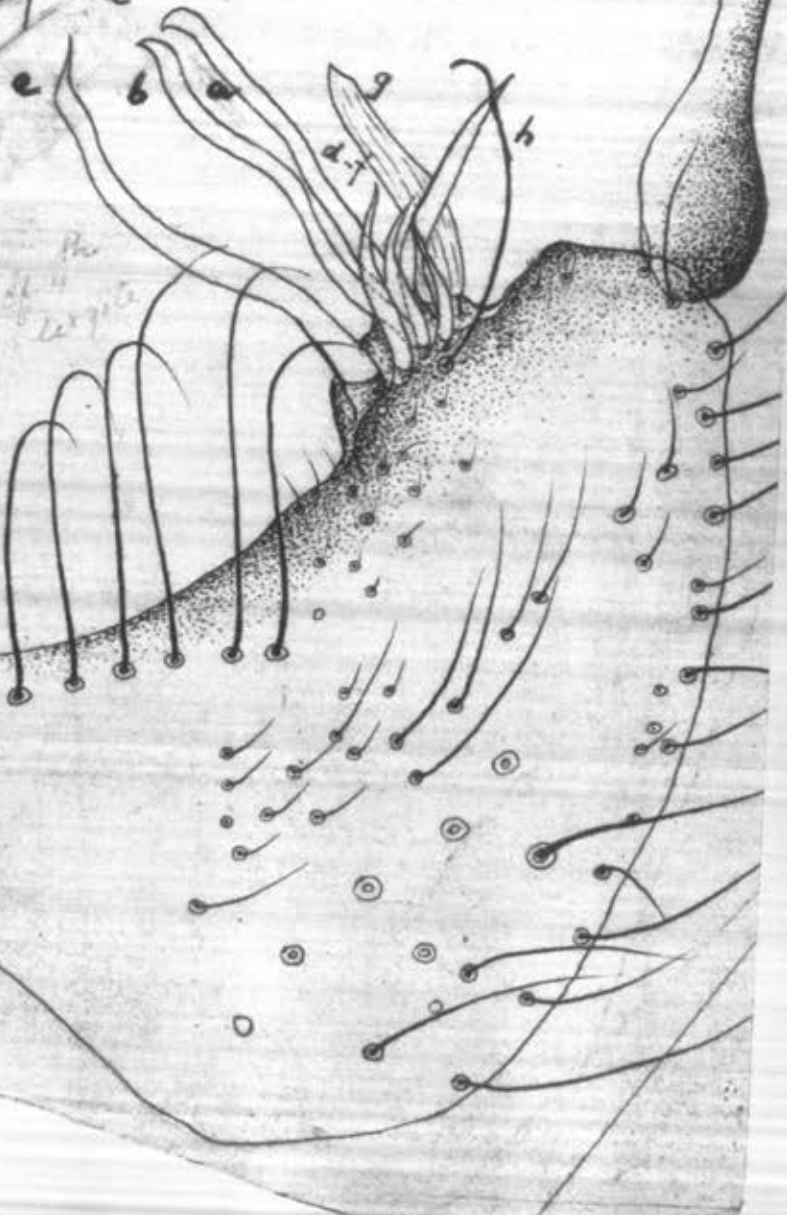
Internal process

Paramere  
Lol

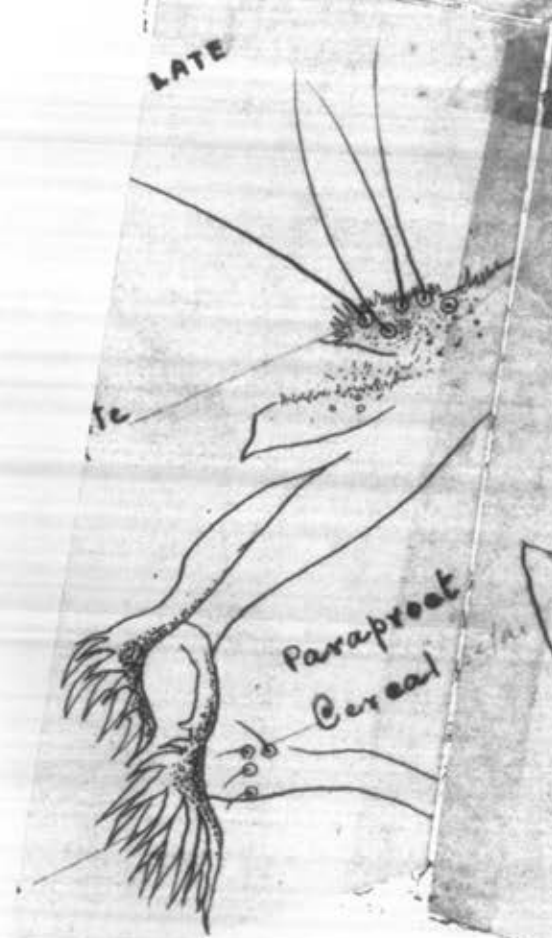
Spiniform  
or  
Terminal seta



LATE



Paraproot  
Cerebral setae



FRAUDATRIX GROUP

Culex (Lophoceraomyia) infantulus Edwards 1922

For synonymy see appendix

Only 8 larvae had been collected from a rockhole at the altitude 800 meters. Larval chaetotaxy see figure 27.



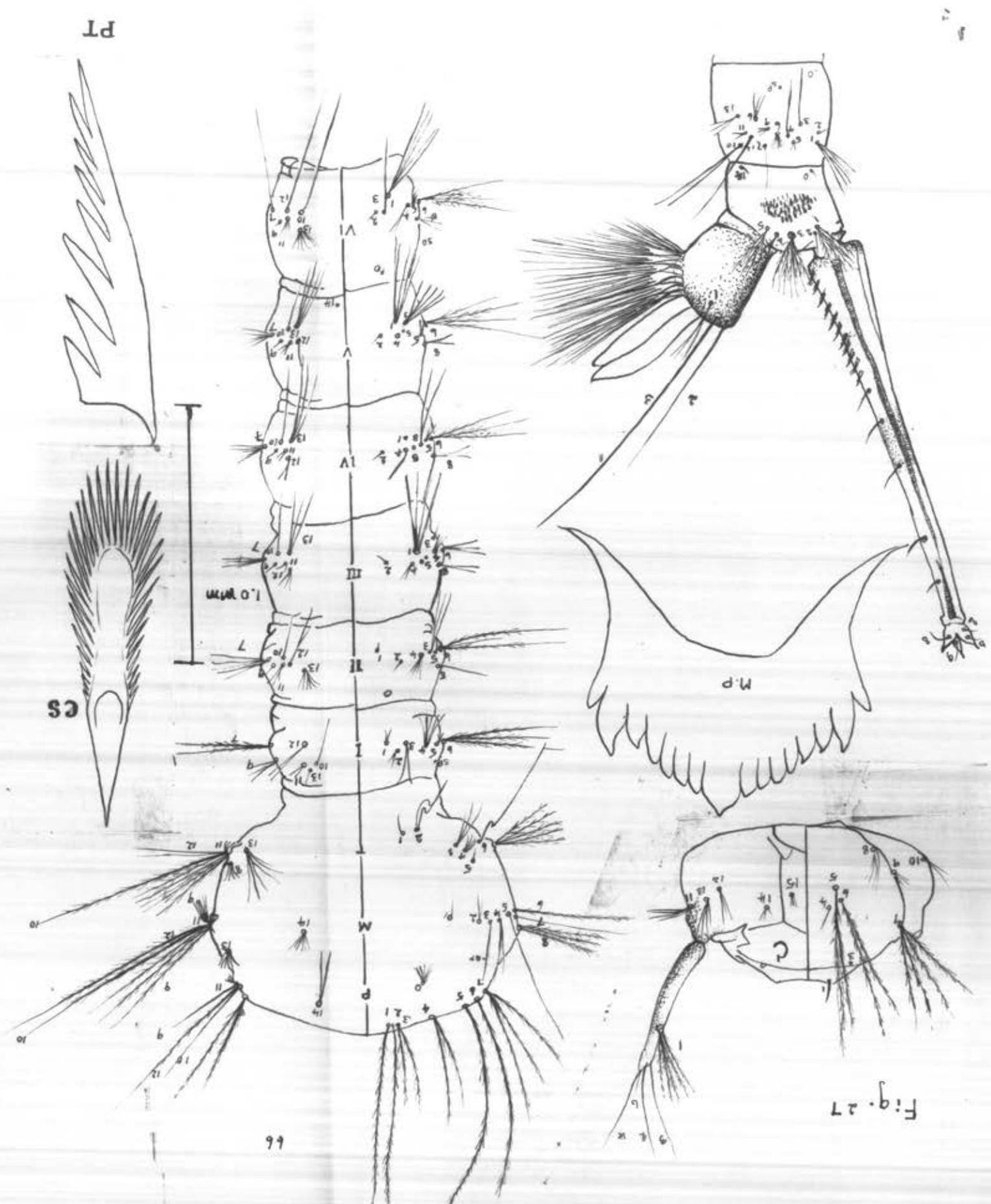


Fig. 27



Culex (Neoculex) brevipalpis (Giles) 1902

For complete synonymy see appendix

MATERIAL EXAMINED : 4 ♂♂ with genitalia; 1 associated pupal and larval skin, 8 larvae.

Female :

Specimens are not available to study, according to the lack associated pupal and larval skins.

Male : Head.

Antenna normal, without specialized hair or scale, usually only slightly longer than the proboscis, flagellar whorls with numerous long hairs; flagellar segment 12 and 13 elongate. Palpus 5 segmented approximately  $\frac{2}{3}$  of the length of the proboscis, curved. Genitalia.

(figure 30). Subapical lobe of the sidepiece or basimere bears 8 setae,

3 strong rodlike setae in (a-c) group which 1 seta blunt, 2 hooked apically; 3 setae in (d-f) group, subequal in length, the shortest one broader, striated, the other two more slender, tapering to apex and hooked apically; seta g leaflike and a short spinelike seta h. Clasper or distimere slender with a distinct subterminal spine; phallosome simple, lateral plate ovoid shape with numerous distinct denticles ventral bridge, paramere and basal process distinct; proctiger well developed, crowned with a tuft of slightly sclerotized setae, 4 cercal setae, basal sternal process not developed.

Pupa :

Chaetotaxy as figure 29

Larva : (Figure 22)

Head : Head hair 1 - C robust, strongly pigmented, tapering to a sharp point; 4 - C single, simple; 5, 6 - C with from 2 - 3 branches; 14 - C dendritic. Thorax : Integument glabrous; hair 1, 2, - P single, sparsely pectinate, subequal in length; 3 - P single, sparsely pectinate about  $\frac{3}{4}$  the length and width of 1; 2 - P; 4 - P with from 2 - 3 branches, very sparsely pectinate; 5, 6 - P single, sparsely pectinate; 7 - P usually 2 branches but occasionally only 1 branch sparsely pectinate; 8 - P usually 1 branch but sometimes 2 branches, sparsely pectinate; 14 - P with from 2 - 3 branches, simple. Abdomen. Hair 6-I usually bifid (rarely trifid), pectinate; hair 7 - I bifid, pectinate. Integument glabrous; comb fan-shaped, consisting of from 42-50 scales; siphon very long and slender ranging from 10 : 1 to 16 : 1; 4 - 6 pairs of subventral tufts, individual tuft with from 3 - to 5 branches, their length less than the width of the siphon at the point of insertion; pecten with from 12 - 17 teeth; saddle completely ringing segment X, ventral brush consisting of 10 individual tuft of setae, all inserted within the grid, 2 pairs of anal gills present, one pair obviously shorter than another one.

HABITATS AND DISEASE RELATION : Larvae of the species have been collected from only treeholes at the elevation of 800 - 900 meters in association with Oulex (Lophoceraomyia) minor and C. (L.) ganapathi. Biting habits of females are unknown. Bram (1967) referred to Bonne-Depster (1964)'s report that man may be attacked near the breeding sites in New Guinea. Members of this species are found throughout Thailand.

Fig. 28

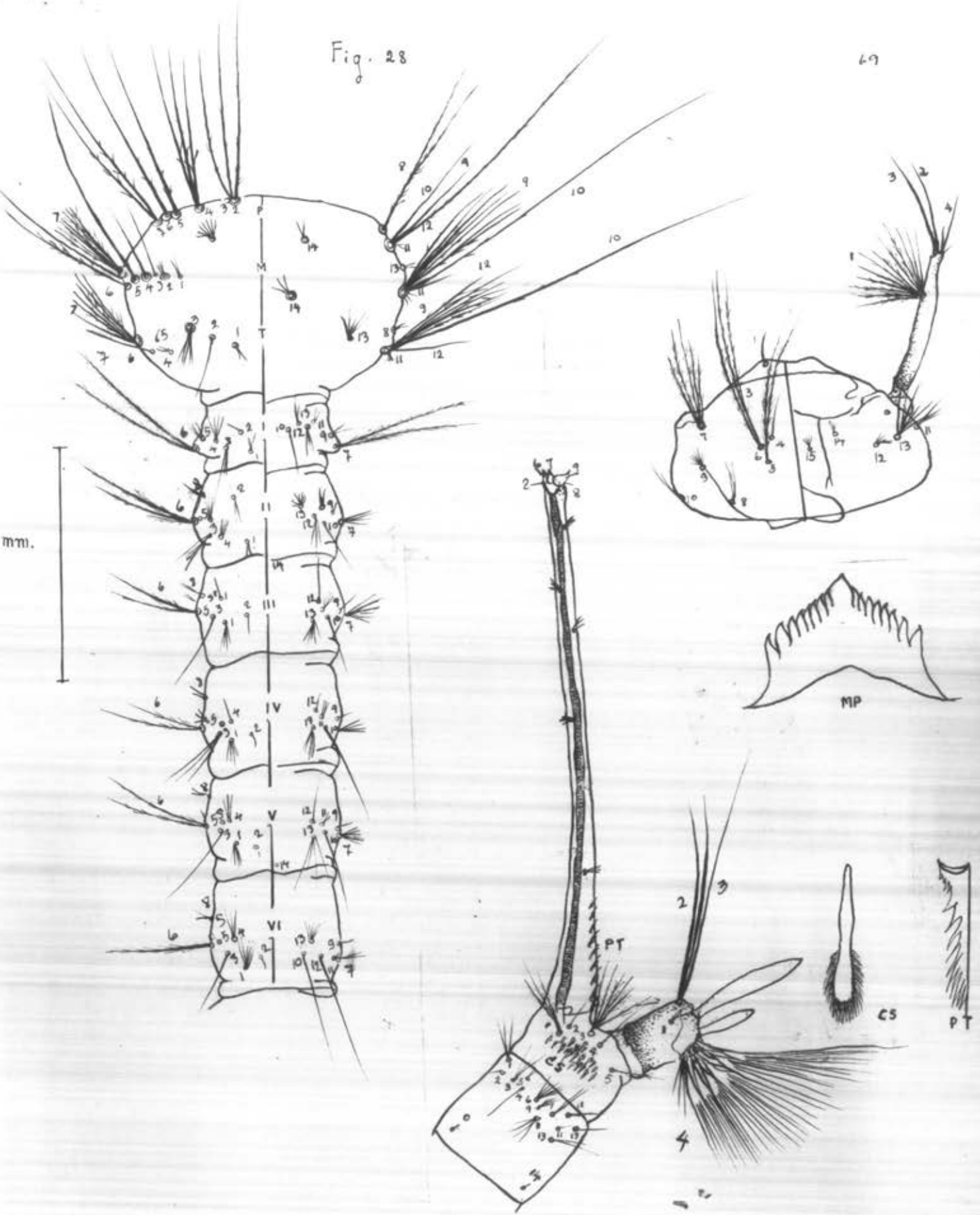


Fig. 29

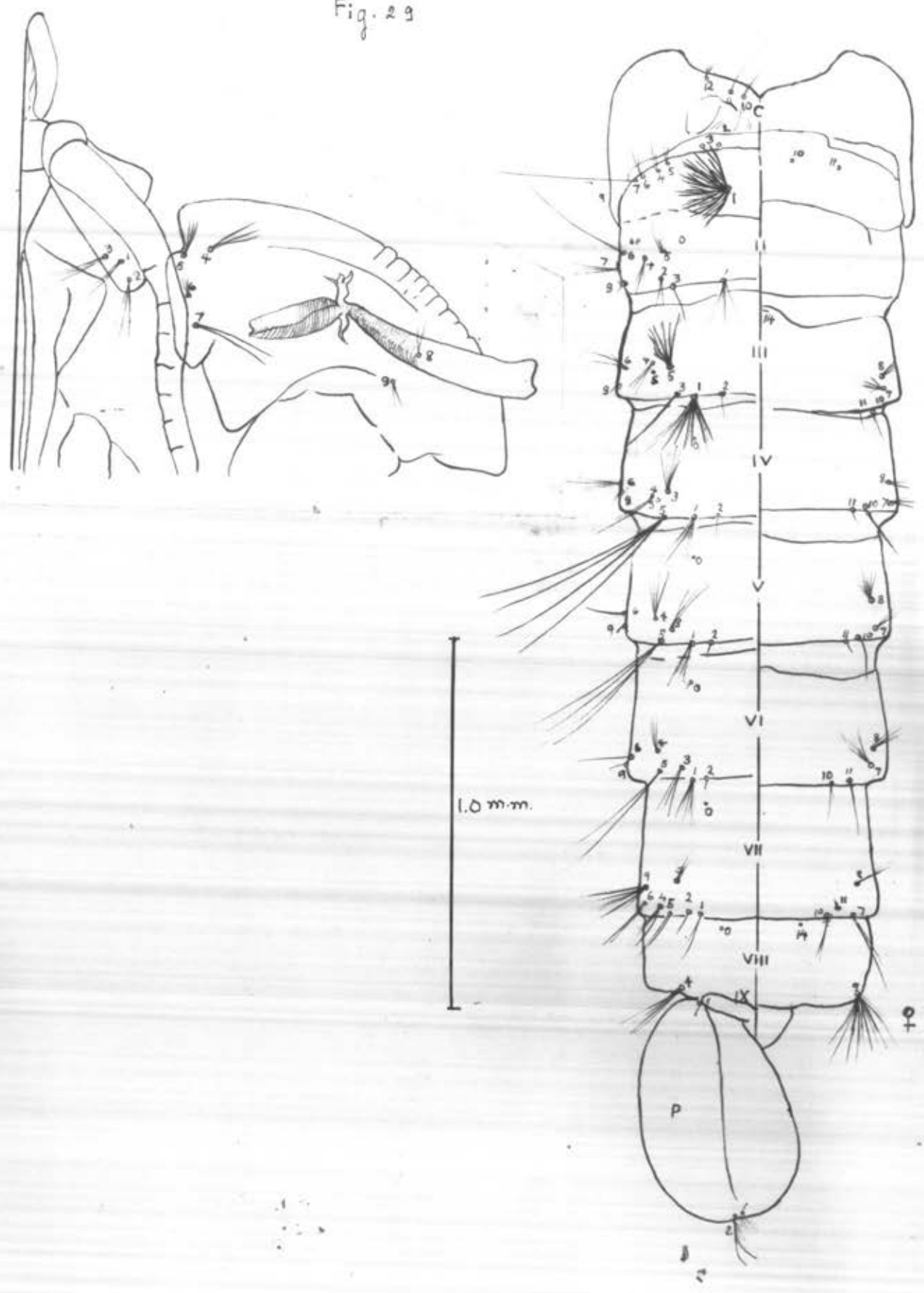
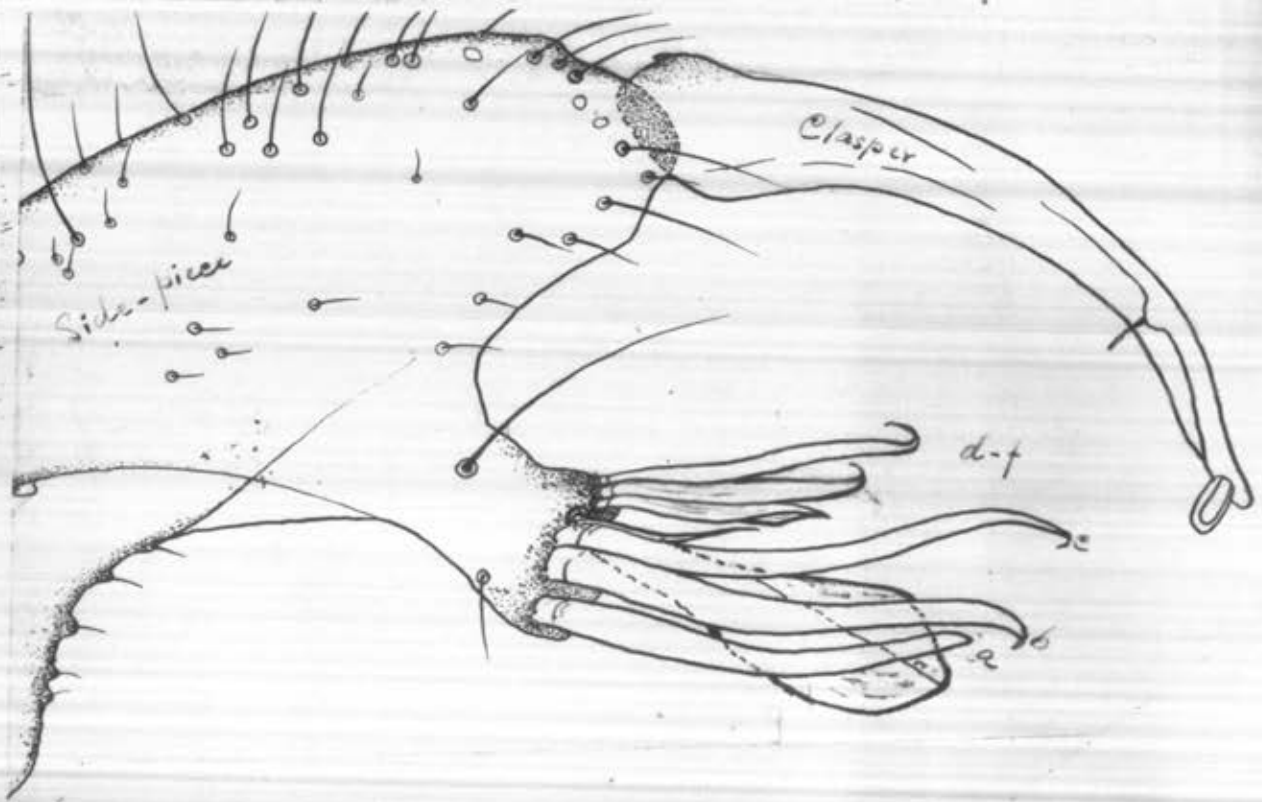
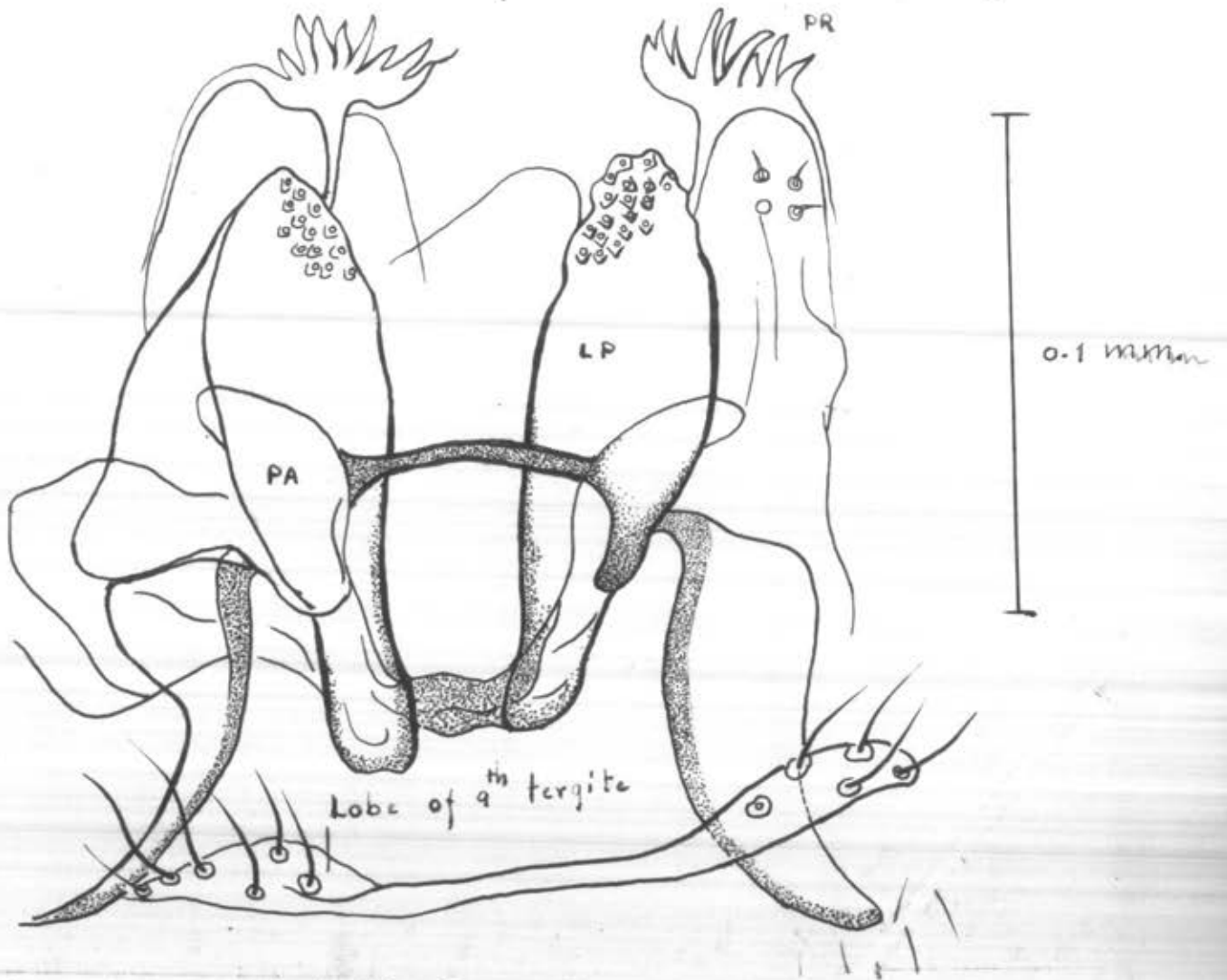


Fig. 30



Culex (Mochthogenes) foliatus Brug 1932

For synonymy see appendix

Female : No specimen available to study.

Male : Genitalia. (Figure 33 )

Subapical lobe of the sidepiece indistinct, composed of 9 setae, 3 setae in (a-c) group, well differentiated, and of the same order, one with blunt apex, elbowed at distal half, one hooked at apex, the last one with bent tip; a row of 4 slender striated leaflet-like setae in (d-f) group, subequal in length; 1 striated leaflike setae and the smallest one behind the 4 striated leafletlike setae. Clasper short and stout, swollen medially, with 2 subapical spines. Lateral plate of the phallosome narrowed distally, setae like fine hair present at base (dorsal aspects), more than 5 distinct and prominent denticles located at the middle portion (lateral aspect). Paraproct crowned with hairlike spines, 2 cercal setae present, basal process, ventral paramere distinct. Lobe of 9<sup>th</sup> tergite indistinct but spine distinct.

Pupa : Chaetotaxy as figure 32

Larva : (Figure 31 ).

Head : Head 4 - C with from 2 to 4 weak branches, simple; 5 - C bifid, slightly pectinate; 6 - C bifid, pectinate; 14 - C bifid; 16, 17 - C distinct. Thorax. Integument glabrous; hair 1, 2, 3 - P single, 1, 2 - P pectinate, 3 - P simple, approximately half the length and width of 1, 2 - P; 4 - P weak with from 2 to 4 branches; 5, 6 - P single, pectinate, 7 - P bifid; pectinate; 8 - P single, pectinate;

14 - P bifid. Abdomen. Comb consisting of fan-shaped scales, fringed with subequal spine; siphon index ranging from 6 : 1 to 7 : 1 saddle ringing segment X.

Habitat and disease relation

Larvae of this species have been collected from ground pool at the elevation of 800 - 900 meters, in association with C. (C) pipiens quinquefasciatus. Female feeding habit is unknown.

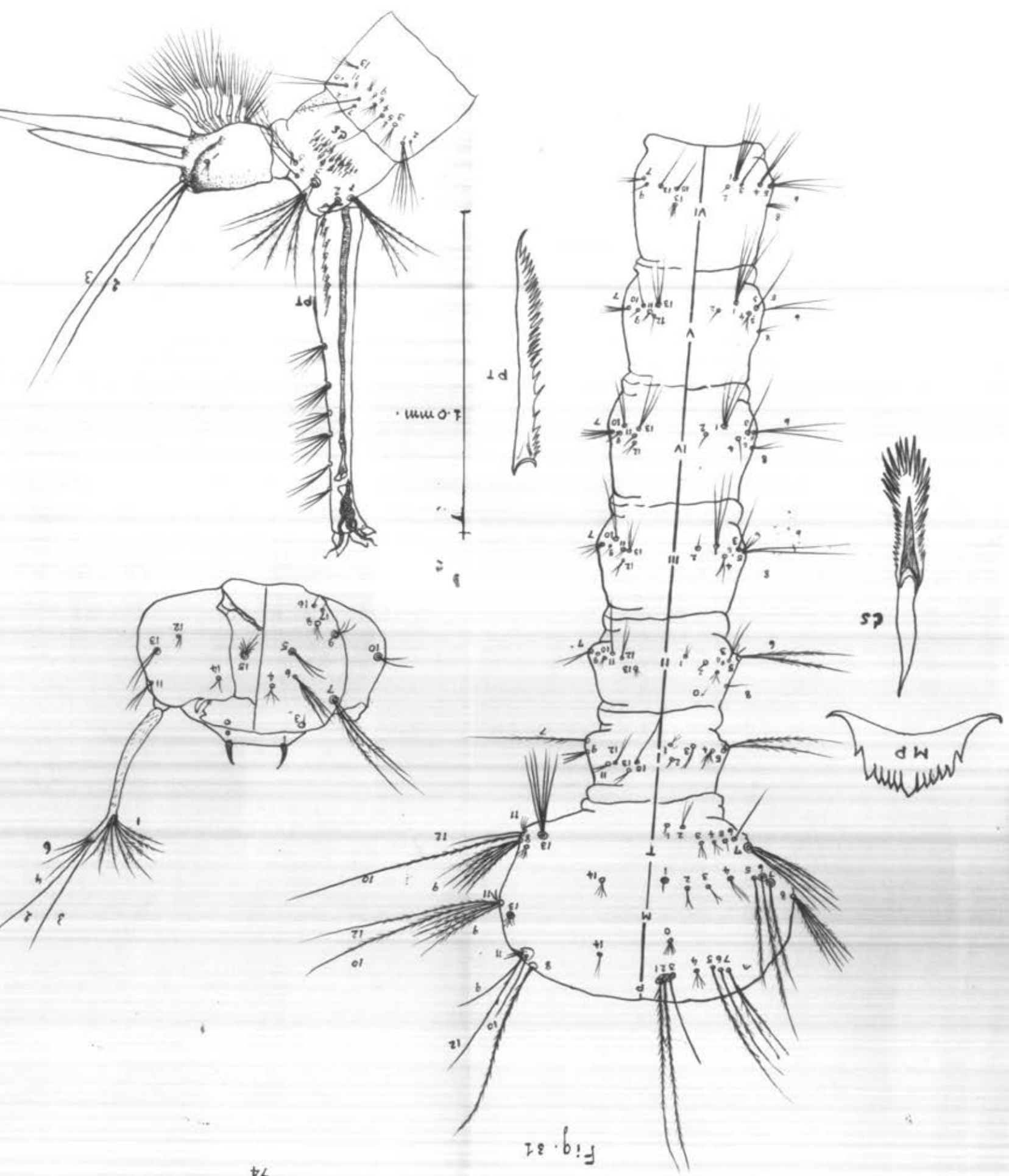
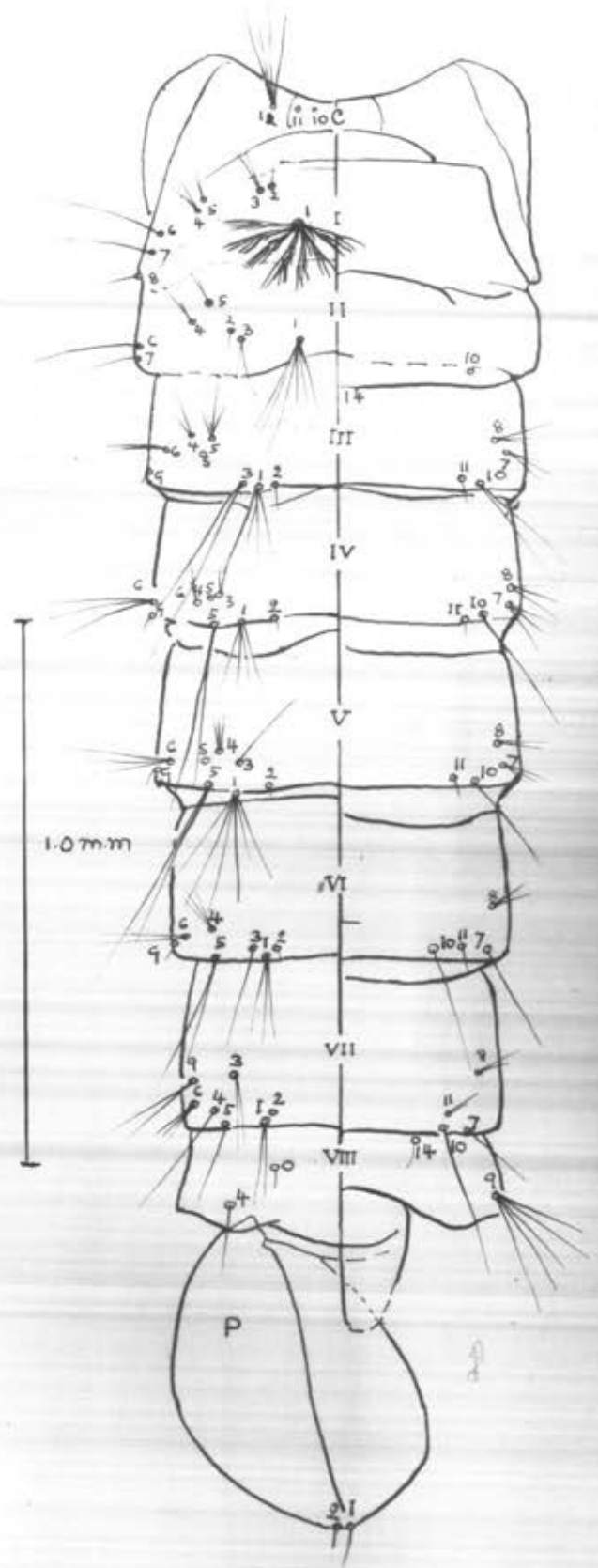
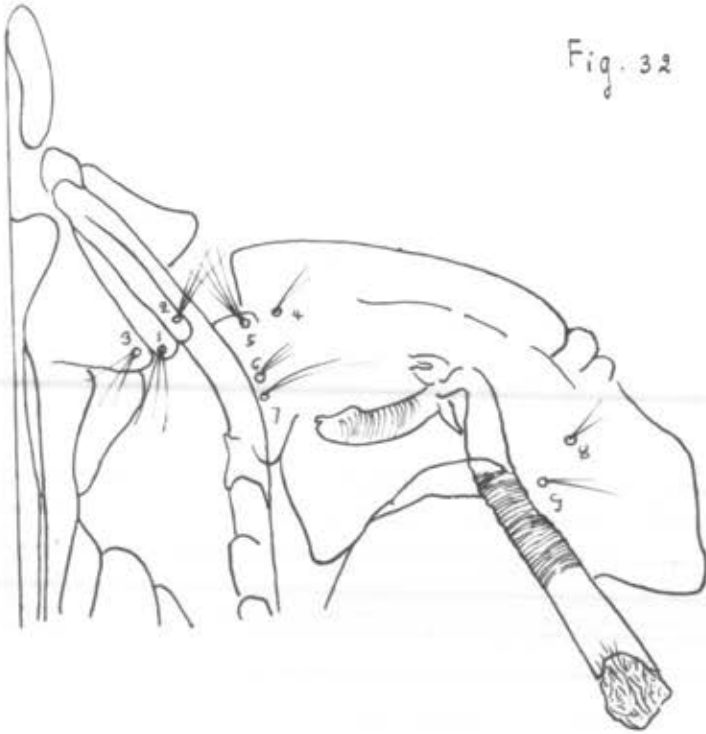


Fig. 31



Fig. 32



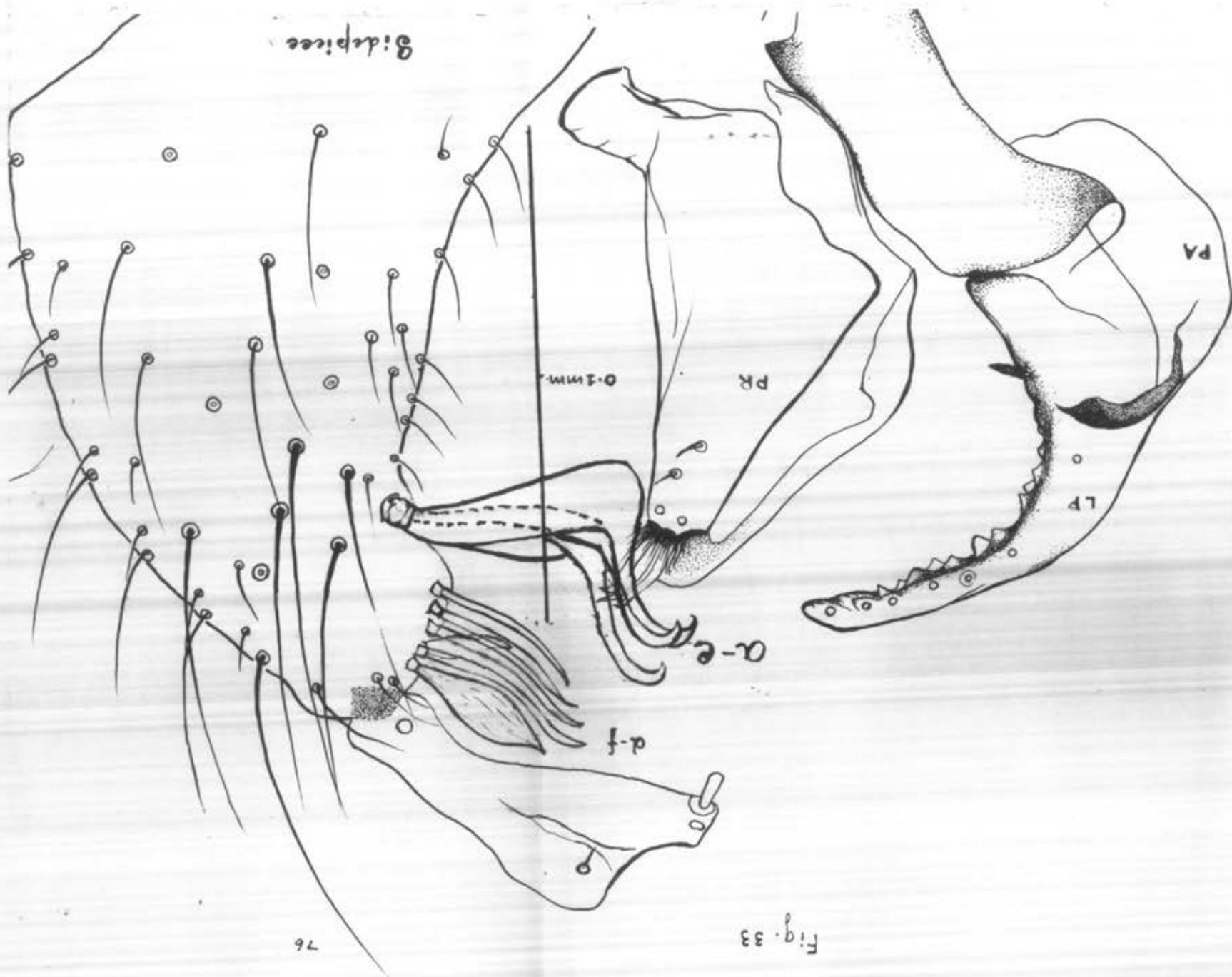


Fig. 33