

# A REVISION OF THE CULICINE MOSQUITOES OF INDIA.

## Part II.

### THE LARVAE OF SOME INDIAN SPECIES OF CULEX.

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THE species of *Culex* which, in the adult stage, have a conspicuous pale band on the proboscis, form an important group. Some of these species are so much alike that the only satisfactory way of distinguishing them is by a detailed examination of the male hypopygium, the female cannot at present be separated on any known characters. Recently two or three new species have been discovered and this has added to the difficulties of identification. It has been found in some cases that there are well-marked distinguishing characteristics in the larvae, and the systematic study of these has therefore become an important part of this revision. Descriptions and figures of the larvae (fourth stage, or instar) of eight of these species are included in this paper.

The greatest care has been taken regarding identification, and the following method has been exclusively adopted in all cases. As opportunity occurs a large number of larvae are isolated in separated tubes. As soon as pupation takes place the larval skin, which is cast complete with hairs, chitinous structures, etc., is transferred to a small tube of fixative or 70% alcohol, and this tube is kept in a stand alongside the tube containing the pupa. When the adult emerges it is mounted, and labelled

with a serial number. An entry is made in a register under this number giving particulars of date, name, locality, kind of breeding place, and any other particulars thought necessary. The pupal skin is placed in the tube with the larval skin, together with a small label bearing the same number as the adult. In order to avoid mistakes in numbering a set of printed serial numbers is used for the adults, so that there is no possibility of duplicating a number. In the case of the skins the numbers are written in pencil, and in order to minimise the risk of mistakes in this direction, as large a number as possible of the same species are preserved and compared. When it is desired to figure the larvae, drawings of certain of the more delicate parts should be made at the time, as they are apt to become shrivelled in preservative, or damaged in transit.

At the present time very little is known regarding the geographical variation of larvae, but it is recognised that in many species there may be a good deal of variation amongst individuals of the same age or instar. Allowance should be made for this when comparing specimens with the drawings reproduced here. Remarks on the amount of variation noticed are included under each species.

*Notes on larval structures referred to in the following descriptions.*

*Head.* On the dorsal surface there are a number of pairs of tufted hairs; the most conspicuous of these, in *Culex*, are the *inner, mid, and outer post-antennal hairs*. Their position and structure does not seem to be of specific importance in closely allied species, but in some the outer post-antennal tufted hairs are heavily chitinised and blackish, and therefore more conspicuous than in other species. On the under surface of the head there is a small, heavily chitinised triangular plate, bearing teeth, called the *mentum, mental plate, or labial sclerite*. The *antenna* has at its tip two *apical bristles*, one usually much longer than the other; slightly below these there is a *papilla*, and below this again a pair of *subapical bristles*. The *antennal tuft*, consisting of a number of hairs springing from a common base, is usually placed on the inner side of the shaft at about the middle, but the position varies in different species. *Comb of eighth abdominal segment*, a row or patch of teeth on either side of the segment; the size, shape, and arrangement of these is of importance. *Siphon*, a tube-like structure arising from the dorsum of the eighth segment. The *siphonal index* used in the descriptions is the ratio of the diameter of the base of the siphon tube to the length, the dorsal plates ('valves') not being included in the length. I have adopted the terms

anterior and posterior, for the surfaces of the siphon, instead of dorsal and ventral, the extreme tip of the siphon being morphologically the true dorsal surface. *Pecten*, a row of teeth on either side of the siphon, commencing at the base, and lying posteriorly. *Anterior apical bristles*, a pair of bristles placed at the anterior apex of the siphon tube. *Siphonal hair tufts*, tufted hairs, usually arranged in pairs along the posterior surface; in some species there are also lateral tufts. The *anal segment* in *Culex* larvae, in which the siphon tube is well developed, has somewhat the appearance of a subventral appendage of the eighth segment; it is usually enclosed dorsally and laterally within a single curved chitinised plate. At the apex of the segment dorsally there are two pairs of hairs, the *outer* and *inner dorsal hairs*. The outer pair are usually divided into several branches, the inner are almost always single and very long. Below the dorsal hairs there are two pairs of *anal papillae*, projecting from the posterior border of the segment, and surrounding the opening of the anus. *Anal fan*, a double row of hairs split into fine branches originating from a curiously shaped plate situated on the ventral border of the segment posteriorly, forming a fan-like or brush-like expansion. *Lateral hair*, a small hair on either side of the anal segment, placed near the posterior border.

#### *Culex bitaeniorhynchus* Giles.

*Larva*, fourth instar, described from skins cast at the time of pupation (*vide* Plate LXIV). *Head* comparatively small; thinly chitinised and pale. *Antenna* pale for about the basal three-quarters, darker apically. *Antennal tuft* rather nearer the base than the apex of the shaft. *Subapical bristles* placed near the tip. The basal half of the shaft bears six or seven minute spicules or spinelets on the dorsal aspect; a rather larger spinelet, with usually a bifid tip overlaps the base of the antennal tuft. *Mentum* triangular and pointed, with a large number of very minute teeth. *Comb of eighth abdominal segment*, four to six large sharp teeth set in an irregular row; the teeth are without lateral denticles, but have some small hairs at their bases. The number of teeth may vary on the two sides of the same individual. The usual number in the specimens I have examined is six. *Siphon* rather pale, and unicolourous throughout; usually more than six times as long as the width at the base, but subject to considerable variations. *Pecten*, three to six teeth, always difficult to see, as they are small and almost transparent. Each tooth has two or three minute lateral denticles. *Hair tufts of siphon*

EXPLANATION OF PLATE LXIV.

Drawings illustrating the larval structure (fourth instar) of *Culex  
bitaeniorhynchus* Giles.

Fig. 1. Anal extremity of abdomen (hair tufts of eighth segment omitted;  
hair tufts of one side of siphon shown).  $\times 60$ .

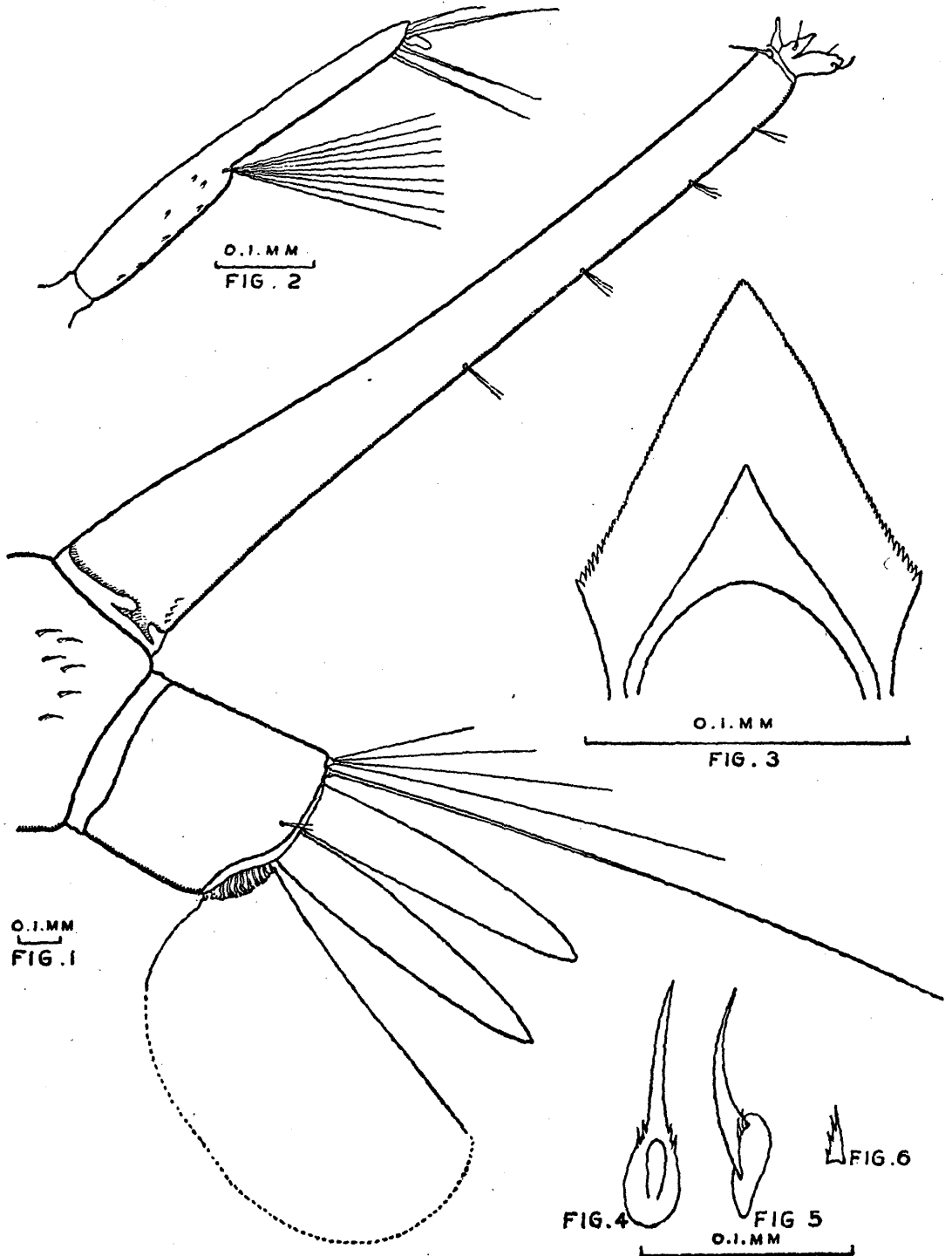
„ 2. Antenna.  $\times 150$ .

„ 3. Mentum.  $\times 485$ .

Figs. 4 and 5. Comb teeth.  $\times 320$ .

Fig. 6. Pecten tooth.  $\times 320$ .

PLATE LXIV.



Drawings illustrating the larval structure (fourth instar) of *Culex cornutus* Edw.

Fig. 1. Anal extremity of abdomen (hair tufts of eighth segment omitted; hair tufts of one side of siphon shown).  $\times 55$ .

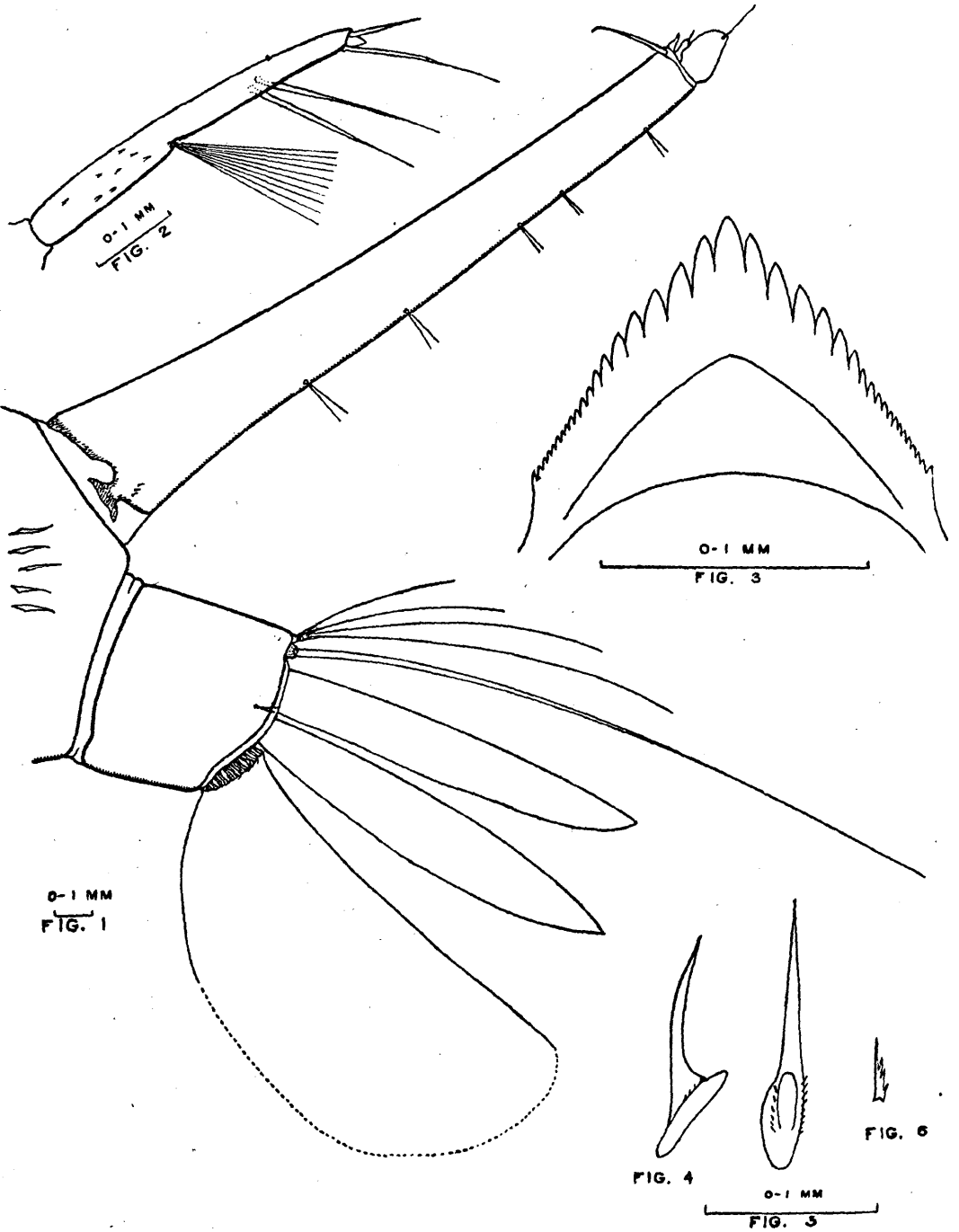
„ 2. Antenna.  $\times 130$ .

„ 3. Mentum.  $\times 490$ .

Figs. 4 and 5. Comb teeth.  $\times 250$ .

Fig. 6. Pecten tooth.  $\times 250$ .

PLATE LXV.



very small, usually four pairs on the posterior surface, the pair nearest the base arising at about midway between the base and the apex. The position of the hair tufts is subject to variation and sometimes they are not arranged in actual pairs, and then form a zigzag row on either side of the posterior border. None of the specimens I have seen show any hair tufts on the anterior or lateral surfaces. *Anterior apical spines* of medium length. *Anal segment*; *outer dorsal hairs* branched into four pairs of increasing length, the shortest being most dorsal; inner pair simple and long. *Lateral hair* very fine and short, usually branched into two before the tip. *Anal papillae* approximately one-and-three-quarter times the length of the chitinised part of the segment. *Anal fan*, longest hairs slightly longer than the papillae.

Var <sup>amblyus</sup> ~~tenax~~. Theo. There appear to be some constant differences between the larvae of this variety and those of the type. *Head* and *siphon* less pale, the former with small darker patches. *Antennae* uniformly rather dark for the whole length, instead of towards the tip only. *Shaft* with about double the number of spicules, which are not confined to the basal half. *Siphon* usually rather less than six times the length of the width at the base. *Pecten*, six to nine teeth, the tooth furthest from the base usually much detached from the others.

On larval characters it would seem justifiable to regard this form as a distinct species, but as there do not appear to be any constant structural differences in the adults, it is advisable for the present to retain it as a variety.

### *Culex cornutus* Edw.

This species was discovered by the writer in July, 1921, at Trombay, Bombay Harbour. The adult has recently been described by Edwards. Some of the specimens were bred from larvae found in marshy fields, others were caught in jungle undergrowth at Trombay, and in similar situations on islands in other parts of Bombay Harbour. In August, 1921, a further number of specimens were bred from larvae found in pools amongst heavy jungle, at Tavargatti, Bombay, Deccan. The larvae from the two localities show small but constant differences. I have examined the hypopygia of males bred from each place, and find that they are identical.

*Larva*, fourth instar, described from skins cast at the time of pupation; Trombay form (*vide* Plate LXV). *Head* comparatively small, pale and almost transparent, without darker spots. *Antenna* pale for the basal two-thirds, darker apically. *Antennal tuft* rather nearer,

the base than the apex of the shaft. *Subapical bristles* placed much further from the apex than in *C. bitaeniorhynchus*, and situated about midway between the tuft and the apex. *Shaft* with a few spinelets on the basal half. *Mentum* subtriangular with a large number of teeth, those towards the base very small, the apical teeth much larger. *Comb of eighth abdominal segment* composed of from four to six large sharp teeth, furnished with a few minute hairs at their bases. *Siphon* yellowish and unicolourous; *index* from five to rather more than six. *Pecten*, two to four small teeth placed close together. *Hair tufts of siphon*, five pairs on the posterior border, composed of few and small hairs, the pair nearest the base placed before the middle point, the next pair at about the middle point, and the remaining pairs between this and the apex; the exact position of the hairs is subject to variation. No anterior or lateral tufts. *Anterior apical bristles* long and hooked. *Anal segment*, *outer pair of dorsal hairs* with four branches, *inner pair* single and long. *Lateral hair* minute, two or three branched. *Anal papillae* rather more than twice the length of the anal segment. *Anal fan*, longest hairs rather longer than the papillae.

The larvae from Tavargatti differ from the above description as follows:—*Head* with darker spots arranged in a regular pattern. *Antenna* pale for the basal half only, remainder darker. *Pecten* of not more than three teeth. *Siphon* with usually six pairs of posterior hair tufts instead of five.

### **Culex vishnui** Theo.

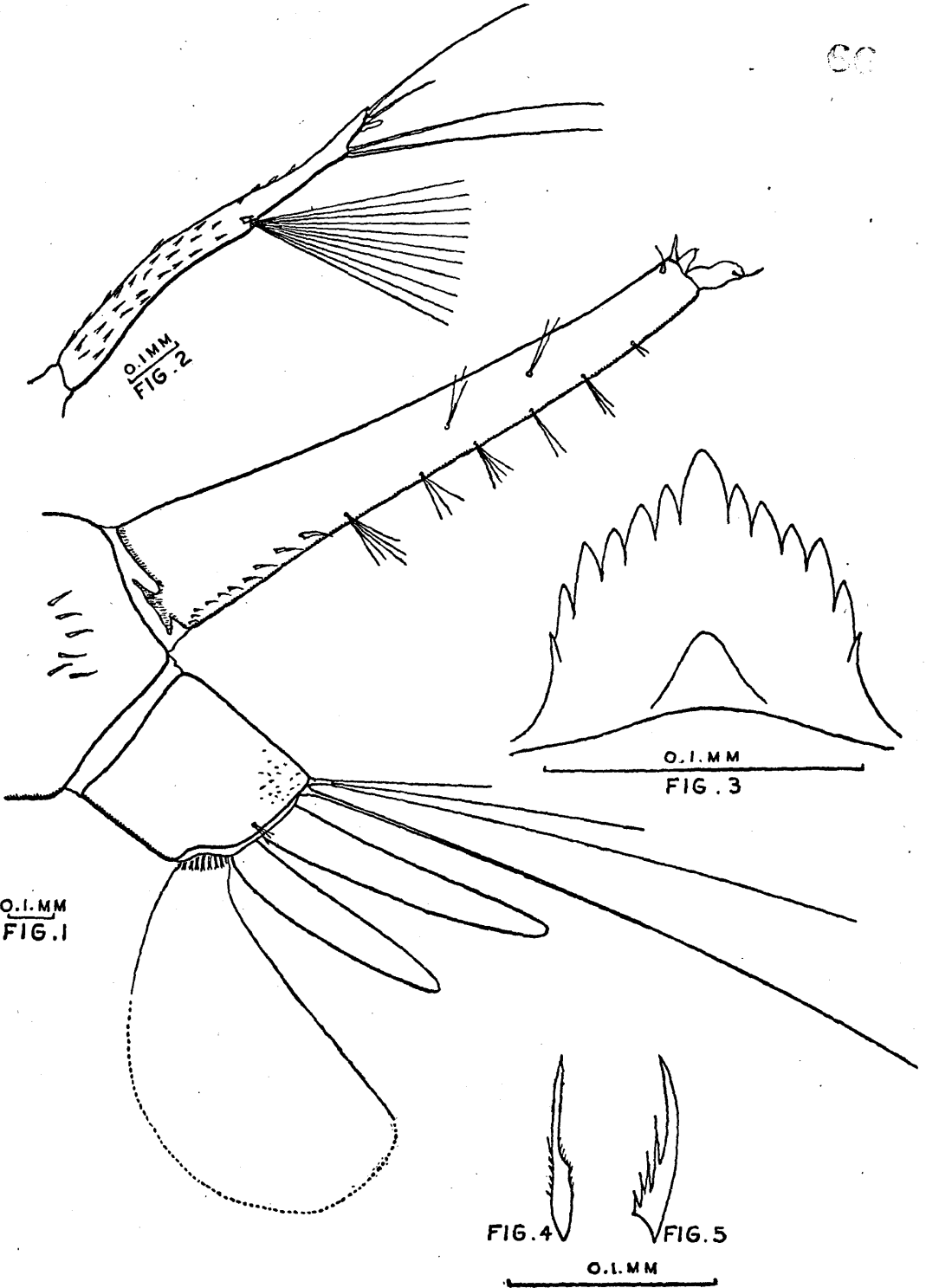
This mosquito belongs to a rather difficult group of small species. In the adult stage it is not easy to distinguish from *C. barraudi* Edw. and *C. tritaeniorhynchus* Giles. As mentioned in the notes further on under the last-named there may be a fourth closely allied species which very closely resembles *C. tritaeniorhynchus*. In the larval stage *C. vishnui* can be distinguished from these other species by several characters, the most obvious being the form of the comb of the eighth abdominal segment, which is composed of a few large teeth. In the other species mentioned above the comb consists of a much larger number of small teeth arranged in a triangular patch.

*Larva*, fourth instar, described from skins cast at the time of pupation. (*vide* Plate LXVI). *Head* comparatively large; *outer post-antennal tufted hairs* conspicuously dark. *Antenna* dark at the extreme base and above the tuft. *Tuft* at three-fifths from the base. *Subapical*

EXPLANATION OF PLATE LXVI.

Drawings illustrating the larval structure (fourth instar) of *Culex vishnui* Theo.

- Fig. 1. Anal extremity of abdomen (hair tufts of eighth segment omitted :  
hair tufts of one side of siphon shown).  $\times 70$ .
- „ 2. Antenna.  $\times 90$ .
- „ 3. Mentum.  $\times 480$ .
- „ 4. Comb tooth.  $\times 310$ .
- „ 5. Pecten tooth.  $\times 310$ .

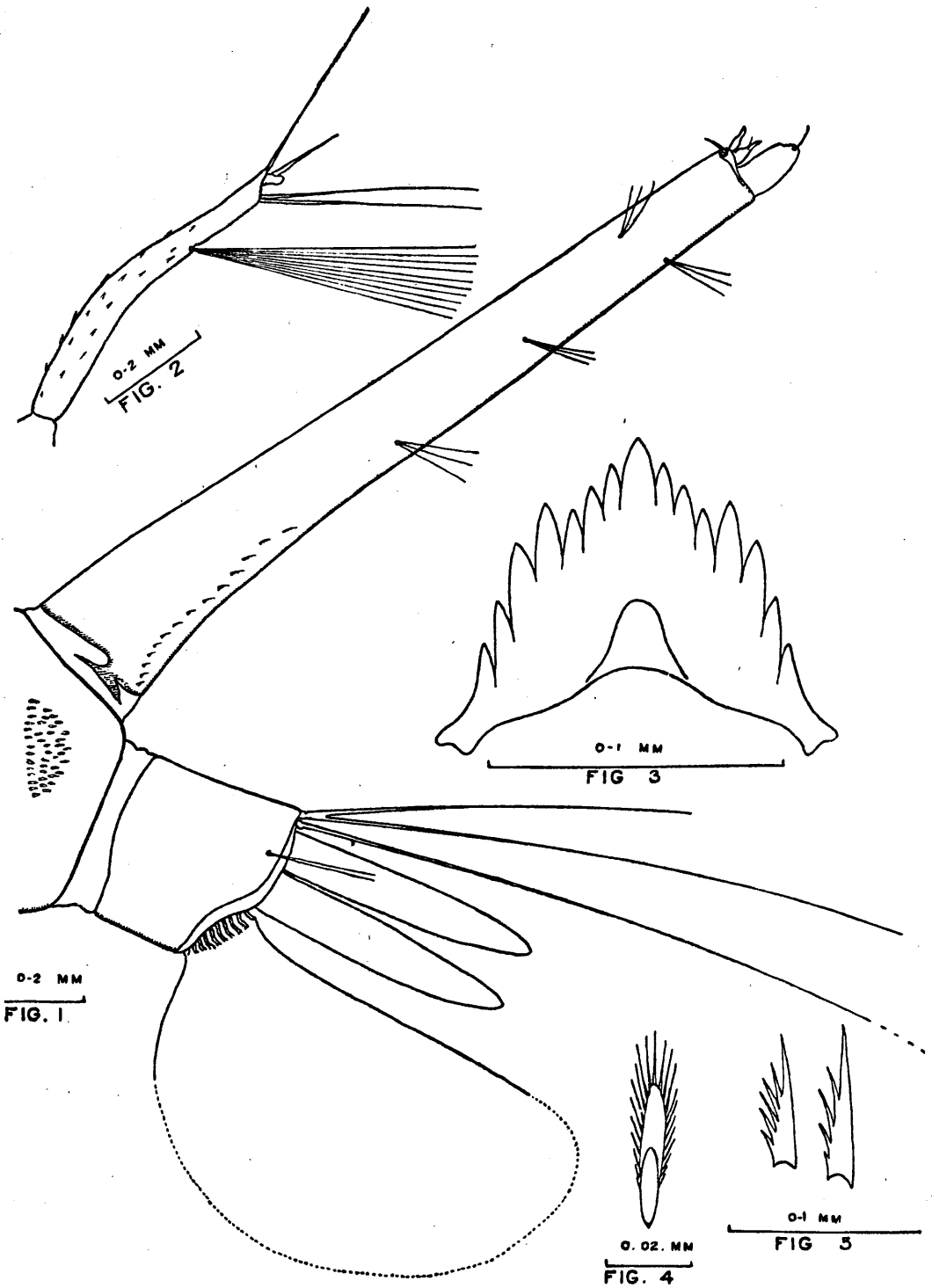


EXPLANATION OF PLATE LXVII

Drawings illustrating the larval structure (fourth instar) of *Culex barraudi* Edw.

- Fig 1. Anal extremity of abdomen (hair tufts of eighth segment omitted ;  
hair tufts of one side of siphon shown).  $\times 65$ .
- „ 2. Antenna.  $\times 82$ .
- „ 3. Mentum.  $\times 440$ .
- „ 4. Comb tooth.  $\times 625$ .
- „ 5. Pecten teeth.  $\times 270$ .

PLATE LXVII.



*bristles* slightly below the tip. *Shaft* with numerous spicules. *Mentum*, teeth moderately large and regular, from six to eight on either side of the central one. *Comb of eighth abdominal segment*, six or seven large sharp teeth set in an irregular row. *Siphon*, index from four to six. *Pecten*, nine to eleven teeth, the apical teeth large and curved, and about the same size as the comb teeth. *Hair tufts of siphon*, six or seven pairs of rather short tufted hairs along the posterior border, commencing just beyond the pecten; two pairs of lateral tufts. *Anterior apical bristles* moderately developed. *Anal segment*, a few very minute spinelets on the dorsal surface towards the apex of the segment. *Outer dorsal hairs* of three branches; *inner* long and simple. Longest hairs of *anal fan* about the length of the dorsal pair of anal papillae. *Lateral hair* minute, usually with several branches.

### *Culex barraudi* Edw.

This species closely resembles *C. vishnui* in the adult, but differs in the structure of the male hypopygium. It has recently been described by Edwards, and was discovered by the writer in May, 1921, at Mahdopur, Punjab. In the larval stage it is quite distinct from *C. vishnui*; but on the other hand it so closely resembles *C. tritaeniorhynchus* that it is difficult to find any satisfactory characters by which the two may be distinguished.

*Larva*, fourth instar, described from skins cast at the time of pupation. (*vide* Plate LXVII). *Head* moderately chitinised; *outer post-antennal tufted hair* not conspicuously dark. *Antenna* pale from the base to just before the tuft, remainder darker. *Antennal tuft* at from five-eighths to three-quarters from the base. *Shaft* with a number of fine spicules. *Subapical bristles* placed close to the tip. *Mentum*, teeth large and irregular, some of the lateral ones being much larger than the others (in the specimens of *C. tritaeniorhynchus* I have examined the teeth are more regular). *Comb of eighth abdominal segment*, a triangular patch of from forty to forty-five small teeth. *Siphon*, usually longer than in *C. tritaeniorhynchus*. *Index* in some specimens as much as seven, but more frequently about five. *Pecten* of from twelve to fourteen teeth, bearing lateral denticles from the base to near the apex. *Siphonal hair tufts*, three or four pairs towards the posterior surface, and one pair (sometimes two) of lateral tufts near the anterior surface. As in most of the allied species the position and number of tufts is subject to variation. *Anal segment*, *outer pair of dorsal hairs* of two, occasionally of

three, branches, *inner* single and long. *Lateral hair* three-quarters the length of the chitinised part of the anal segment, and either single or two branched (in *C. tritaeniorhynchus* the lateral hair is much shorter, and divided into several branches). *Anal papillae* nearly twice the length of the anal segment, and longer than in *C. tritaeniorhynchus*. I do not think that much reliance can be placed on this character as in some species I have found a considerable range of variation in the length of the papillae in larvae of the same instar. Longest hairs of *anal fan* longer than the papillae.

### ***Culex tritaeniorhynchus* Giles.**

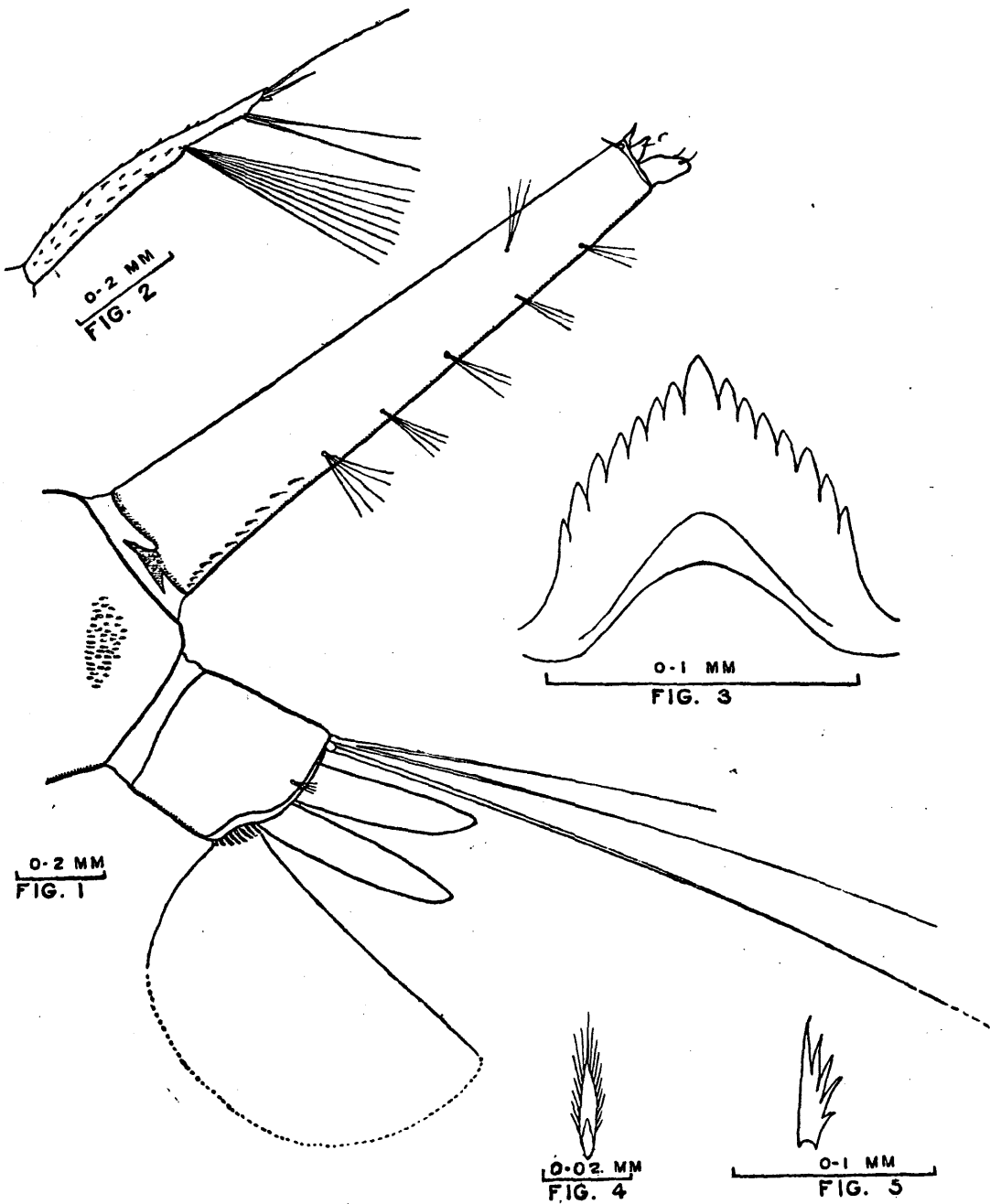
The larva of this species so closely resembles that of the preceding that a full description is unnecessary. The form of the *mentum*, and the length of the *lateral hair* of the anal segment, appear to be characters by which the two species may be separated. The differences will be seen by reference to Plates LXVII and LXVIII. In *C. tritaeniorhynchus* the siphon is usually shorter, and there are a larger number of hair tufts along the posterior border, and one lateral pair, but it is likely that the variation of the two species may overlap in these characters. The *antennal tuft* springs from a point two-thirds from the base of the shaft, or rather nearer the base than in *C. barraudi*. It should be mentioned here that the larva of *Culex perexiguus* Theo. is also extremely similar. The last-mentioned species does not fall into the group dealt with in this paper, as the adult is without a conspicuous pale band on the proboscis. In a recent paper Edwards mentions that the hair tufts on the siphon of the larva of *C. tritaeniorhynchus* (from Mesopotamia) are all sub-ventral (*i.e.*, along the posterior border), and that there are no lateral tufts. I have found however that a pair of lateral tufts is present in the Indian specimens I have examined.

I think that it is probable that there is yet another species belonging to this puzzling group, which is at present confused with *C. tritaeniorhynchus*. At Karwar, Kanara district, in September, 1921, a few adults were bred by the isolation method. These specimens very closely resemble *C. tritaeniorhynchus*, except for some small differences in the male hypopygium. Until further material has been obtained and studied I am unable to say whether these differences are constant, and sufficient to justify the separation of this form as a distinct species. The larva differs from *C. tritaeniorhynchus* in several features (*vide* Plates LXVIII and LXIX). *Siphon tube* much longer. *Pecten* with

EXPLANATION OF PLATE LXVIII.

Drawings illustrating the larval structure (fourth instar) of *Culex tritaeniorhynchus* Giles.

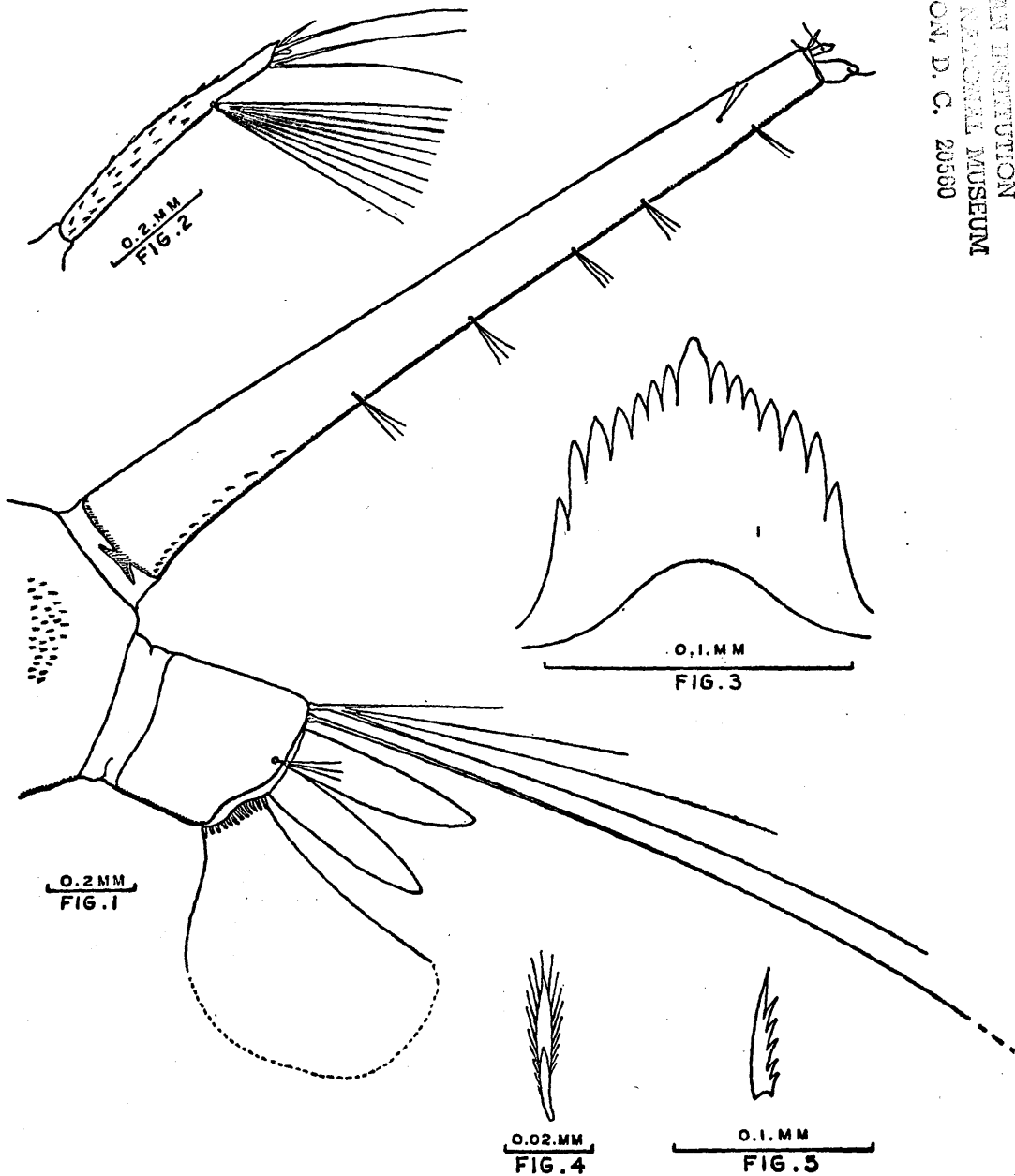
- FIG. 1. Anal extremity of abdomen (hair tufts of eighth segment omitted ;  
hair tufts of one side of siphon shown).  $\times 62$ .
- „ 2. Antenna.  $\times 82$ .
- „ 3. Mentum.  $\times 450$ .
- „ 4. Comb tooth.  $\times 650$ .
- „ 5. Pecten tooth.  $\times 290$ .



EXPLANATION OF PLATE LXIX.

Drawings illustrating the larval structure (fourth instar) of a local form of *Culex tritaeniorhynchus* Giles, or possibly a new species.

- Fig. 1. Anal extremity of abdomen (hair tufts of eighth segment omitted; hair tufts of one side of siphon shown).  $\times 60$ .
- „ 2. Antenna.  $\times 80$ .
- „ 3. Mentum.  $\times 430$ .
- „ 4. Comb tooth.  $\times 600$ .
- „ 5. Pecten tooth.  $\times 280$ .

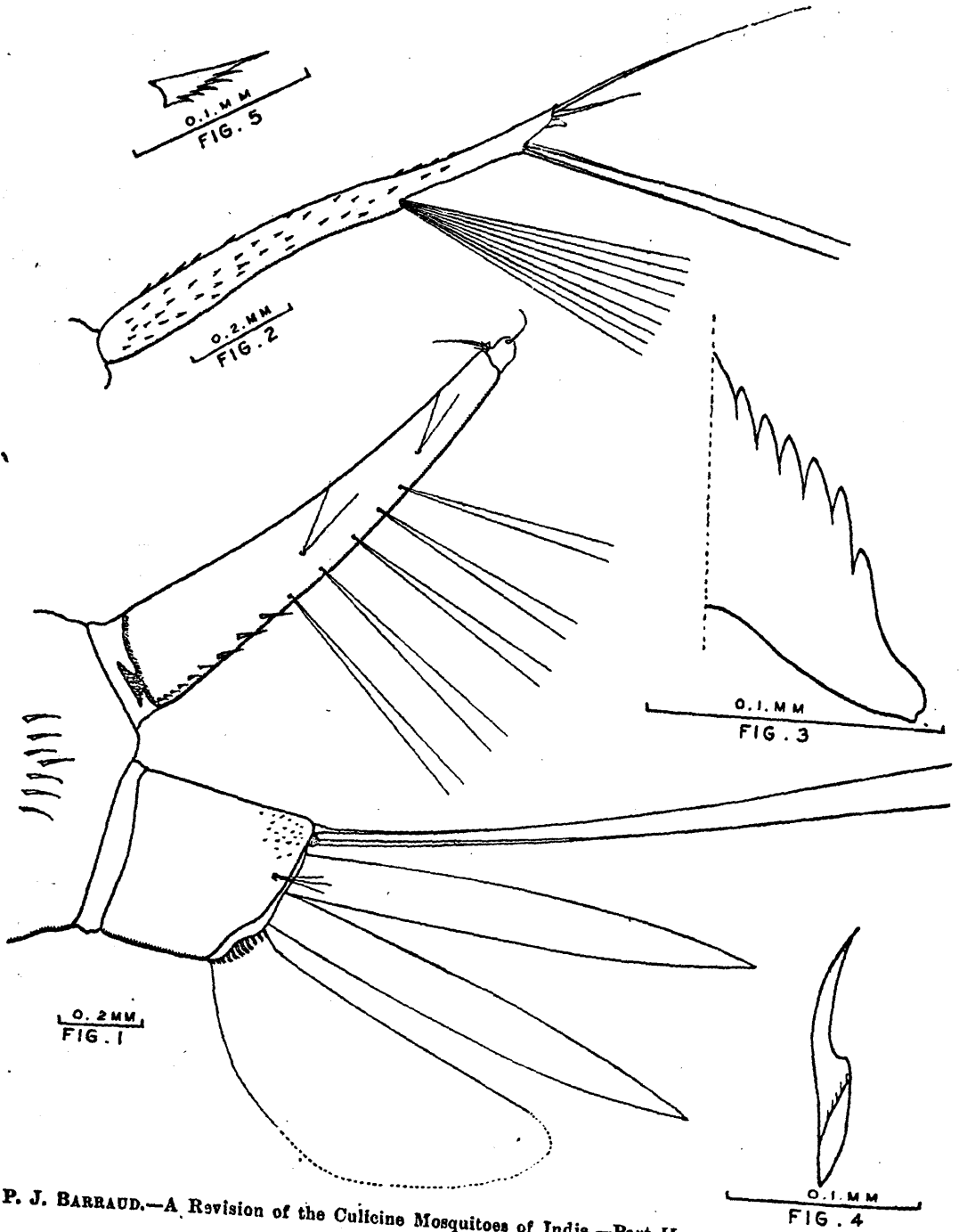


EXPLANATION OF PLATE LXX.

Drawings illustrating the larval structure (fourth instar) of *Culex whitmorei* Giles.

- Fig. 1. Anal extremity of abdomen (hair tufts of eighth segment omitted ;  
hair tufts of one side of siphon shown).  $\times 60$ .
- „ 2. Antenna.  $\times 80$ .
- „ 3. One side of mentum.  $\times 440$ .
- „ 4. Comb tooth.  $\times 285$ .
- „ 5. Pecten tooth.  $\times 280$ .

PLATE LXX.



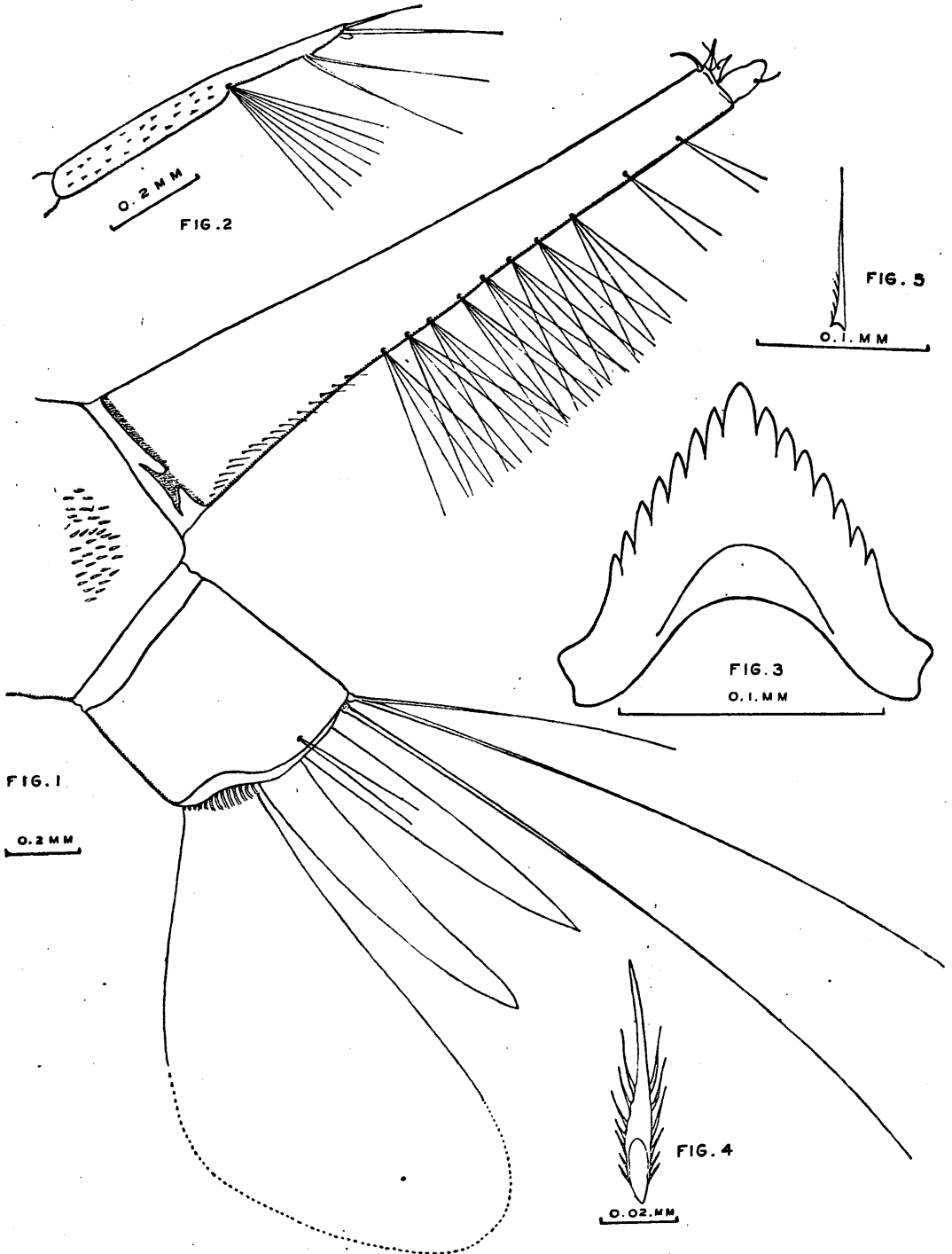
EXPLANATION OF PLATE LXXI

65

Drawings illustrating the larval structure (fourth instar) of *Culex mimeticus* Noé.

- Fig. 1. Anal extremity of abdomen (hair tufts of eighth segment omitted ; all the larger hair tufts of siphon shown, and smaller tufts of one side).  $\times 55$ .
- „ 2. Antenna.  $\times 75$ .
- „ 3. Mentum.  $\times 390$ .
- „ 4. Comb tooth.  $\times 550$ .
- „ 5. Pecten tooth.  $\times 250$ .

PLATE LXXI.



the teeth furthest from the base more detached. The pair of hair tufts nearest to the base placed some distance from the pecten. *Lateral hair* of anal segment rather long. *Outer pair of dorsal hairs* of anal segment with usually four branches instead of two. It will be seen that this larva also very closely resembles that of *C. barraudi*, differing only in the shape of the mentum, and in having more numerous hair tufts on the siphon.

#### **Culex whitmorei** Giles.

*Larva*, fourth instar, described from skins cast at the time of pupation (*vide* Plate LXX). *Head* moderately chitinised. *Antenna* unusually long, *tuft* at two-thirds from the base; one *apical bristle* much longer than the other; *subapical bristles* slightly below the tip. *Mentum*, six to seven teeth on either side of the central one, moderately large and regular. *Comb of eighth abdominal segment*, seven large sharp teeth set in an irregular row. *Siphon* remarkably small and curved, somewhat cut away anteriorly at the base. *Index* from four to rather more than four-and-a-half. Five or six pairs of hair tufts along the posterior border, each tuft of two long subplumose hairs. These hairs are about half the length of the siphon tube. Two pairs of lateral tufts, each of two shorter hairs. *Pecten*, eight to fourteen teeth with lateral denticles. *Anterior apical bristles* large with hairs around their bases. *Anal segment* with minute spicules on the dorsal surface towards the apex. *Outer* and *inner* dorsal hairs each of one long pair of about equal length. *Lateral hair* of medium length with several branches. *Anal papillae* unusually long, as long as the siphon. *Anal fan* shorter than the papillae.

#### **Culex mimeticus** Noé.

*Larva*, fourth instar, described from skins cast at the time of pupation (*vide* Plate LXXI). *Head* pale. *Antenna* light in colour for the basal three-quarters, a little darker apically. *Antennal tuft* at three-fifths from the base of the shaft; the latter with fine spicules, chiefly on the basal two-thirds. *Subapical bristles* placed below the apex, but nearer to it than to the tuft. In this respect the larvae found in North India differ slightly from those occurring in the Palearctic Region. In the latter the subapical bristles usually arise at a point midway between the tuft and the apex. *Mentum* furnished with moderately large teeth, regular in size, seven to nine on either side of the central one. *Comb of eighth abdominal segment*, a triangular patch of about thirty-five small teeth.

The appearance of one of these under a high magnification will be seen on Plate LXXI, fig. 4. *Siphon* usually about five times as long as the width at the base; the *index* varies from four and a half to six. *Pecten* with from twelve to twenty-three teeth. The teeth near the base are sometimes crowded together, this is especially the case in specimens possessing the larger number. Sometimes there may be extra teeth alongside the main rank. The teeth are long, thin, and pointed, with hair-like lateral denticles. *Siphonal hair tufts*, eight or ten rather long tufted hairs along the posterior border, not usually arranged in pairs and commencing just beyond the pecten. The hairs are at least twice as long as the diameter of the siphon in the middle; each tuft has four or five branches. Towards the apex there are two pairs of smaller tufts. *Anterior apical bristles* moderate in size and curved. *Anal papillae* long and pointed. Longest hairs of *anal fan* appreciably longer than the papillae; *outer dorsal hairs* of two branches, *inner* simple. *Lateral hair* of two long branches.

#### **Culex mimulus** Edw.

*Larva*, fourth instar, described from skins cast at the time of pupation (*vide* Plate LXXII). *Antenna* pale for the basal two-thirds, darker apically. *Antennal tuft* at between three-fifths and two-thirds from the base. *Subapical bristles* only slightly below the apex. *Mentum*, teeth large and irregular, one of the lateral teeth usually larger than the others. *Comb of eighth abdominal segment*, a triangular patch of from thirty to thirty-five small teeth. The *siphon* shows considerable variation in length and width. In the specimens I have been able to examine the *index* works out at from six to as much as nine. On Plate LXXII, fig. 6 drawings on the same scale of the siphon tube of three specimens are given. I have mounted the hypopygia of various males which resulted from some of these skins, and find that they all agree. The lateral process of the ventro-lateral plate of the anal segment (basal arm of tenth sternites of Edwards) is well developed, and the structure of the phallosome somewhat closely resembles that of *C. vishnui*. *Pecten*, twelve to sixteen teeth; these are stouter and with more pronounced lateral denticles than in *C. mimeticus*. *Siphonal hair tufts*, five or six pairs along the posterior border, shorter than in *C. mimeticus*; one pair of lateral tufts towards the apex. *Anterior apical bristles* rather small. *Anal segment*; *outer dorsal hairs* of two branches, *inner* simple and long. *Lateral hair* of two or three moderately long branches. *Anal papillae* rather long and pointed. Longest hairs of *anal fan* about the length of the papillae.

## EXPLANATION OF PLATE LXXII

Drawings illustrating the larval structure (fourth instar) of *Culex mimulus* Edw.

- Fig. 1. Anal extremity of abdomen (hair tufts of eighth segment omitted; posterior hair tufts of both sides of siphon shown, and lateral tuft of one side).  $\times 65$ .
- „ 2. Antenna.  $\times 80$ .
- „ 3. Mentum.  $\times 440$ .
- „ 4. Comb tooth.  $\times 650$ .
- „ 5. Pecten tooth.  $\times 280$ .
- „ 6. Outline drawings showing variation in the length of the siphon tube.  $\times 30$ .

FIG. 2

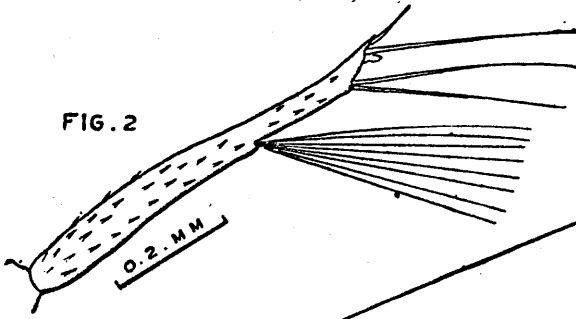


FIG. 1

0.2 MM

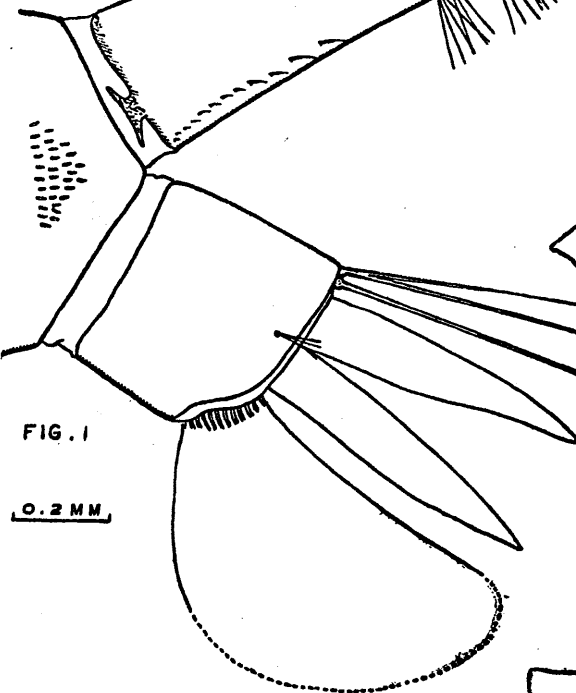
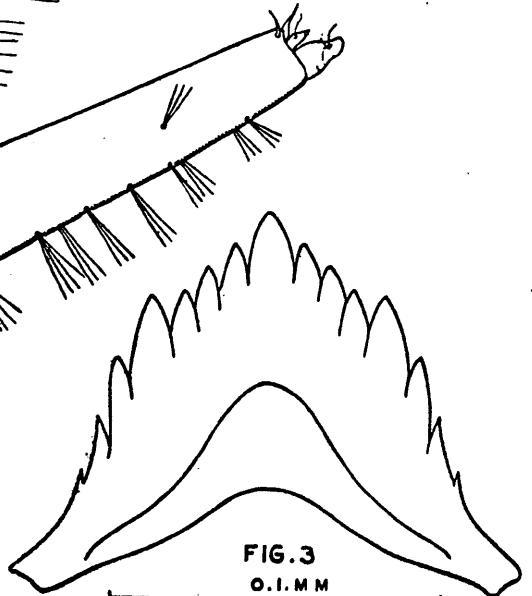


FIG. 3

0.1 MM



0.02 MM

FIG. 4



0.1 MM

FIG. 5



1.0 MM

FIG. 6

