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NOTES ON PHILIPPINE MOSQUITOES, V

THE PUPAL CHARACTERS OF ANOPHELINES UNDER
THE MYZORHYNCHUS SERIES AND GROUP NEO-
CELLIA, WITH FURTHER COMMENTS ON THE LAR-
VÆ AND ADULTS OF *SINENSIS*

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TWENTY-THREE PLATES AND FOUR TEXT FIGURES

GENERAL CONSIDERATIONS

The Myzorhynchus series of Philippine anopheles is composed of:

- Anopheles barbirostris* van der Wulp, 1884.¹
- Anopheles gateri* Baisas, 1935.
- Anopheles hyrcanus* var. *nigerrimus* Giles, 1900.
- Anopheles hyrcanus* var. *sinensis* Wiedemann, 1828.
- Anopheles pseudobarbirostris* Ludlow, 1902.

And the members of group ~~Neocellia~~ Neocellia are:

- Anopheles annularis* van der Wulp, 1884.
- Anopheles karwari* James, 1903.
- Anopheles maculatus* Theobald, 1901.²
- Anopheles philippinensis* Ludlow, 1902.

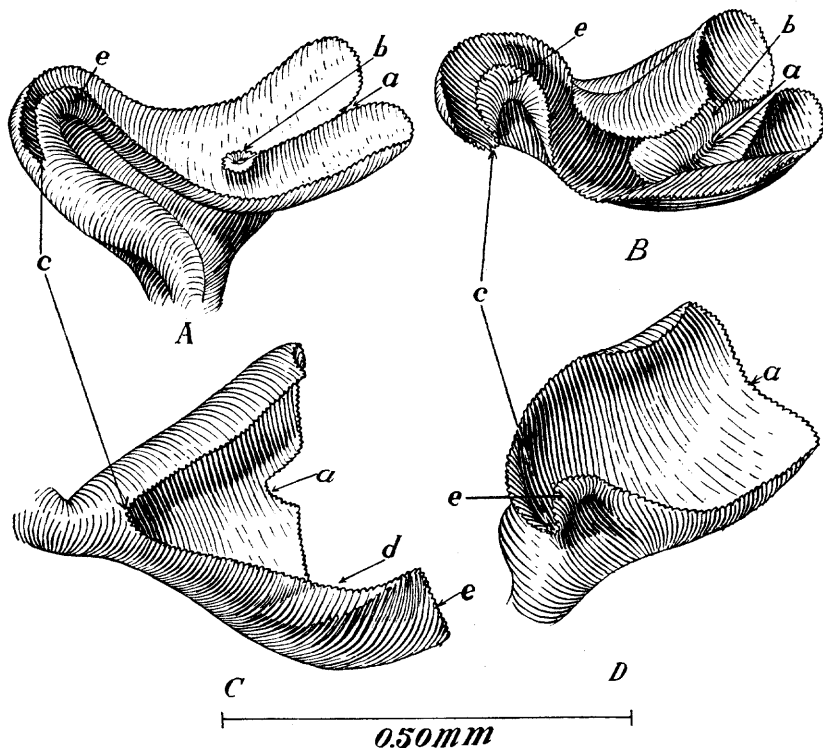
¹ The pupal characters of *barbirostris* discussed in this paper are only those whose larvæ possess numerous (over 30) branches on the outer anterior clypeal hair. No pupal materials of the type having fewer branches (about 20) on the outer anterior clypeal of the larva are on hand. Whether the latter form may prove a new variety (as indicated by Laurel, 1932, and Russell & Baisas, 1934) or not remains to be shown from the studies now being undertaken by Dr. A. Ejercito, chief of the Malaria Section.

² Only the pupal characters of *maculatus* from the lowlands of Luzon are included here.

In a previous paper the pupal characters of *A. gateri* and *A. karwari* were presented, but will be recapitulated here for the sake of completeness.

THE RESPIRATORY TRUMPETS

For convenience I propose to name the parts of a *Myzorhynchus* pupal respiratory trumpet as shown in text figure 1.



TEXT FIGURE 1. Respiratory trumpets. A. *A. barbirostris*; B. *A. pseudobarbirostris* (top view); C. *A. gateri*; D. *A. hyrcanus* var. *sinensis*. Labels: (a) apical notch, (b) fold of apical notch, (c) basal notch, (d) lateral notch, (e) flap.

Distinct specific status among the members of the *Myzorhynchus* series is indicated by the peculiarities of the respiratory trumpets; but varieties under one species as those of *nigerrimus* and *sinensis* are characterized by a similarity in trumpets, and are separable from one another on the basis of other characters. Like other organs, the trumpets among individuals within a species are subject to variations, but such are not sufficient to obscure the main characteristics. An example of these varia-

tions is the occasional presence of the lateral notch in the trumpets of the varieties under *hyrcanus*, which, however, does not materially affect the characteristic wide respiratory opening of this species, nor does it assume the marked proportion it attains in *gateri*.

It is best to examine the trumpets unmounted, but after some practice even mounted flat preparations can be recognized with comparative ease. If the pupal cast is allowed to float in its natural position on a large drop of water on a slide, the openings of the respiratory trumpets can be seen very nicely under low magnifications. *Barbirostris* and *pseudobarbirostris* have the openings similarly narrow and "S"-shaped, but differ from each other in certain details. The rims of the lateral sides in *pseudobarbirostris* are more distinctly bent inwardly; the apical notch is not very pronounced but has large folds. In *barbirostris* the lateral rims are less bent inwardly, thus giving the trumpet a shallower and wider aspect towards the outer half. The apical notch is pronounced but with smaller folds. *Gateri* differs from all the others in having particularly long flap; its respiratory opening is wide but shaped differently from those of the varieties under *hyrcanus*. *Nigerrimus* and *sinensis* have their respiratory openings shaped very much like the seed of a large bean; the flap in both is short and round-ended.

Text figure 1 gives only an imperfect view of the different respiratory openings as the illustrations were drawn primarily to show other details of the trumpets.

The respiratory trumpets of the species under group *Neocellia* show no specific characters; they are very closely similar to each other.

SPINES AND HAIRS

The pupal spines and hairs and other parts of diagnostic value are designated in accordance with Senevet (1930) as modified by Sir Christophers (1933). These are partly shown in plates 1 and 2. For brevity I refer to these spines and hairs in the text as: "M-O," "1-1-II," "C'," "A-VII," "5-VIII," etc. which respectively means: metathoracic hair O, hairs 1-1 of abdominal segment II (the first 1 being the external), hair C' of segment VI (this hair being present only on segment VI reference to the segment is omitted), spine of segment VII, hair 5 of segment VIII, etc.

Specific differences are found not only in the branching of the hairs and spines, but also in their relative lengths, sizes and

shapes. The dorsal hairs are more useful in differential diagnosis; those on the ventral are of very little or no value.

H-*I* and *K*-*I* are variable in positions in the species under the *Myzorhynchus* series (and in those of the *Anopheles* series which I have so far examined); *K* may be internal or external to, or in line with *H* in the longitudinal plane (the only exception being *A. lindesayi* var. *benguetensis* in which *H* has been found constantly and distinctly internal to *K*). In my papers on pupæ of the subgenus *Anopheles*, the one anterior in position is considered *H* regardless of its longitudinal location in relation to the other which is regarded as *K*.

In group *Neocellia* *H* has been found constantly internal though more or less posterior to *K*, excepting in *annularis* in which it may be a little anterior or posterior to, or in line with *K*.

Duplication of the smaller, but not of the larger hairs is sometimes met with. Sometimes a hair that is normally with few branches may have many branches or *vice versa*, so that it is always best to consider the corresponding hair on the other side of the segment or on other segments to avoid wrong interpretation. No abnormality in the spines was seen except in one *gateri* in which *A*-*IV* is double, and *A*-*V* is split into two at the apex; and in one *maculatus* in which the spines on both sides of segments *VI* and *VII* are split into two at the spices.

THE PADDLES

Of the species under the subgenus *Anopheles* which I have so far examined, only *A. lindesayi* var. *benguetensis* shows specific characteristics in the paddles. The hairs of its paddles are the longest and most numerous (see Baisas, 1935.) Two other species may possibly be separated on the basis of the peculiar shapes of their paddles, but these are not very distinctive. *A. hyrcanus* var. *sinensis* has the most pointed posterior border, while *A. gateri* has the greatest curve on the external border.

There is a great deal of overlapping in the extent, size and shapes of denticles and hairs among members of a series or group. The indices are of the same order.

The line of minute hairs on the posterior border of the paddle is frequently double in the species under the *Myzorhynchus* series; one line having the hairs pointing posteriorly, and the other directed anteriorly in mounted preparations. The midrib in fresh specimens is distinct, and extends almost to the posterior border of the paddle, but the distal third or so is usually rendered invisible in fixed mounts with Gater's fluid.

COMMENTS ON SINENSIS

Russell and Baisas (1934 b) indicate certain differences between the larvæ of *sinensis* found in the highlands of Baguio and those collected from the lowlands. The present studies have shown that more marked differences between the two forms occur in the pupæ. This prompted me to review my old materials (1929), and to collect more specimens, from which I draw the conclusion that two varieties are present in the Philippines.

One of the forms may be designated as the highland variety because it is the only type present in Baguio (5,000 feet elevation) although it is also found in the lowlands. For contrast the other may be called the lowland variety. Further observations are necessary to determine which of the two types predominates in the lowlands. My old and new collections indicate that they do not often associate in one breeding place. In Calauan, Laguna, the lowland variety prefers an impounded spring water, and a small, heavily vegetated lake; while the highland variety frequents irrigation ditches and rice paddies. Outside of Laguna Province, the lowland variety has been found in an impounded water at barrio Burabod, Daet, Camarines Norte; and in a large vegetated pool formed by digging of adobe building stones at Balintawak, Rizal, just beyond the boundary of Manila. Two larvæ of the highland variety were found mixed with many of the lowland type in the lot from barrio Burabod. Of the many larvæ I collected lately from the impounded water at Calauan, only one proved to be of the highland variety; while those from irrigation ditches and rice paddies were exclusively of the highland variety and other species, but none of the lowland form. In Baguio, *sinensis* also breeds in irrigation ditches and rice paddies.

Many workers are not in sympathy with the idea of splitting a species into varieties or races; and there seems to be no definite criterion as to which may be regarded a variety and which a race. Strickland (1924, p. 152) suggests "a standard practice of giving distinct anophelines varietal rank if their larvæ are identical; and specific rank if their larvæ are distinct." Root (1926, p. 688) states: "* * * where well-marked and constant differences existed in larval structure and male genitalia, it was preferred to consider the two forms as distinct species even though no satisfactory characters for the separation of adult females could be presented. Conversely, * * * where male genitalia and larvæ are identical or practically so, I have con-

sidered the small but definite differences in adult markings as deserving only a varietal status." Gater (1934, p. 46) discards the use of "variety" altogether for being a term of too uncertain meaning, and simply places the subspecific designation after the specific name. He defines his stand as: "Categories less than species which are generally accepted as 'varieties' are regarded as subspecies in the sense used by students of mammals and birds." In designating a race or races (which is commonly understood to be of a lesser order than a subspecies) workers in Europe like Roubaud, Martini, de Buck, Swellengrebel, van Thiel, and others, employ a method similar to that of Gater's. It would appear, therefore, that a name written in this way may mean either a variety, subspecies, or race, and thus gives to the three terms an equal significance or standing. This seems to be the view taken by Edwards as may be gathered from the way he designates the races of *maculipennis* in which he inserts the word "var." between the specific and racial names in the same way as he designates subspecies or varieties (1932, p. 39). Misiroli *et al.* (1933) use "var." in some parts and omit it in other places of one and the same article. Hackett uses "race," "variety," and "subspecies" interchangeably (1932, 1934, 1935) and employs "var." like Edwards. In a very interesting article he discusses the difficulties of recognizing races from morphological evidences alone. He thinks *maculipennis* conforms " * * * to the geneticist's definition of a so-called *Rassenkreis* which is a series of typically different forms or subspecies, found at different points within the geographical range of a species. * * * adaptive characters must first appear as chance mutation in the original environment of the species, and not in the surroundings where they are found. They are a prerequisite for the spread of the species into areas from which they were previously excluded. Hence, physiological characters and not visible traits are of primary importance." This has been well demonstrated by the investigations of de Buck, Schoute, and Swellengrebel (1931, 1932, 1934). Their work on cross-breeding (1934) shows the very interesting fact that " * * * the dutch races can be considered as species from a genetic point of view, because they maintain their independent status in nature by their interracial sterility. *Atroparvus*, moreover, has to be

assigned a position quite apart from all known races of *maculipennis* on the strength of its stenogamy (mating in captivity).” Viewed from this angle a “variety” or “race” or “subspecies” becomes much more relative in meaning.

In qualifying varieties or subspecies Sir Christophers (1933) and Barraud (1934) also use “var.” in their latest, and what may be taken as their most modern interpretation of zoölogical nomenclature in relation to mosquitoes. From the standpoint of popularity alone, the use of “var.” is warranted.

While it may be admitted that “matters are made much more difficult for the ordinary field worker in malaria when a species is split into varieties and races,” it is also undeniably true that certain very important phases of malaria control hinge primarily if not entirely on the ability to discriminate one variety from another. It has been shown that certain races of *maculipennis* in Europe are more dangerous than others. *Sinensis* has more than once been considered responsible for malaria outbreaks in certain parts of the world (as listed by Covell, 1927, pp. 35–38; 1931. p. 21.)

I believe that the differences between the local forms of *sinensis* are more than ordinary individual variations, and are sufficiently marked and constant to warrant their separation into distinct varieties. These are not melanotic manifestations either in relation to distance from the equator or to climatic conditions (as the effects of these factors are interpreted by Root, 1926, and Davis, 1928) because the area involved is not extensive, and if climatic conditions are responsible for these variations in the local forms, certainly those from Baguio which is temperate in climate due to altitude, would have exhibited greater differences.

Provisionally I shall assume that our highland variety is identical with the true *A. hyrcanus* var. *sinensis* Wied. This assumption is based on certain similarities between the local highland type and *sinensis* from Hongkong both in the larval and adult stages. I shall propose to erect the local lowland type into a varietal rank for which the name *A. hyrcanus* var. *pseudo-sinensis* is offered. Until more materials are secured from China this arrangement must remain in a temporary nature; there are points of differences in the adults which can be settled only by an examination of a large series from China in comparison with our own.

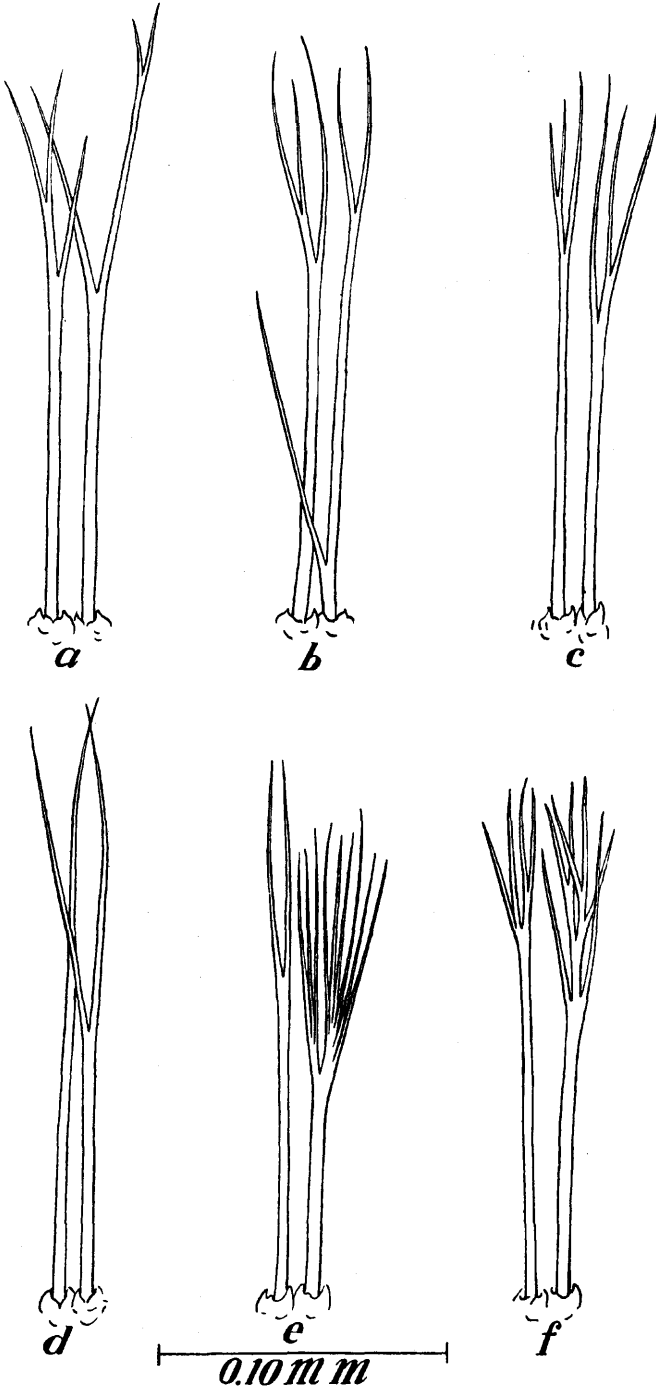
The type specimens of var. *pseudosinensis* are a male (lot F165-4), and a female (lot F165-9) with their corresponding larval and pupal skins. The type locality is Calauan, Laguna Province, island of Luzon; the collector is F. E. Baisas; date of collection was June, 1935. The types together with a number of cotypes and other specimens most of which also have their corresponding larval and pupal skins are now in the collections of the Bureau of Health.³ The breeding place from which the types, cotypes and other specimens were collected is locally known as "tanque" or impounded water. This and a breeding place of *sinensis* in the same locality are pictured in Russell and Baisas (1934 a, plate 3, fig. 1; and plate 2, fig. 3 respectively).

The erection of a new Philippine variety adds one more member to the already many varieties under *hyrcanus* reported from different parts of the world. Sir Christophers lists: *nigerrimus*, *sinensis*, *pseudopictus*, *pictus*, *mesopotamiae*, *mahmouti*, *marsinowskii*, *flerowi*, and *argyropus* as the recognized varieties of *hyrcanus*.

In the larval stage *pseudosinensis* is easily recognized macroscopically for its very light yellowish coloration; *sinensis* is darker and usually bigger. The color is apparent even under the microscope; the head hairs as the post clypeals, inner and outer occipitals, etc., are readily seen in *pseudosinensis* but are difficult to make out in *sinensis* due to the deep pigmentation of the head capsule. Larval casts mounted in 1929 and those mounted lately similarly show this difference in transparency between the two varieties.

The branching of the inner anterior clypeal hairs which I formerly considered (1927) a varietal manifestation of *sinensis*, and subsequently thought of as an abnormality by Laurel (1932) appears to be a normal character of *pseudosinensis*. Very few individuals of this variety have both the inner anterior clypeals simple. The high percent. of larvæ with simple inner clypeals presented in my table of 1931 (p. 440) was due to an indiscriminate mixing of the two varieties. The materials I used in 1929 proved to be mostly *pseudosinensis*. Various types of branchings

³ Pursuant to the request of the Director of the Philippine National Museum and in accordance with the law promulgated by the Government all the types of new species and varieties of both *Culex* and *Anopheles* which I have described and published will be transferred from the Bureau of Health to the National Museum.



TEXT FIGURE 2. Some types of branchings in the inner anterior clypeal hairs of the larva of *A. hyrcanus* var. *pseudosinensis*.

in the inner anterior clypeals have been noted, some of which are shown in text figure 2. The most usual form is merely a splitting of the hair into two towards the apex. The branchings seem to reduce the length of the hair so that the inner clypeals of *pseudosinensis* are comparatively shorter in relation to the outer clypeals than those of *sinensis*. It may be expected that branching in the inner clypeals of *sinensis* also occurs, but not one in my material shows this peculiarity.

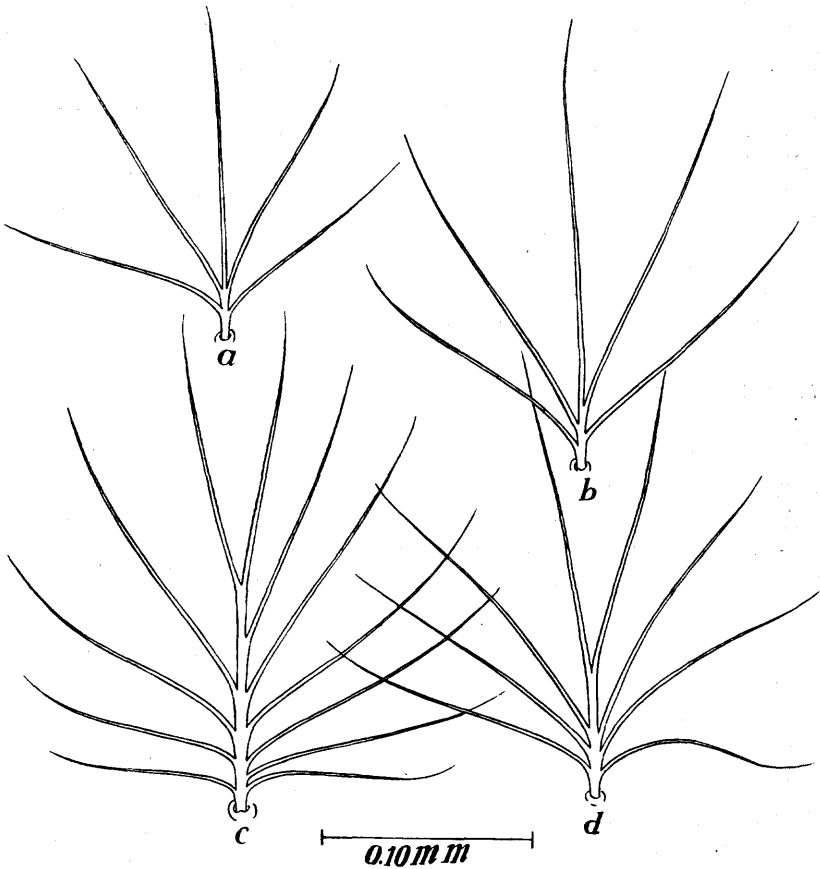
Prothoracic hair No. 13 of *pseudosinensis* is usually longer and possesses more branches than that of *sinensis*. The rachis of this hair is about equal, sometimes even longer than that of the middle anterior submedian thoracic hair; that of *sinensis* is frequently only about one-third. In cases where hair 13 is not of the usual type a combination of characters should be considered in order to make a correct diagnosis. Text figure 3 illustrates the usual and unusual types of hair No. 13.

Lateral hair III tends to have fewer branches in *pseudosinensis* than in *sinensis*; around 13 is the usual number of branches, but ranges from 9 to 17 in the former, and about 18 or 19, but varies from 15 to 23 in the latter.

Pupal differences between the two varieties are marked. Hairs *B* of segments III to VII possess decidedly more branches in *sinensis* where these hairs appear like brushes, than in *pseudosinensis* in which the branches are few and easy to count. The branches of *B-V* vary from about 20 to 37 in *sinensis*, and from 4 to 11 in *pseudosinensis*. *C-VI* and *C-VII* are simple in *pseudosinensis* but are branched up to 6 in *sinensis*. As shown in the table below, some other hairs, like hair 5, tend to have fewer branches in *pseudosinensis* than in *sinensis*. In fact, there are more similarities in hairs between *sinensis* and *nigerrimus* than between *sinensis* and *pseudosinensis*.

The posterior border of the paddle in *sinensis* is more pointed, while its paddle hair has not been found simple; usually this hair is 3- or 4-branched. The paddle of *pseudosinensis* has the posterior border more rounded or else has a small indentation at the point where the paddle hair is located, while its paddle hair is normally simple, sometimes split into 2 or 3.

Of the adult characters only the palpal bands and the hind tarsal rings indicate differences between the two. The palpal white bands are more conspicuous in *sinensis* than in *pseudosinensis*, while the reverse is true with regards to the hind tarsal rings.



TEXT FIGURE 3. Prothoracic hair No. 13 of larvæ. (a) *A. hyrcanus* var. *nigerrimus*; (b) *A. hyrcanus* var. *sinensis* (usual); (c) *A. hyrcanus* var. *pseudosinensis* var. nov. (usual); (d) A form found in unusual cases of either *sinensis* or *pseudosinensis*.

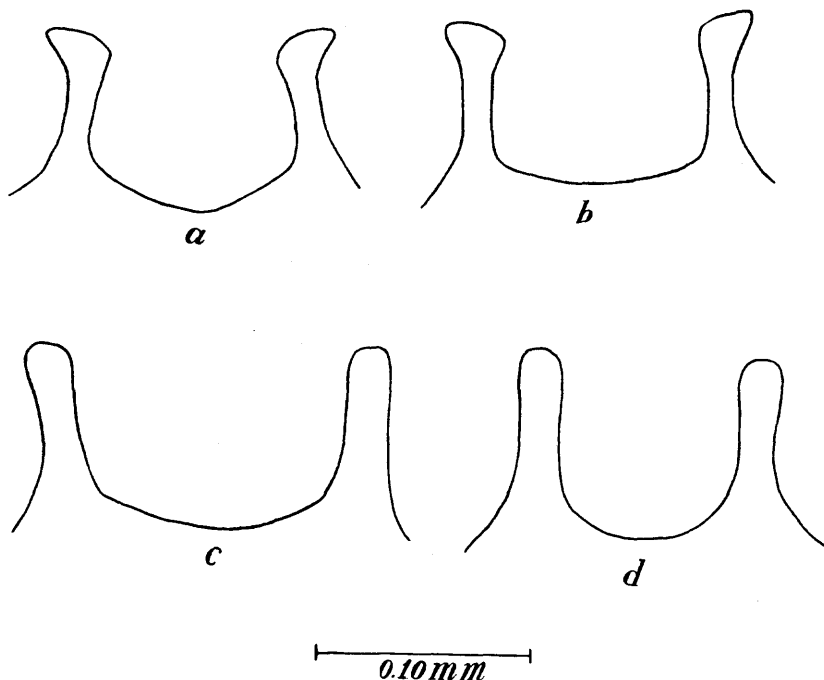
This effect is primarily produced by the wider apical and subapical palpal white bands, and the narrower fourth hind tarsal ring in *sinensis*. The apical and subapical palpal white bands in *sinensis* are usually about twice or more the width of the intervening black band; but a number of those from Baguio has the subapical black about as wide, and sometimes even wider than the white on either side, yet proportionately not as wide as that in *pseudosinensis* in which this is usually twice or thrice the width of the white band on either side. In some abnormal cases where the subapical black in *pseudosinensis* is very narrow or entirely absent only a consideration of the larval and pupal characters will give a satisfactory identification. An easy method of calculating the width of the hind tarsal rings is to

compare them with the last segment. The second and third hind tarsal rings of *pseudosinensis* are about one-third to over one-half the length of the last tarsal segment, while the fourth ring is only a little narrower. In *sinensis* the second and third hind tarsal rings range from about one-fifth to about one-third the length of the last segment, while the fourth hind tarsal ring is much narrower, sometimes hardly visible in some Baguio specimens. In some *pseudosinensis* two or more white scales are present at the base of the last hind tarsus; this has not been found in *sinensis*.

No constant difference has been found in the wing markings. Some individuals of either variety are more dark-winged than others due to the smallness of the pale spots, the entire absence or fewness of the pale scales on the basal half of the wing on the region of the costa, subcosta and vein 1, and the great predominance of dark scales on the stems of veins 2 and 4. The subcostal spot is very variable. In female *sinensis* this is frequently wide, but has not been found extending to the posterior lateral squames of vein 1, and is sometimes confined only to the costa and subcosta. The same is true in some *pseudosinensis* although in others this spot involves the entire width of vein 1, and in rare cases, joins the line of pale median scales this vein possesses under the subcostal region. A few pale scales are sometimes present on the basal third of the costa in *pseudosinensis*, a peculiarity that is usually correlated with the presence of more pale scales than usual on the subcosta, vein 1, and on the stems of veins 2 and 4. The remigium in both varieties is variably marked. Some have more pale scales than black, others have more dark than pale. The pale scales usually occupy the distal half or so of the anterior lateral squames of the remigium, but may be irregularly scattered. In one *sinensis* the remigium is entirely dark-scaled.

The males generally conform to the corresponding females in markings of the hind tarsal segments. Excepting, perhaps, in the shape of the process of segment IX of the male terminalia, there is no significant difference between the genitalic characters of the two. In *sinensis* the apices are more enlarged than those in *pseudosinensis*. The typical forms are shown in text figure 4. The lengths of the phallosomal leaflets do not seem to be influenced by the varying sizes of the males. Large and small individuals have practically the same sized phallosomal leaflets.

Adult *sinensis* from Hongkong are similar to the local *sinensis* in the markings of the female palps and the hind tarsal segments.



TEXT FIGURE 4. Process of segment IX of male terminalia. (a) *hyrcanus* var. *sinensis* (Calauan); (b) *hyrcanus* var. *sinensis* (Baguio); (c) *hyrcanus* var. *sinensis* (Hongkong); (d) *hyrcanus* var. *pseudosinensis* (Calauan).

The wings, however, are very much paler than either of the local forms. The subcostal spot is constantly much wider, and completely involves the entire width of vein 1, aside from joining the pale area this vein has under the subcostal region. Moreover, this pale area covers almost all of the lateral and median squames. Numerous pale scales are also present on the basal half of the subcosta and vein 1, and some on the costa. The stems of veins 2 and 4 are predominantly pale. The remigium is frequently mainly pale, only one or two dark scales being present on the posterior border. Others have more dark scales but not as many as those found in the local forms. The process of segment IX in the male is similar to that of *pseudosinensis*.

VAR. NIGERRIMUS

The pupa of *nigerrimus* is comparatively easy to separate from those of the other varieties. The form of its A-VIII is peculiar in having very few, short sharp-pointed branches which are located laterally towards the base. In a few specimens the spine on one side of segment VIII is absolutely without any

branch. No terminal branch has been found in the many specimens I have on hand, although in some cases the apical portion of the rachis is elongated into a very sharp point like a branch. Sir Christophers (1933, p. 149) states that terminal branches are present in the Indian *nigerrimus*. The number of branches in our *nigerrimus* varies from 1 to 7. *Sinensis* and *pseudosinensis* have more as may be seen in table below.

GROUP NEOCELLIA

Under group Neocellia two natural sub-groups may be distinguished. *A. annularis* and *A. philippinensis*, which are very similar in the larval and pupal stages, form one subgroup; and *A. karwari* and *A. maculatus* which in their turn are alike in many respects during the post imaginal stages, form the other subgroup. The first subdivision is characterized in the pupal stage mainly by the great inequality in lengths of hairs 1-1-II, the external being more than twice the internal; and by the relatively shorter paddle hair. The other subdivision has hairs 1-1-II about equal in lengths, and the paddle hair much longer.

The peculiar white marking the living pupa of *philippinensis* possesses is a macroscopic character that readily segregates it from the pupae of other species with which it is frequently associated. But in pupal casts this species is difficult to separate from *annularis*. The characters employed by Senevet (1931, 1932) in differentiating these two species often do not hold good for the Philippine forms. *C'* of the local *annularis* is not always simple; quite often it is forked. The shape of A-IV in both species is not constant; they are frequently similar to each other. This is illustrated in plate 21, figs. 4, 5, 6, 8, 9, and 10. Generally A-VI and A-VII are longer in *philippinensis* in which they are about one-half the length of segments VII and VIII, respectively, than in *annularis* where these spines are only about one-third the length of the succeeding segments. However, overlapping in this is not uncommon. Again C-VI is usually longer in *philippinensis* than in *annularis*, the tip of that for the former usually extending up to the middle of segment VIII, whereas that for the latter extends up to only about the anterior fourth of that segment; yet some *philippinensis* are also similar to *annularis* in this respect.

In a large series of *philippinensis* collected from "tanque" at Calauan, Laguna, the pupal clypeus is constantly different in shape from that of *annularis*. The term "clypeus" is here used to designate that structure of the cephalothorax which, in the living pupa, covers the clypeus and part of the eyes and head of the adult within. In flat preparations of pupal casts the clypeus can be seen projecting prominently from the middle anterior side of the cephalothorax. It is very much like the human head and neck in outline. In *annularis* the clypeus has a shorter, but well-constricted neck; in *philippinensis* from "tanque" the neck is longer, but imperfectly constricted. (See plate 21). *Philippinensis* from Manila and elsewhere, however, oftentimes has the pupal clypeus very similar to that of *annularis*.

The denticles and hairs of the paddles are useful in differentiating these two species. It may be mentioned in this connection that the denticles and hairs of the paddles of the species under group *Neocellia* are not sharply differentiated. The larger ones may be interpreted either as elongated denticles or enlarged hairs—the change in form from denticles (bases enlarged) to hairs (bases not distinctly enlarged) is so gradual that the demarcation line between them can be assigned only arbitrarily if at all. I find it quite convenient to designate as hairs those that are more transparent, and denticles those that are more pigmented and are therefore more readily seen under low magnifications. By this criterion the division between the two is distinct and unmistakable. The smaller denticles are greater in extent in *philippinensis* where they extend beyond the middle of the external border; than in *annularis* in which these extend up to about the middle of the external border. The larger denticles, however, are coarser, and more widely separated, besides encroaching upon a varying portion of the posterior border in *annularis*; in *philippinensis* these are finer, more closely placed, and do not quite reach the latero-posterior angle of the paddle.

TABULATIONS OF PUPAL CHARACTERS

The following tables show the variations in the different dorsal hairs and spines, and in the indices of the paddles. The indices are computed by dividing the greatest length by the greatest width.

TABLE 1.—Pupal characters of species under *Myzorhynchus* series

Hairs and spines	<i>Barbirostris</i>		<i>Pseudobarbirostris</i>		<i>Galeri</i>		
	Range	Usual	Range	Usual	Range	Usual	
Metathorax.....	R.....	1-3	2	2-4	2	2-4	3
	P.....	2-4	3	2-4	3	4-6	5
	O.....	1-3	2	1-3	2	3-5	3
Abdominal segment I.....	H.....	3-6	5	3-5	4	4-11	7
	K.....	2-6	3	2-3	3	2-5	3
	L.....	3-7	5	4-7	5	4-8	5
	M.....	2-5	4	1-2	2	2-5	3
	S.....	2-6	3	1-3	2	4-6	5
	T.....	1-2	1	1-1	1	2-5	3
	U.....	1-3	1	1-3	1	1-1	1
Abdominal segment II.....	A.....	tiny, blunt		tiny hair		tiny, blunt	
	C.....	3-13	6	3-7	5	4-19	7
	1.....	1-1	1	1-1	1	2-4	3
	2.....	2-5	3	1-3	2	3-7	4
	3.....	3-5	4	1-3	2	2-4	3
	4.....	4-6	4	2-4	3	3-5	4
	5.....	1-2	1	1-3	2	3-5	4
III.....	A.....	4-14	10	3-5	4	9-13	10
	B.....	2-5	2	1-1	1	1-3	1
	C.....	longer, blunt		large, blunt		short, blunt	
	1.....	9-15	12	4-9	7	10-14	12
	2.....	5-14	7	3-9	6	7-16	11
	3.....	1-2	1	1-2	1	2-6	3
	4.....	2-4	3	1-3	2	2-5	3
5.....	3-6	4	2-4	3	5-10	6	
IV.....	A.....	6-9	9	2-4	3	9-15	12
	B.....	2-5	3	1-2	1	1-2	1
	C.....	long, pointed		long, blunt		short, blunt	
	1.....	8-20	13	3-12	5	5-13	12
	2.....	4-14	7	2-7	3	5-11	10
	3.....	1-1	1	1-1	1	1-3	2
	4.....	2-4	3	1-3	2	2-4	3
5.....	4-7	5	2-3	3	6-11	8	
V.....	A.....	3-7	4	2-3	2	11-14	11
	B.....	2-5	3	1-1	1	1-1	1
	C.....	lanceolate		blunt		very blunt	
	1.....	7-15	12	3-9	4	4-8	6
	2.....	3-14	5	2-6	3	2-4	3
	3.....	1-2	1	1-1	1	1-2	2
	4.....	1-4	3	1-2	2	2-4	3
5.....	1-4	3	1-2	1	2-4	3	
VI.....	A.....	3-6	4	2-3	2	10-16	11
	B.....	2-8	3	1-2	1	1-1	1
	C.....	lanceolate		blunt		very blunt	
	1.....	6-14	10	3-11	4	3-6	5
	2.....	2-10	2	1-4	3	1-3	2
	3.....	2-4	3	1-2	1	1-2	1
	4.....	1-2	1	1-1	1	1-2	1
5.....	1-2	2	1-1	1	1-3	2	
VII.....	A.....	3-9	5	2-4	2	6-12	9
	B.....	2-7	3	1-2	1	1-1	1
	C.....	lanceolate		blunt		very blunt	
	1.....	4-10	6	2-9	3	3-7	5
	2.....	1-6	1	1-3	1	1-2	1
	3.....	2-5	4	1-2	1	2-6	4
	4.....	1-2	2	1-1	1	2-3	2
5.....	2-8	4	1-3	2	4-7	5	
VIII.....	A.....	4-7	5	1-3	2	4-11	6
	B.....	2-5	3	1-2	1	1-3	1
	C.....	lanceolat.		blunt		very blunt	
	1.....	9-17	10	14-24	20	12-20	15
	2.....	1-3	2	1-2	2	3-4	3
Paddle.....	A.....	1-2	2	1-2	1	1-1	1
	5.....	1-1	1	1-1	1	5-12	8
Index.....	p.....	1-5	1	1-2	2	3-6	4
	ap.....	1-1	1	1-1	1	3-6	4
		1.25 to	1.3	1.3 to	1.4	1.3 to	1.4

TABLE 1.—Pupal characters of species under *Myzorhynchus* series—Ctd.

Hairs and spines	<i>Nigerrimus</i>		<i>Sinensis</i>		<i>Pseudosinensis</i>		
	Range	Usual	Range	Usual	Range	Usual	
Metathorax	R	2-3	2	2-4	3	1-4	2
	P	2-4	3	3-5	4	2-5	3
	O	1-3	1	3-5	3	2-4	2
Abdominal segment I	H	2-5	3	5-8	5	2-6	5
	K	1-4	3	2-6	3	2-5	2
	L	4-8	5	3-7	5	3-6	5
	M	2-4	2	2-4	3	1-2	1
	S	3-5	5	3-7	4	2-5	3
	T	1-2	1	1-3	2	1-2	1
	U	1-3	2	1-3	1	1-2	1
Abdominal segment II	A	tiny, pointed	5	tiny, blunt	7	tiny, blunt	8
	C	2-10	1	4-12	1	6-13	1
	1	1-2	3	1-2	3	1-2	3
	2	2-3	2	2-4	3	1-5	3
	3	3-5	3	2-5	3	1-3	1
	4	1-2	1	2-6	3	2-4	3
	5	3-7	5	2-4	2	1-4	3
III	A	lanceolate	16	longer, blunt	21	longer, blunt	11
	B	11-26	12	12-31	16	5-14	7
	C	7-17	3	9-20	3	5-14	1
	1	1-5	2	2-5	3	1-2	2
	2	1-4	2	1-4	2	1-3	2
	3	1-3	5	4-7	5	2-5	3
	5	3-7	2	5-10	8	2-3	3
IV	A	lanceolate	18	blunt	25	blunt	13
	B	16-25	9	20-37	10	8-17	7
	C	5-14	1	9-19	2	4-11	1
	1	1-4	2	1-2	3	1-1	2
	2	1-3	4	1-4	5	1-3	3
	3	3-5	4	3-6	6	1-4	2
	5	3-5	3	4-8	3	1-2	2
V	A	lanceolate	18	blunt	25	blunt	6
	B	10-23	3	20-37	8	4-11	1
	C	1-5	1	3-12	1	1-2	1
	1	1-2	3	1-2	3	1-1	2
	2	1-5	3	2-5	3	1-3	1
	3	2-4	4	1-4	2	1-2	1
	5	3-5	4	4-7	5	1-2	1
VI	A	lanceolate	12	blunt	14	blunt	4
	B	6-16	1	11-32	3	1-8	1
	C	1-3	1	2-6	1	1-1	1
	1	1-2	1	1-3	1	1-2	1
	2	1-1	2	1-2	1	1-1	1
	4	1-2	4	1-2	5	1-1	1
	5	2-4	3	3-6	3	1-2	1
VII	A	lanceolate	7	blunt	5	blunt	1
	B	3-9	1	3-14	3	1-3	1
	C	1-2	2	2-5	2	1-1	1
	1	1-2	2	1-3	1	1-1	1
	2	1-2	2	1-2	1	1-1	1
	3	1-3	2	1-4	2	1-3	1
	5	2-3	2	2-6	4	1-2	1
VIII	A	0-7	4	11-25	17	8-17	12
	A'	2-3	2	1-3	2	1-1	1
	5	1-3	2	1-3	2	1-2	1
Paddle	p	1-2	1	2-5	3	1-2	1
	ap	1-2	1	1-3	2	1-2	1
Index	1.25 to	1.3	1.3 to	1.4	1.3 to	1.4	

TABLE 2.—Pupal characters of species under Group *Neocellia*

Spines and hairs	<i>Annularis</i>		<i>Philippinensis</i>		<i>Karwari</i>		<i>Maculatas</i>		
	Range	Usual	Range	Usual	Range	Usual	Range	Usual	
Metathorax.....	R.....	2-4	3	3-5	4	1-4	3	1-4	4
	P.....	2-4	3	2-5	4	1-3	2	3-4	3
	O.....	1-2	1	1-2	1	1-3	2	1-2	1
Abdominal segment I.....	H.....	1-1	1	1-1	1	1-1	1	1-1	1
	K.....	3-6	5	3-7	5	3-5	4	4-9	7
	L.....	3-6	5	3-7	5	3-5	4	5-6	5
	M.....	1-3	2	1-3	2	2-5	4	3-4	3
	S.....	3-6	4	4-6	5	2-5	4	4-7	5
	T.....	2-3	2	1-2	2	2-3	3	2-3	2
U.....	2-4	2	1-3	2	1-1	1	1-1	1	
II.....	A.....	tiny, blunt		tiny, blunt		tiny, blunt		tiny, blunt	
	C.....	4-7	5	4-7	5	7-14	11	6-7	6
	1.....	1-3	2	1-2	1	2-4	3	3-4	4
	2.....	3-5	4	4-6	5	2-4	4	4-7	7
	3.....	2-4	3	2-3	3	2-5	3	3-5	5
	5.....	4-7	6	4-7	5	3-6	5	3-5	3
III.....	A.....	longer, blunt		longer, blunt		tiny, blunt		tiny, blunt	
	B.....	4-7	6	5-8	7	4-7	5	5-8	6
	C.....	4-7	5	3-7	5	3-8	5	6-8	6
	1.....	3-5	4	2-4	3	3-3	3	6-8	6
	2.....	2-6	4	3-6	5	4-6	4	4-5	4
	5.....	1-4	2	2-3	3	1-4	2	2-5	4
IV.....	A.....	pointed		pointed		tiny, blunt		longer, blunt	
	B.....	4-5	5	4-7	5	3-5	3	5-7	6
	C.....	4-5	4	2-7	3	2-5	3	4-5	5
	1.....	2-3	2	2-4	3	1-2	1	3-4	3
	2.....	2-4	3	2-4	3	2-5	4	3-6	3
	5.....	4-7	5	2-5	4	3-5	4	4-7	7
V.....	A.....	long, pointed		long, pointed		long, pointed		long, pointed	
	B.....	2-4	3	2-4	3	1-3	2	4-6	5
	C.....	1-2	1	1-1	1	1-1	1	1-1	1
	1.....	2-3	2	1-3	2	1-3	1	2-3	3
	2.....	2-4	3	2-5	3	1-3	2	3-5	4
	5.....	1-3	2	1-3	2	1-3	2	3-5	3
VI.....	A.....	long, pointed		long, pointed		long, pointed		long, pointed	
	B.....	3-4	3	3-5	3	1-2	1	4-5	4
	C.....	1-1	1	1-1	1	1-1	1	1-1	1
	1.....	1-2	1	2-3	3	1-3	2	2-3	2
	2.....	2-3	2	2-3	2	1-3	1	2-3	2
	5.....	2-3	2	2-3	2	1-2	1	2-3	2
VII.....	A.....	long, pointed		long, pointed		long, pointed		long, pointed	
	B.....	2-4	3	2-5	3	1-2	1	2-5	5
	C.....	1-1	1	1-1	1	1-2	1	1-1	1
	1.....	1-3	2	1-2	2	1-3	1	1-3	1
	2.....	1-3	2	1-3	2	1-2	1	1-2	2
	5.....	1-4	3	2-3	3	1-3	2	1-3	2
VIII.....	A.....	6-14	11	7-23	13	7-16	12	13-16	16
	A'.....	2-4	3	2-3	3	1-3	1	2-2	2
	5.....	1-1	1	1-1	1	1-1	1	1-1	1
Paddle.....	p.....	1-1	1	1-1	1	1-1	1	1-1	1
ap.....	2-4	2	1-3	2	1-3	2	2-3	2	
Index.....	1.3 to 1.5		1.4 to 1.5		1.5 to 1.6		1.4 to 1.5		

SUMMARY, CONCLUSION AND SYNOPTIC KEYS

Pupal characters of the species under the *Myzorhynchus* series and group *Neocellia*, with additional comments on the larvæ and adults of *sinensis*, are given.

It is shown that what was previously known locally as *sinensis* is composed of two varieties. One is provisionally considered identical with *hyrcanus* var. *sinensis* Wied., and the other is erected into a varietal rank for which the name *A. hyrcanus* var. *pseudosinensis* is proposed. Differentiation of these two forms in the larval, pupal and adult stages are discussed.

For the rapid determination of the pupæ under the *Myzorhynchus* series and group *Neocellia*, the following keys are offered:

Synoptic key to pupæ under the Myzorhynchus series

1. Respiratory trumpet with wide, irregular, but not "S"-shaped opening; lateral sides not compressed or bent inwardly; apical notch shallow or imperfectly defined 2.
Respiratory trumpet with narrow, "S"-shaped opening; lateral sides compressed, the rims turned inwardly; apical notch deep..... 3.
2. Lateral notch pronounced; flap long, its end fairly straight. Spines very short, and stout, very blunt; A-VII only about twice as long as A-II. C' distinctly longer than C-VI. 4-V with 10 or more branches.
..... *gateri*.
Lateral notch shallow or absent; flap short, round-ended; spines longer, less stout, less blunt; A-VII about four times as long as A-II. C' shorter than, or only about as long as C-VI. 4-V with less than 8 branches 4.
3. Fold of apical notch large; A-II represented by a small normal hair; A-VIII usually with more than 15 branches..... *pseudobarbistrotris*.
Fold of apical notch very small; A-II a normal, blunt, but tiny spine; A-VIII usually with less than 15 branches..... *barbistrotris*.
4. A-VIII with lateral but no terminal branches; branches short, less than 8. Denticles coarse, involve part of posterior border of the paddle.
..... *hyrcanus* var. *nigerrimus*.
A-VIII with both lateral and terminal branches; branches long, more than 8. Denticles finer, involve one-half to two-thirds of the external, but not any part of the posterior border of paddle..... 5.
5. B-V branched from 20 to about 37; C-VI 3- to 6-branched. Posterior border of paddle pointed; paddle hair branched up to 5.
..... *hyrcanus* var. *sinensis*.
B-V branched from 4 to 11; C-VI simple. Posterior border of paddle rounded or else with a small indentation at the point where the paddle hair is located; paddle hair normally simple, sometimes split into 2 or 3..... *hyrcanus* var. *pseudosinensis*.

Synoptic key to pupæ under group Neocellia

1. External hair 1 of segment II only a little longer than the internal.
A-III rudimentary, about one-sixth the length of A-V. Paddle hair over one-half the length of paddle..... 2.
External hair 1 of segment II more than twice the length of the internal.
A-III more developed, about one-fourth the length of A-V. Paddle hair about half or less the length of the paddle..... 3.
2. A-IV also rudimentary like A-III. B-V simple or branched up to 3.
..... *karwari*.
A-IV developed; over four times as long as A-III. B-V 4- or 5-branched
..... *maculatus*.
3. Denticles of paddle extend beyond latero-posterior angle. A-VI and A-VII usually about one-third the length of segments VII and VIII respectively. C-VI normally extends up to anterior fourth of segment VIII *annularis*.
Denticles of paddle do not extend to latero-posterior angle. A-VI and A-VII longer, about one-half the length of VII and VIII respectively. C-VI normally extends to middle of VIII..... *philippinensis*.

REFERENCES

1. BAISAS, F. E.
Preliminary differential characters of Philippine anopheline mosquito larvæ. Mon. Bull. Phil. Health Service 7 (1927) 267-280.
a. The barbirostris-hyrcanus group of Philippine Anopheles. Phil. Journ. Sci. 44 (1931) 425-448.
b. The morphology of some Philippine Anopheles. Rev. Filip. de Med. y Farm. 22 (1931) 189-196.
Notes on Philippine Mosquitoes, IV. On the pupal, and certain adult characters of some rare species of Anopheles. Phil. Jour. Sci. (in press, submitted for publication July, 1935).
2. BARRAUD, P. J.
Diptera. Family Culicidae. Tribe Megarhinini and Culicini. Fauna of British India 5 (1934) 1-463.
3. COVELL, G.
A critical review of the data recorded regarding the transmission of malaria by different species of Anopheles, with notes on distribution, habitats and breeding places. Ind. Jour. Med. Res. Mem. No. 7 (1927) 35-38.
The present status of our knowledge regarding the transmission of malaria by the different species of Anopheles mosquitoes. Rec. Mal. Surv. Ind. 2 (1931) 21.
4. CHRISTOPHERS, SIR S. R.
Studies on the anopheline fauna of India. Rec. Mal. Surv. Ind. 2 (1931) 305-332.
Diptera. Family Culicidae. Tribe Anophelini. Fauna of British India. 4 (1933) 1-371.
5. DAVIS, N. C.
A consideration of the variability of the Nyssorhynchus group of the genus Anopheles. Am. Jour. Hyg. 8 (1928) 539-563.

6. DE BUCK, A., E. SCHOUTE, and N. H. SWELLENGREBEL.
 Studien uber anophelismus ohne malaria in der Umgebung Amsterdams. Zentr. f. Bakt. I. Or. 109 (1928) 251-284.
 Further investigations on the racial differentiation of *A. maculipennis* in Netherlands and its bearing on malaria. Riv. di Malar. 11 (1931) 137-156.
 Crossbreeding experiments with dutch and foreign races of *A. maculipennis*. Riv. di Malar. 13 (1934) 237-263.
7. DE BUCK, A. and N. H. SWELLENGREBEL.
 On anophelism without malaria in Amsterdam, IV. The pattern on the dorsal surface of the ova of two races of *A. maculipennis*. Proc. Roy. Acad. of Sci. in Ams. 35 (1932) 335-339.
 Behaviour of dutch *Anopheles atroparvus* and *messeeae* in winter under artificial conditions. Riv. di Malar. 13 (1934) 406-413.
8. DE BUCK, A., G. v. d. TORREN, and N. H. SWELLENGREBEL.
 Report for the year 1932 on investigations in the racial composition of *Anopheles maculipennis* in Holland. Riv. di Malar. 12 (1933) 266-280.
9. DE MURO, P.
 Sulle diverse razze di *A. maculipennis* nell'Agro Pontino. Riv. di Malar. 12 (1933) 98-107.
10. EDWARDS, F. W.
 Mosquito Notes VI. Bull. Ent. Res. 17 (1924) 124.
 Mosquito Notes VIII. Bull. Ent. Res. 20 (1929) 323-324.
 Diptera. Family Culicidae. Genera Insectorum (1932) 1-257.
11. EJERCITO, A.
Anopheles maculatus Theo. another vector of malaria in the Philippines. Jour. Phil. Is. Med. Assoc. 14 (1934) 342-346.
12. GATER, B. A. R.
 On *Anopheles baezai* n. sp. from Malay Peninsula. Bull. Raffl. Mus. Singapore, Straits Settlement No. 8 (1933) 162-168.
13. KING, W. V.
 The Philippine varieties of *A. gigas* and *A. lindesayi*. Phil. Jour. Sci. 46 (1931) 751-757.
14. KIRKPATRICK, F. W.
 The Mosquitoes of Egypt. (1925) 33.
15. KOIDZUMI, M. and K. MORISHITA.
 The identification of the Formosan anophelines. Jour. Med. Assoc. of Formosa. 31 (1932) 28-29.
16. HACKETT, L. W.
 The present status of our knowledge of the subspecies of *A. maculipennis*. Trans. Roy. Soc. Trop. Med. and Hyg. 28 (1934) 109-140.
- 16(a) HACKETT, L. W., and A. MISSIROLI.
 The varieties of *A. maculipennis* and their relation to the distribution of malaria in Europe. Riv. di Malar. 14 (1935) 1-67.
17. HACKETT, L. W., E. MARTINI, and A. MISSIROLI.
 The races of *A. maculipennis*. Am. Jour. Hyg. 16 (1932) 137-162.
18. LAMBORN, W. A.
 The bionomics of some Malayan *Anopheles*. Bull. Ent. Res. 13 (1932) 131-133.

19. LAUREL, A. G.
Notes on abnormalities of some Anopheles. Mon. Bull. Phil. Health Service. 12 (1932) 689-695.
20. LI, FENG-SWEN and SHIH-CHENG WU.
The classification of mature Chinese anopheline mosquitoes. Reprint from Ent. & Phytoph. 2 (1934) 13-15.
21. MARTINI, E.
(a) Über einige für das System bedeutungsvolle der stechmücken. Zool. Jahrb. f. Sys. 46 (1923) 517-590.
(b) Lehrbuch der medizinischen Entomologie. (1932) 298-304.
22. MISSIROLI, A., L. W. HACKETT, and E. MARTINI.
Le razze di *A. maculipennis* e la loro importanza nella distribuzione della malaria in alcune regioni d'Europa. Riv. di Malar. 12 (1933) 1-56.
23. MORIN, H. G. S.
Sur la présence de *A. (Myzomyia) kawari* en Conchinchine. Bull. Soc. Path. Exot. 22 (1929) 253.
24. MORIN, H. G. S. and C. TÓUMANOFF.
Sur le rôle de *A. maculatus* Theo. dans la transmission du paludisme au Tonkin. Bull. Soc. Path. Exot. 26 (1933) 83-92.
25. MORISHITA, K.
Comparison of Formosan anophelines with related forms from India and Malaya with regard to the problem of their identification. Jour. Med. Assoc. of Formosa 31 (1932) 20.
26. NURSING, D., B. A. RAO and W. C. SWEET.
Notes on malaria in Mysore State. Part VII. The anopheline transmitters of malaria. Rec. Mal. Surv. Ind. 4 (1934) 243-251.
27. ROOT, F. M.
Further notes on the male genitalia of American Anopheles. Am. Jour. Hyg. 4 (1924) 456-465.
Studies on Brazilian mosquitoes, I. The Anopheles of the Nyssorhynchus group. Am. Jour. Hyg. 6 (1926) 684-717.
Studies on Brazilian mosquitoes, IV. Notes on the Brazilian species of Anopheles. Am. Jour. Hyg. 7 (1927) 599-605.
28. ROUBAUD, E.
Nouvelle contribution à l'étude du zootropisme anophéliens *A. maculipennis*. Bull. Soc. Path. Exot. 24 (1931) 229-246.
Recherches sur les variations trophiques et biologiques des peuplements de l'anopheles *maculipennis*. Bull. Soc. Path. Exot. 25 (1932) 755-762.
Un type racial nouveau de l'anopheles *maculipennis*. Bull. Soc. Path. Exot. 27 (1934) 737-740.
Variété nouvelle de l'anopheles *maculipennis* au Maroc, *A. maculipennis sicaulti* (n. var.) Bull. Soc. Path. Exot. 28 (1935) 107-111.
29. ROUBAUD, E. ET H. GASCHEN.
Insuffisance de caractères de l'oeuf pour la distinction des races trophiques et biologiques de l'anopheles *maculipennis*. Bull. Soc. Path. Exot. 26 (1933) 447-452.

30. RUSSELL, P. F.
Malaria and Culicidae in the Philippine Islands: history and critical bibliography, 1898-1933. Manila, Bur. of Print. (1934) 1-115.
31. RUSSELL, P. F. and F. E. BAISAS.
(a) Habitats of Philippine Anopheles larvae. Phil. Jour. Sci. 55 (1934) 297-306.
(b) A practical illustrated key to larvae of Philippine Anopheles. Phil. Jour. Sci. 55 (1934) 307-325.
A practical illustrated key to adults of Philippine Anopheles. Phil. Jour. Sci. (in press).
32. SENEVET, G.
Contribution a l'etude des nymphes de culicides. Description de celles de certains anophelines et plus specialement des especes europeennes et mediterraneennes. 2e. Cong. Inst. du Palud. I (1930) 69-154.
Contribution a l'etude des nymphes d'Anophelines. 2e. Mem. Arch. Inst. Past. d'Alg. 9 (1931) 17-112.
Contribution a l'etude des nymphes d'Anophelines. 3e. Mem. Arch. Inst. Past. d'Alg. 10 (1932) 204-254.
33. SHANNON, R. C.
Observations on the Anophelini (Culicidae) of Bahia, Brazil. Ann. Ent. Soc. Am. 23 (1930) 467-505.
34. STRICKLAND, C.
The anophelines funestus, minimus, and aconitus including a description of the larva of minimus. Ind. Jour. Med. Res. 12 (1924) 145-167.
The mosquito factor in the malaria of Assam Tea Gardens. Ind. Med. Gaz. 40 (1925) reprint pp. 7-10.
35. TOUMANOFF, C.
Recherches sur la transmission du paludisme au Tonkin. Arch. Inst. Past. d'Indochine. April (1933) 1-46.
Recherches sur la frequence saisonniere de diverse espece anopheliennes au Tonkin (Basin du Fleuve-Rouge) 3e. Note: A. (Neocellia) maculatus (Theo.) Bull. Soc. Path. Exot. 26 (1933) 1020-1022.
Recherches sur la frequence saisonniere de diverse especes anopheliennes au Tonkin. 4e. Note: A. (Neocellia) fuliginosus Giles, A. (Neocellia) maculipennis Ludl. Bull. Soc. Path. Exot. 26 (1933) 1167-1171.
Etude de l'indice maxillaire de Roubaud en tant que methode pratique d'investigation sur les aptitudes trophiques des especes anopheliennes d'extrema-orient. Trans. 9th. Cong. Far. East. Assoc. Trop. Med. Nanking. 2 (1934) 37-51.
36. VAN THIEL, P. H.
Sur l'origine des variations de taille de l'anopheles maculipennis dans les Pays-Bas. Bull. Soc. Path. Exot. 20 (1927) 366-390.
Investigations on the range and differentiation of A. maculipennis races and their bearing on the existence or absence of malaria in Italy. Riv. di Malar. 10 (1933) 281-318.

ILLUSTRATIONS

- PLATE 1. *A. barbirostris*. 1. Respiratory trumpet. 2. Paddle and part of segment VIII. *A*—spine; *A'*—accessory hair of spine; 5—small dorsal hair.
- PLATE 2. *A. barbirostris*. Parts of metathorax and abdominal segments I, II, and VI. *R*, *P*, and *O*—hairs of metathorax. *H*, *K*, *L*, *M*, *S*, *T* and *U*—hairs of segment I. *A*—spine; *B*, 1-1, 2-2, 4, and 5 dorsal hairs of segment II. *A*—spine; *B*, *C*, *C'*, 1, 2, 4, and 5 dorsal hairs of segment VI.
- PLATE 3. *A. gateri*. 1. Respiratory trumpet. 2. Paddle and part of segment VIII.
- PLATE 4. *A. gateri*. Parts of metathorax and abdominal segments I, II, and VI.
- PLATE 5. *A. hyrcanus* var. *nigerrimus*. 1. Respiratory trumpet. 2. Paddle and part of segment VIII.
- PLATE 6. *A. hyrcanus* var. *nigerrimus*. Parts of metathorax and abdominal segments I, II, and VI.
- PLATE 7. *A. hyrcanus* var. *sinensis*. 1. Respiratory trumpet. 2. Paddle and part of segment VIII.
- PLATE 8. *A. hyrcanus* var. *sinensis*. Parts of metathorax and abdominal segments I, II, and VI.
- PLATE 9. *A. hyrcanus* var. *pseudosinensis* var. nov. 1. Respiratory trumpet. 2. Paddle and part of segment VIII.
- PLATE 10. *A. hyrcanus* var. *pseudosinensis* var. nov. Parts of metathorax and abdominal segments, I, II, and VI.
- PLATE 11. *A. pseudobarbirostris*. 1 & 2. Respiratory trumpets. 3. Paddle and part of segment VIII.
- PLATE 12. *A. pseudobarbirostris*. Parts of metathorax and abdominal segments I, II, and VI.
- PLATE 13. *A. annularis*. 1. Respiratory trumpet. 2. Paddle and part of segment VIII.
- PLATE 14. *A. annularis*. Parts of metathorax and segments I, II, and VI.
- PLATE 15. *A. philippinensis*. 1. Respiratory trumpet. 2. Paddle and part of segment VIII.
- PLATE 16. *A. philippinensis*. Parts of metathorax and segments I, II, and VI.
- PLATE 17. *A. karwari*. 1. Respiratory trumpet. 2. Paddle and part of segment VIII.
- PLATE 18. *A. karwari*. Parts of metathorax and segments I, II, and VI.
- PLATE 19. *A. maculatus*. 1. Respiratory trumpet. 2. Paddle and part of segment VIII.
- PLATE 20. *A. maculatus*. Parts of metathorax and abdominal segments I, II, and VI.

PLATE 21. *Clypeus and Spines*.—1 and 3 clypeus of *A. annularis*. 2, 7, and 11 clypeus of *A. philippinensis*. 4, 6 and 9 various types of spines on abdominal segment IV of *A. annularis*. 5, 8, 10 and 12 various types of spines on abdominal segment IV of *A. philippinensis*.

PLATE 22. Spines on Abdominal Segments II to V. 1. *A. maculatus*. 2. *A. karwari*. 3. *A. annularis*. 4. *A. philippinensis*.

PLATE 23. Spines on Abdominal Segments II, III, V, and VIII. 1. *A. gateri*. 2. *A. barbirostris*. 3, and 6. *A. hyrcanus* var. *sinensis*. 4, and 7. *A. hyrcanus* var. *nigerrimus*. 5. *A. pseudobarbirostris*.

TEXT FIGURE 1. Respiratory trumpets. *A*—*A. barbirostris*; *B*—*A. pseudo-barbirostris* (top view); *C*—*A. gateri*; *D*—*A. hyrcanus* var. *sinensis*.

Labels: *a*—apical notch; *b*—fold of apical notch; *c*—basal notch; *d*—lateral notch; *e*—flap.

TEXT FIGURE 2. Some types of branchings found in inner anterior clypeal hairs of the larvæ of *A. hyrcanus* var. *pseudosinensis* var. nov. *a*, *b*, *c*, and *d* from Burabod, Daet, Camarines Norte. *e* and *f* from Calauan, Laguna.

TEXT FIGURE 3. Prothoracic hair No. 13 of the larvæ.

a—*A. hyrcanus* var. *nigerrimus* (Note the lesser expanse despite the fact that *nigerrimus* is normally bigger than the other varieties).

b—*A. hyrcanus* var. *sinensis* (usual type).

c—*A. hyrcanus* var. *pseudosinensis* var. nov. (usual type).

d—An unusual type that may be found in either *sinensis* or *pseudosinensis*.

TEXT FIGURE 4. Process of segment IX of male terminalia.

a—*A. hyrcanus* var. *sinensis* (from Calauan; lowland).

b—*A. hyrcanus* var. *sinensis* (from Baguio; highland).

c—*A. hyrcanus* var. *sinensis* (from Hong Kong).

d—*A. hyrcanus* var. *pseudosinensis* var. nov. (from Calauan).

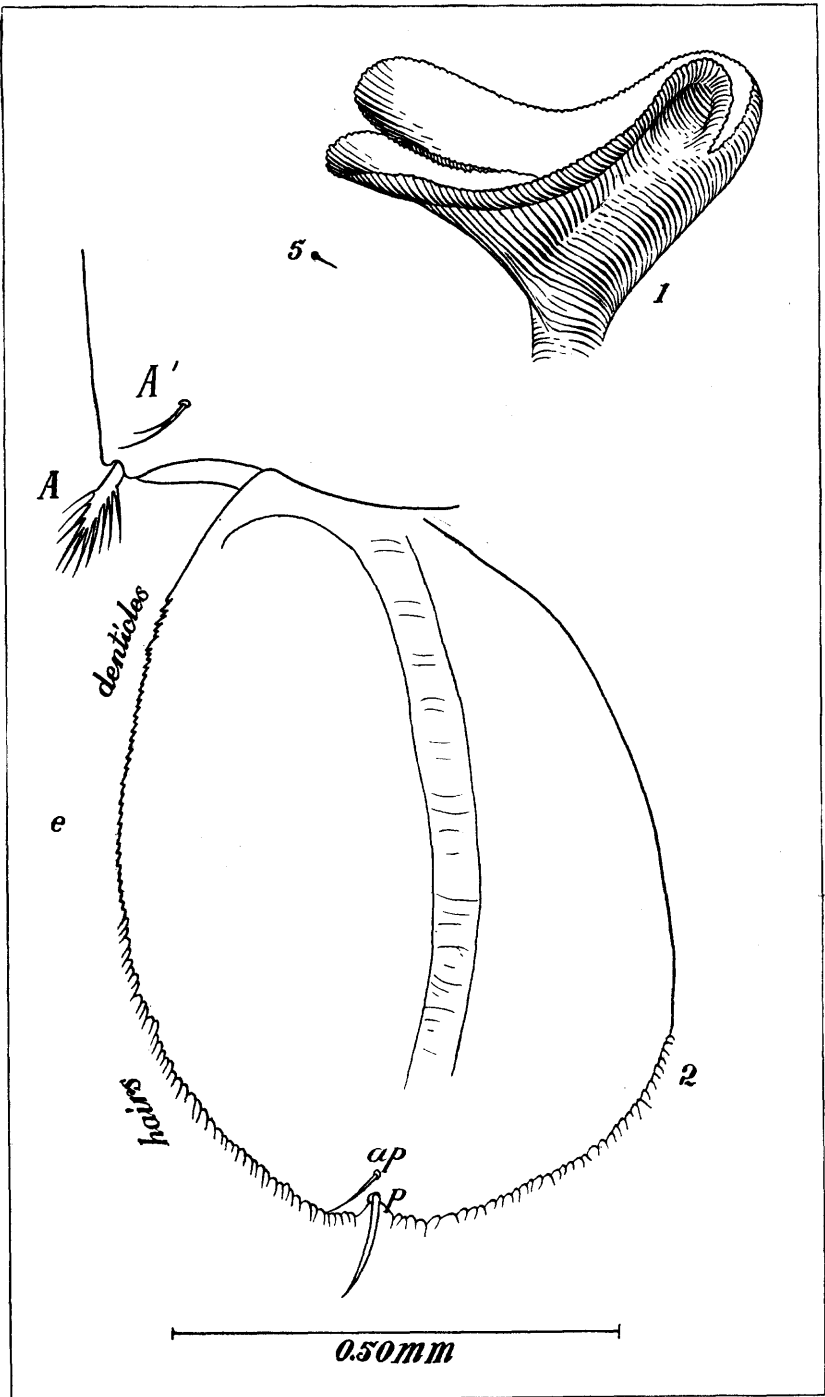


PLATE 1. A. BARBIROSTRIS

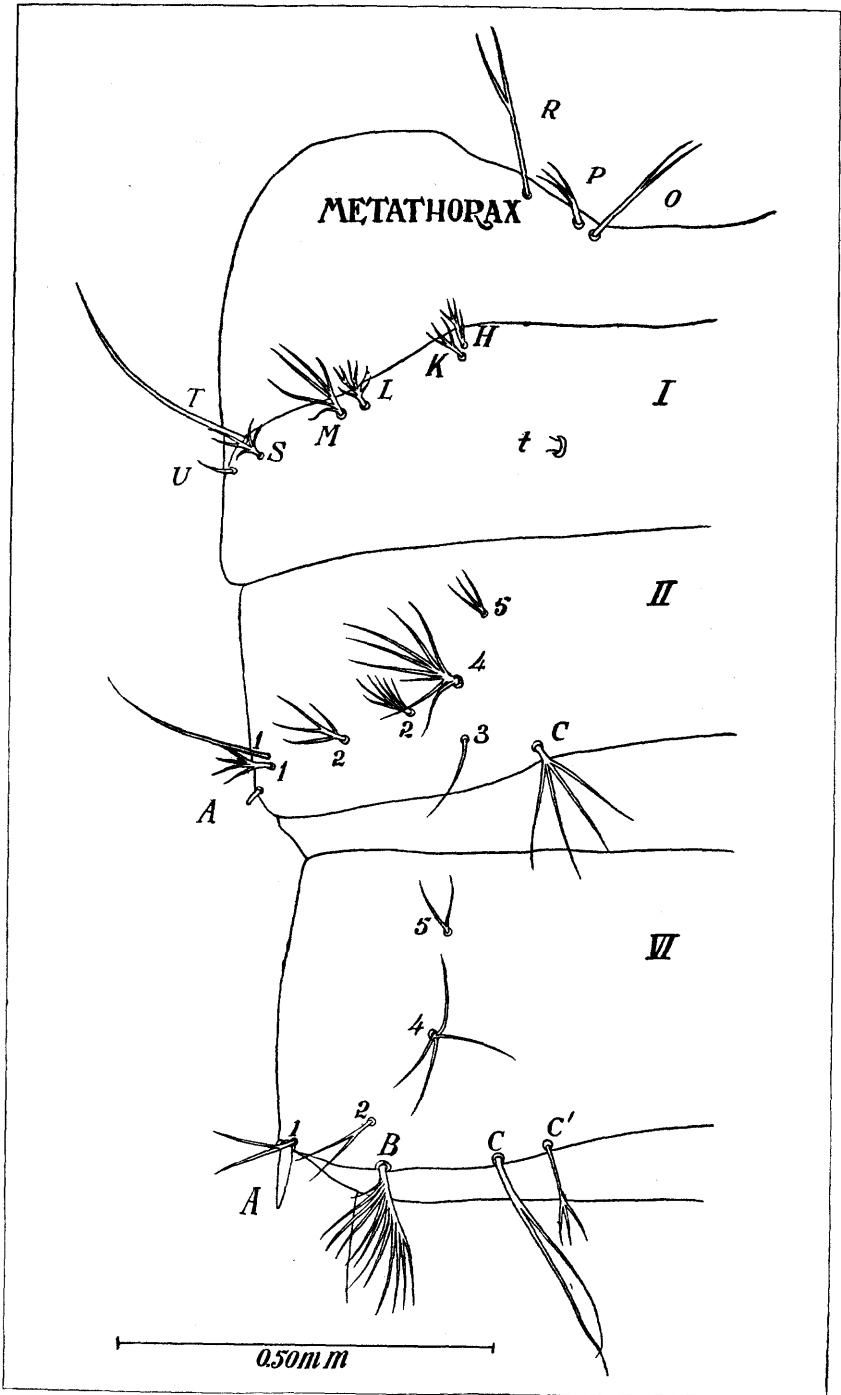


PLATE 2. A. BARBIROSTRIS

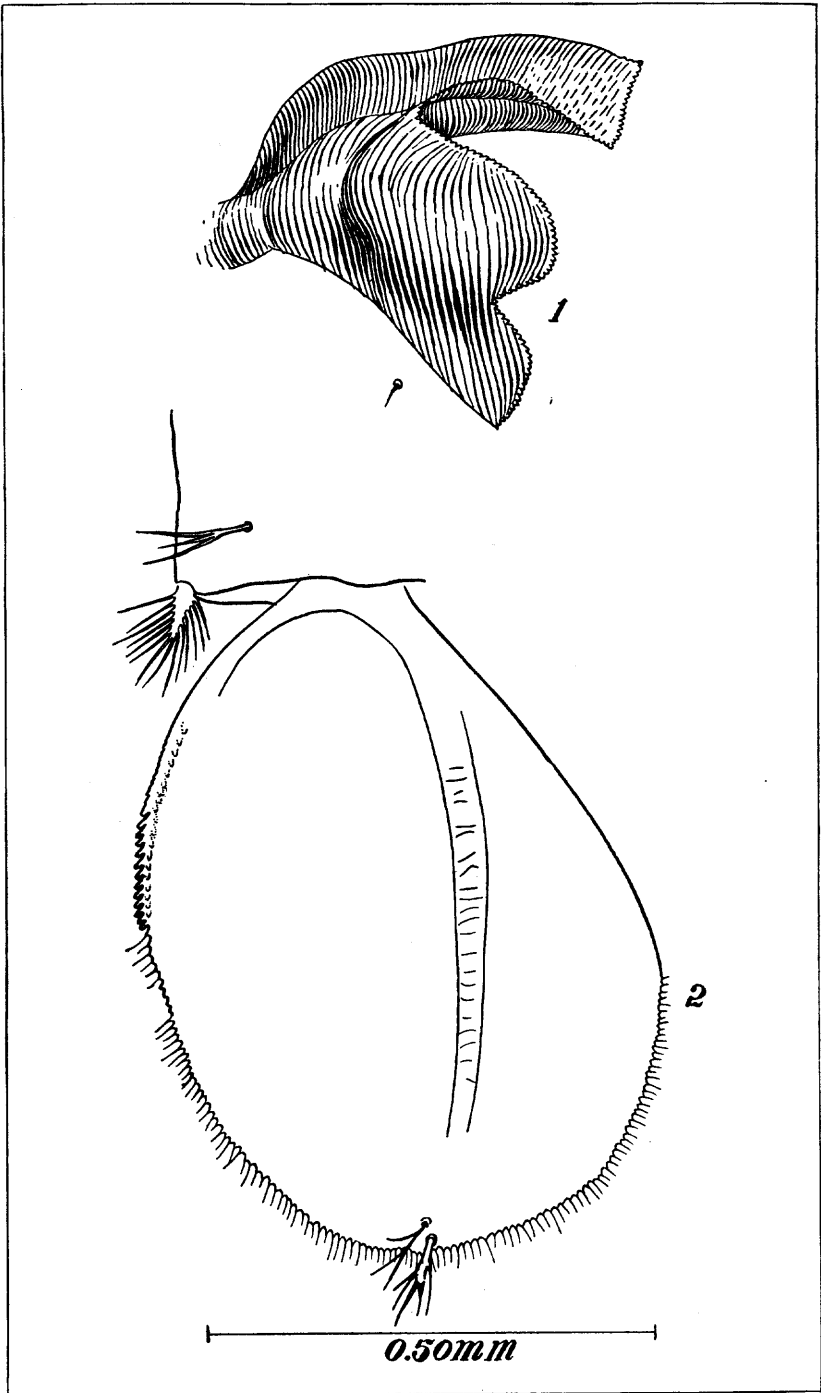


PLATE 3. A. GATERI

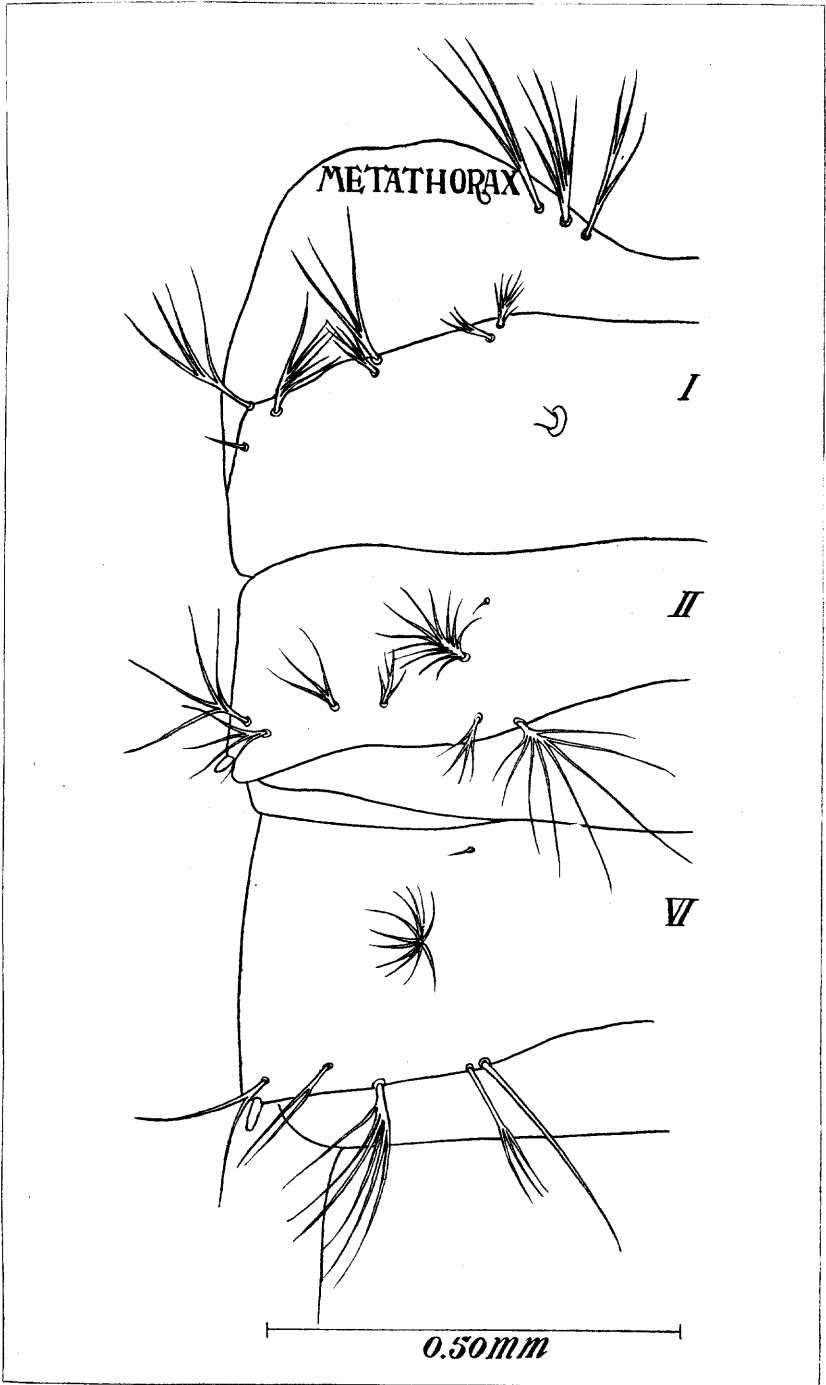


PLATE 4. A. GATERI

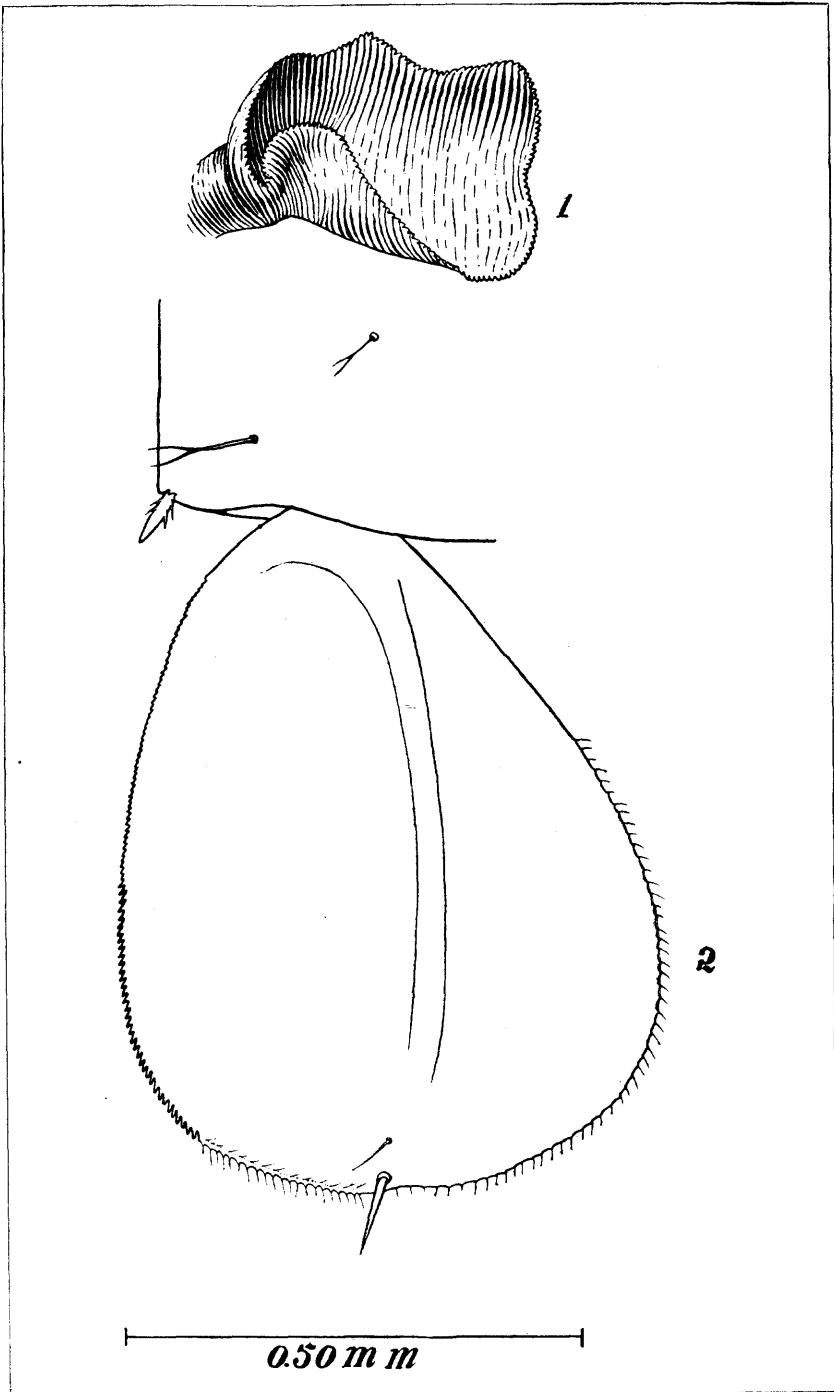


PLATE 5. A. HYRCANUS VAR. NIGERRIMUS

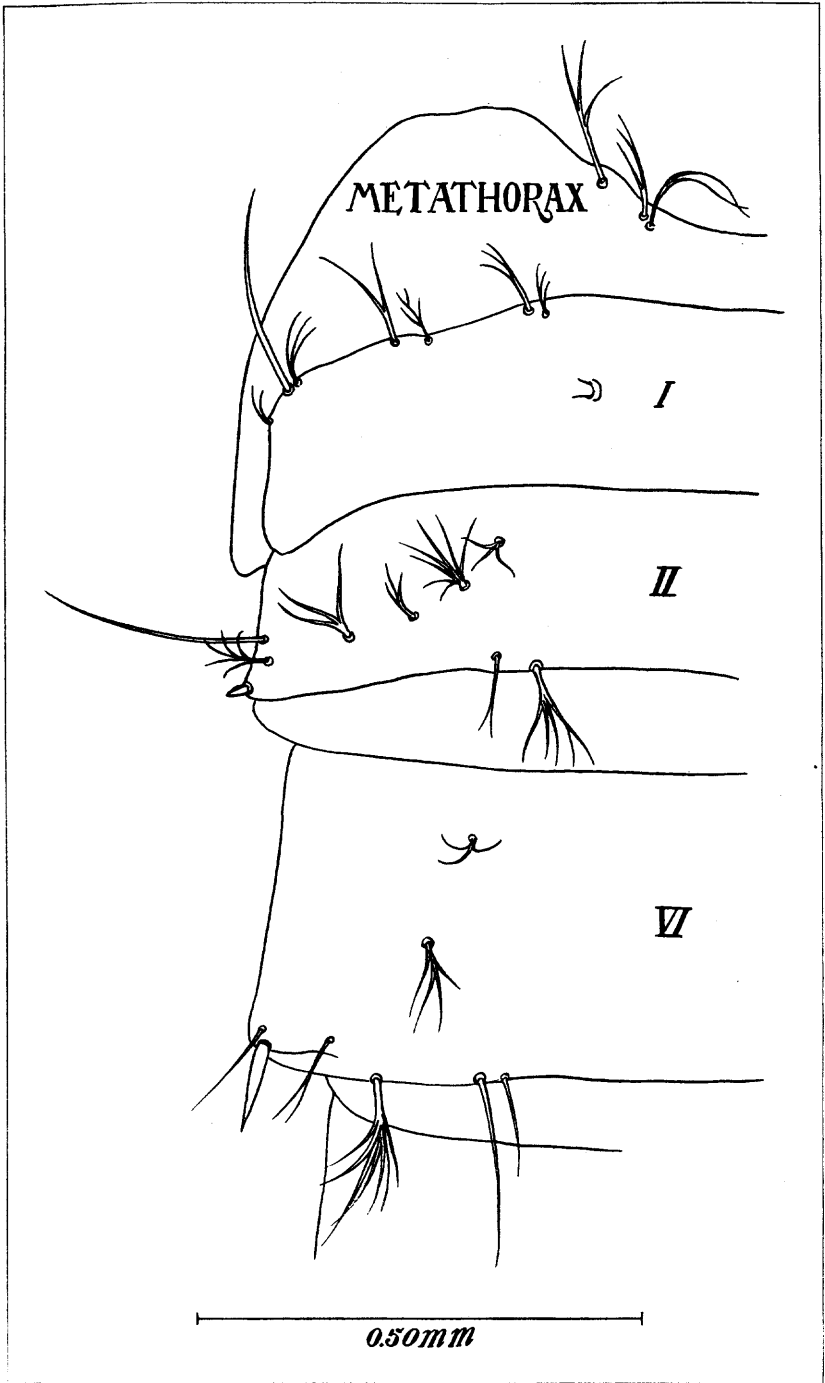


PLATE 6. A. HYRCANUS VAR. NIGERRIMUS

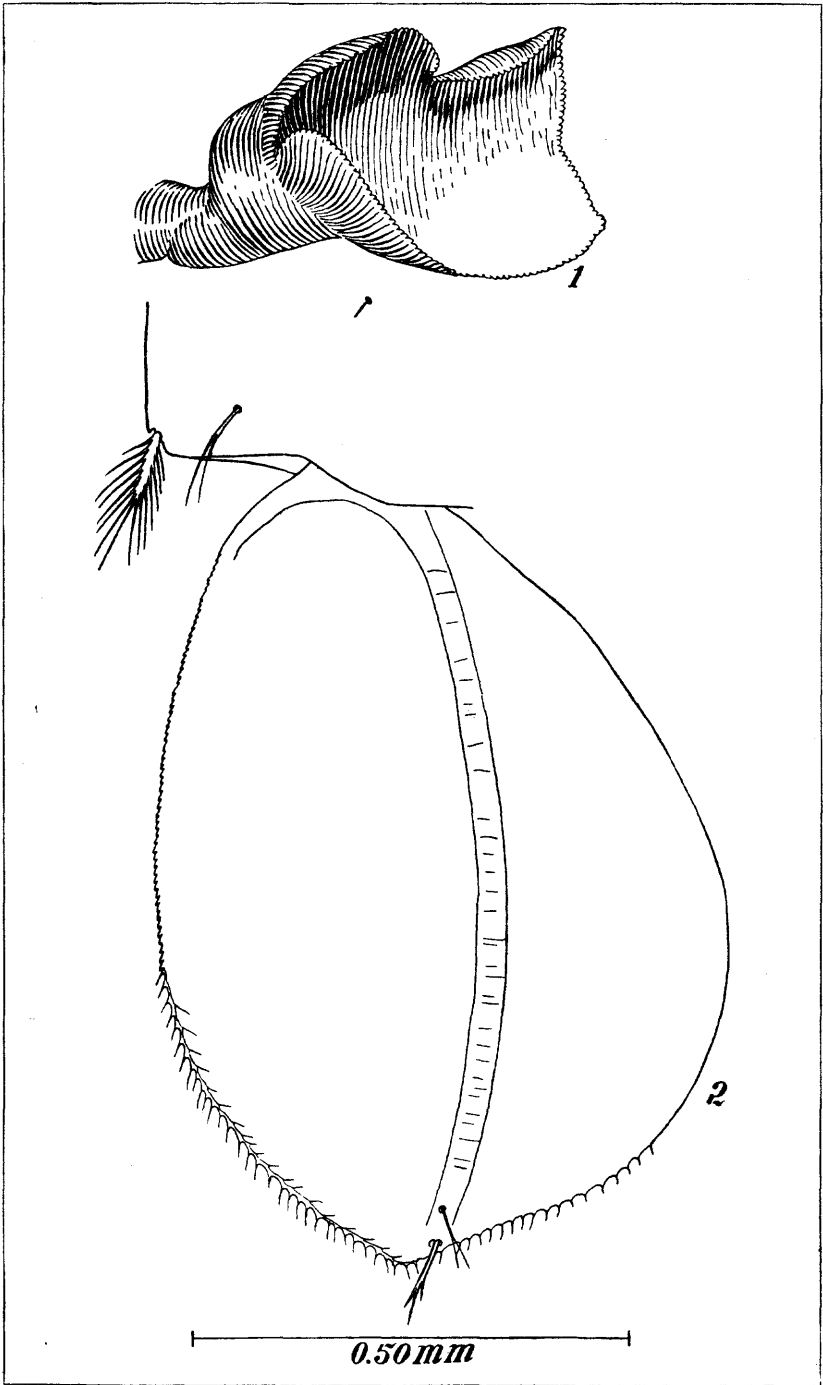


PLATE 7. A. HYRCANUS VAR. SINENSIS

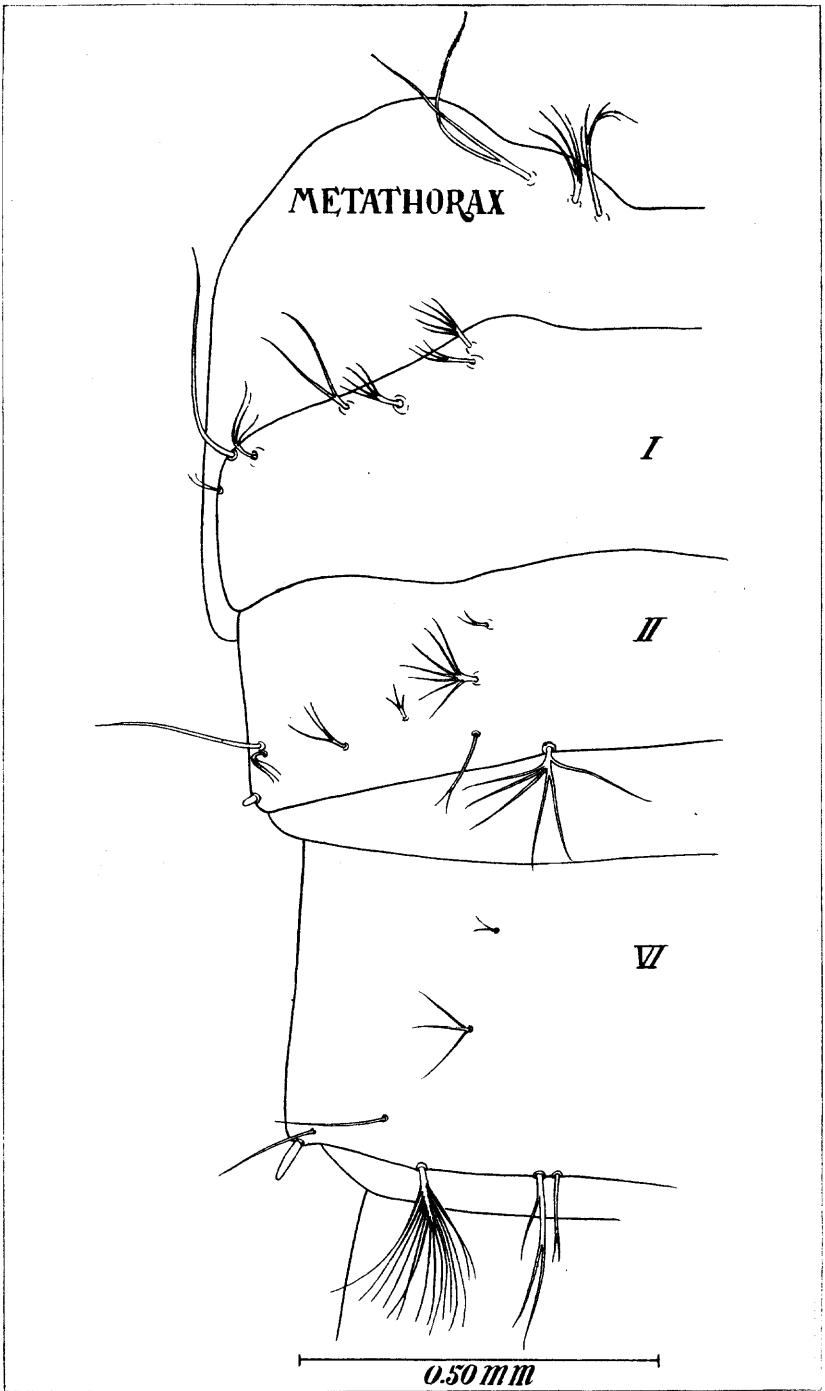


PLATE 8. *A. HYRCANUS* VAR. *SINENSIS*

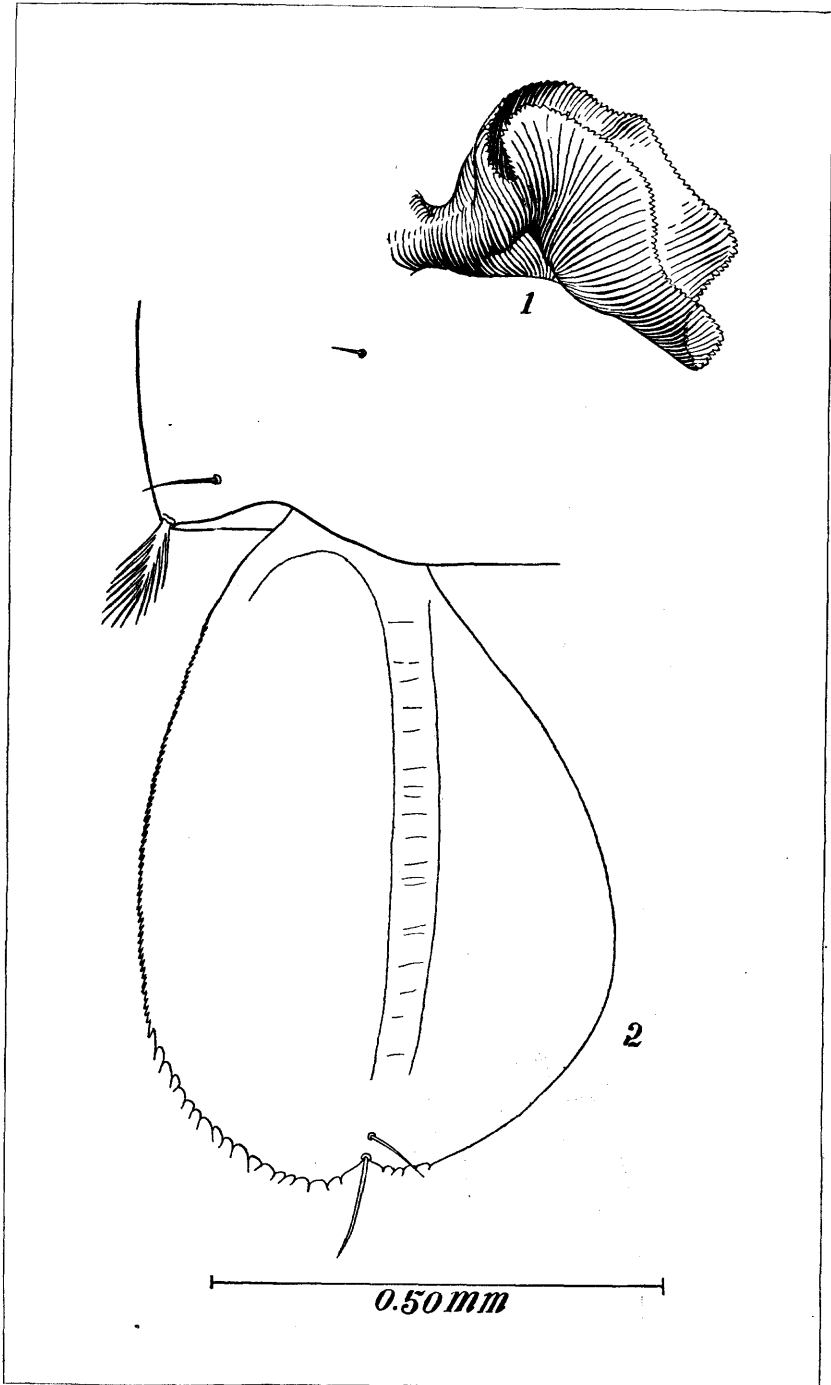


PLATE 9. A. HYRCANUS VAR. PSEUDOSINENSIS VAR. NOV.

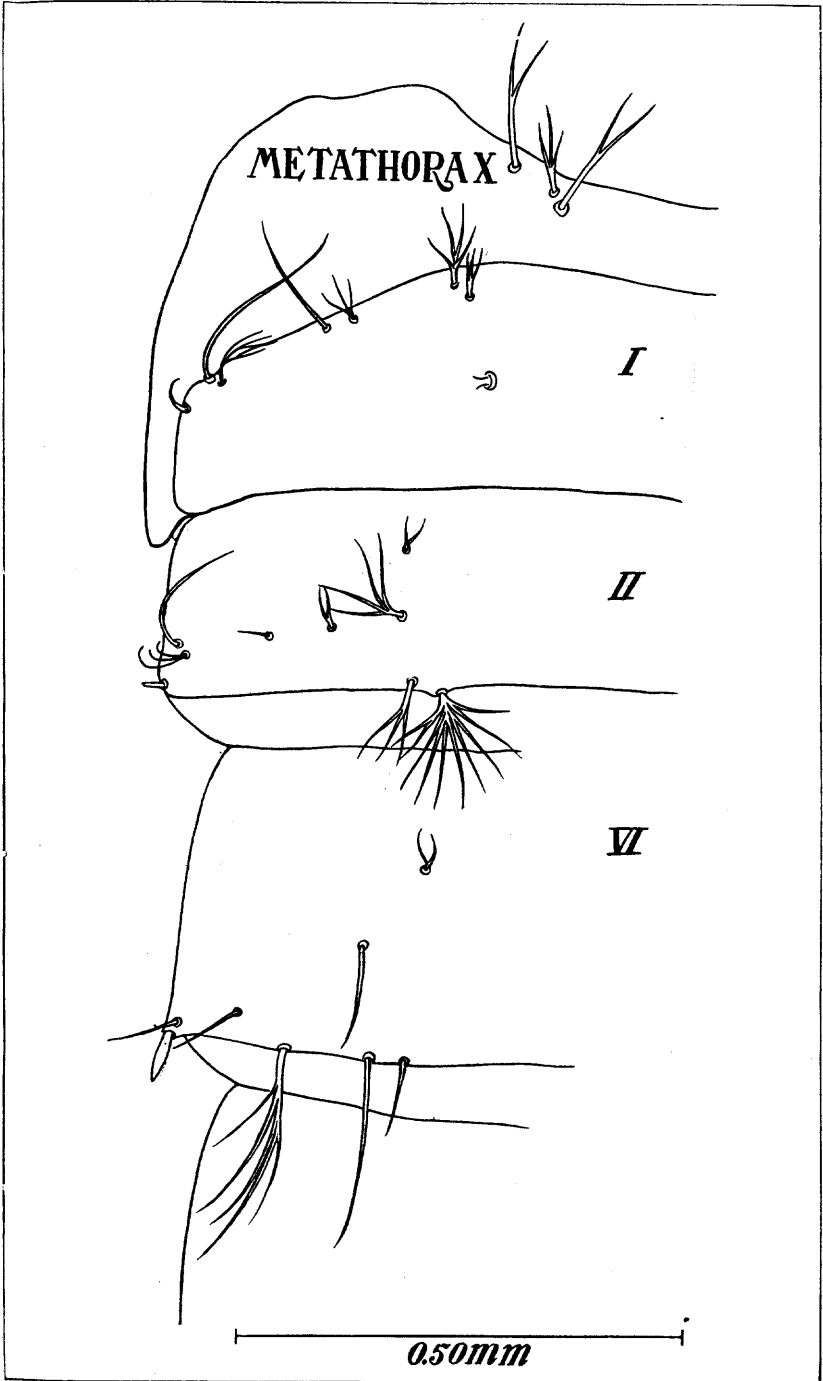


PLATE 10. A. HYRCANUS VAR. PSEUDOSINENSIS VAR. NOV.

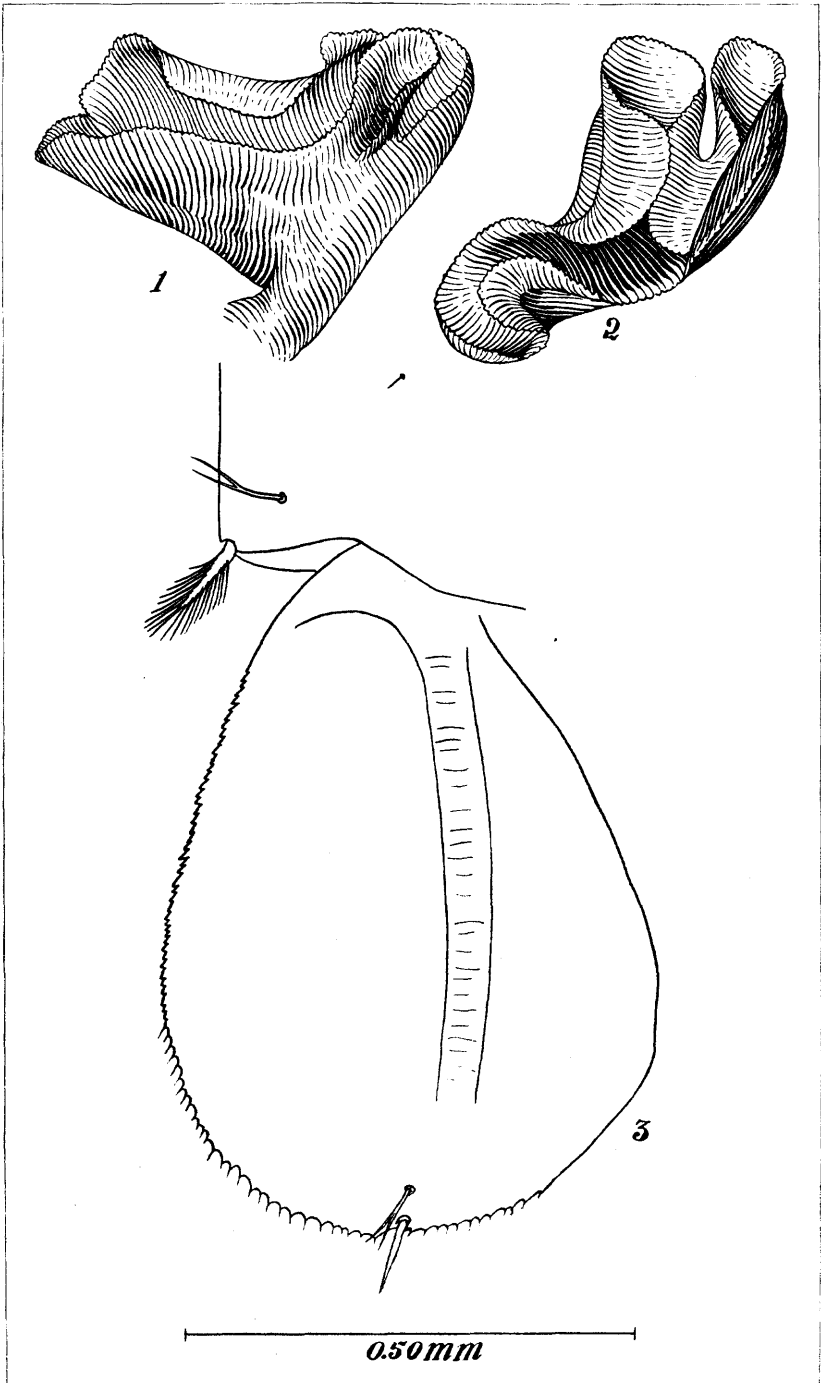


PLATE 11. A. PSEUDOBARBIROSTRIS

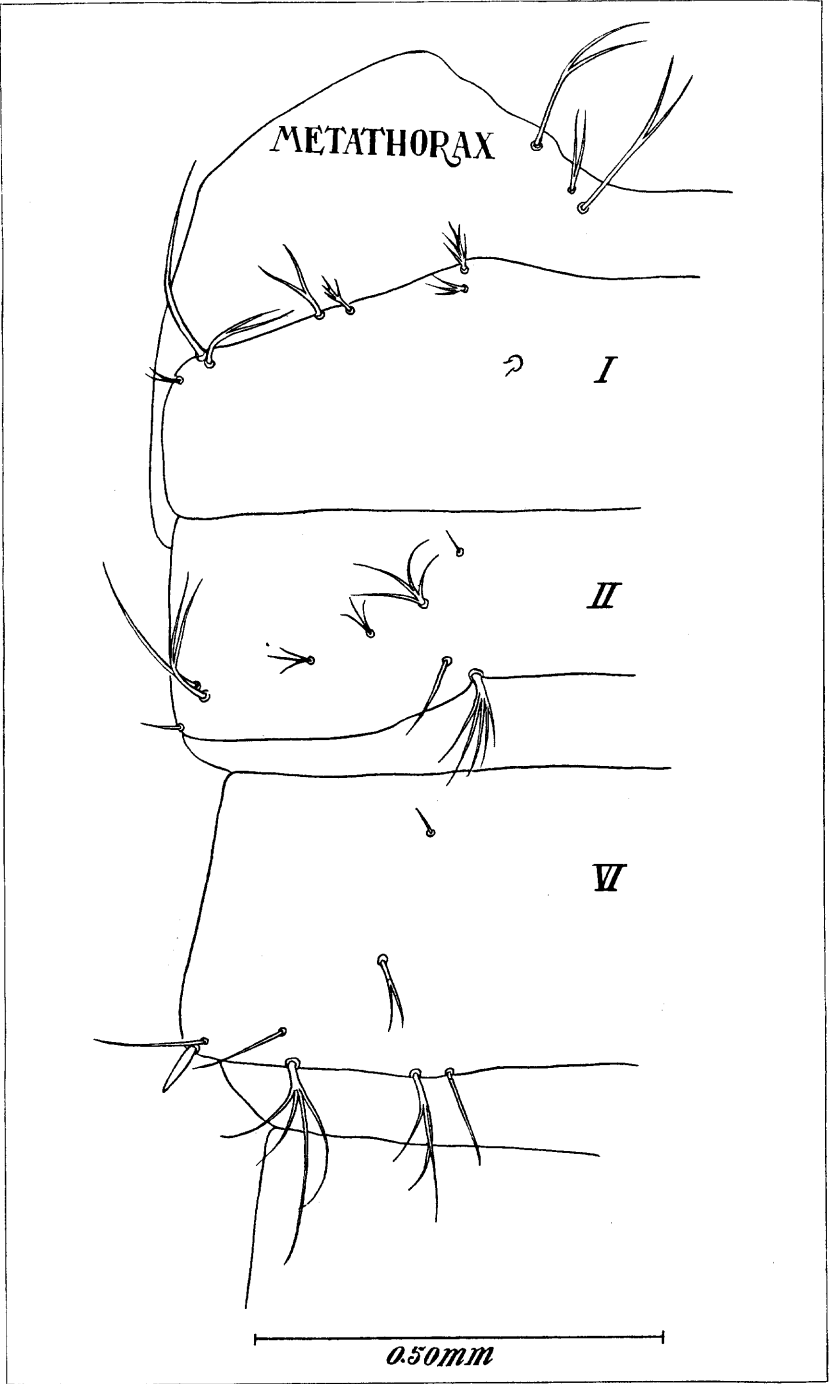


PLATE 12. A. PSEUDOBARBIROSTRIS

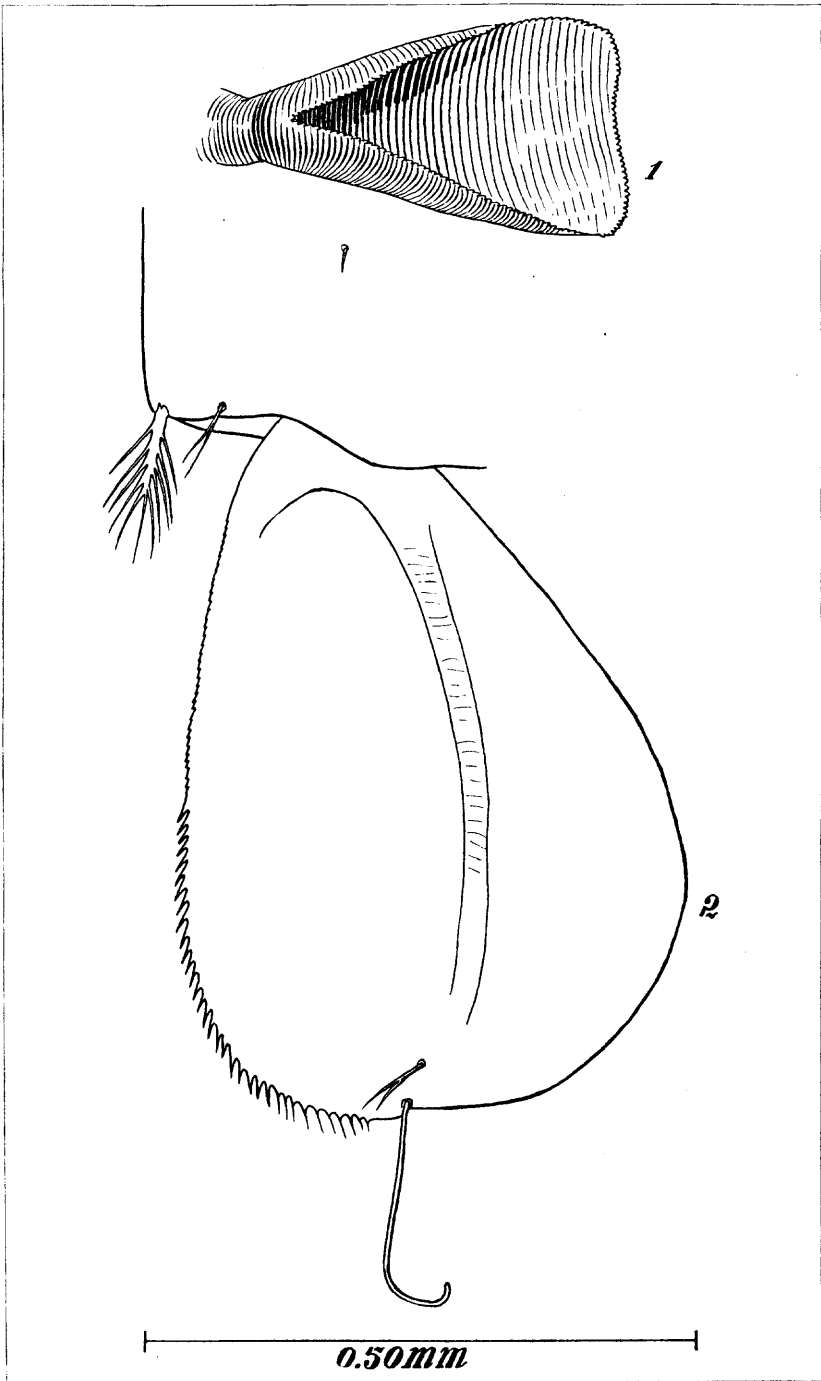


PLATE 13. A. ANNULARIS

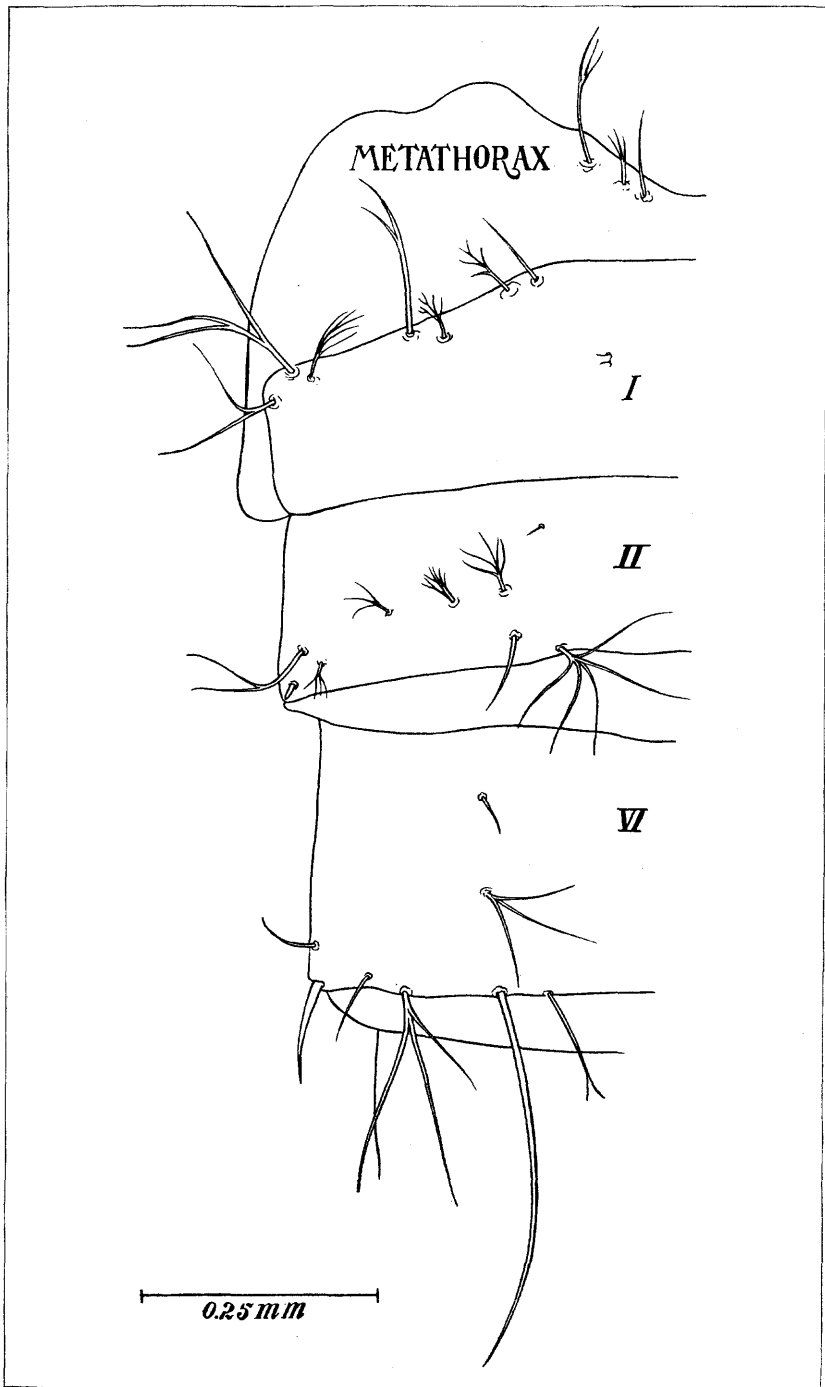


PLATE 14. A. ANNULARIS

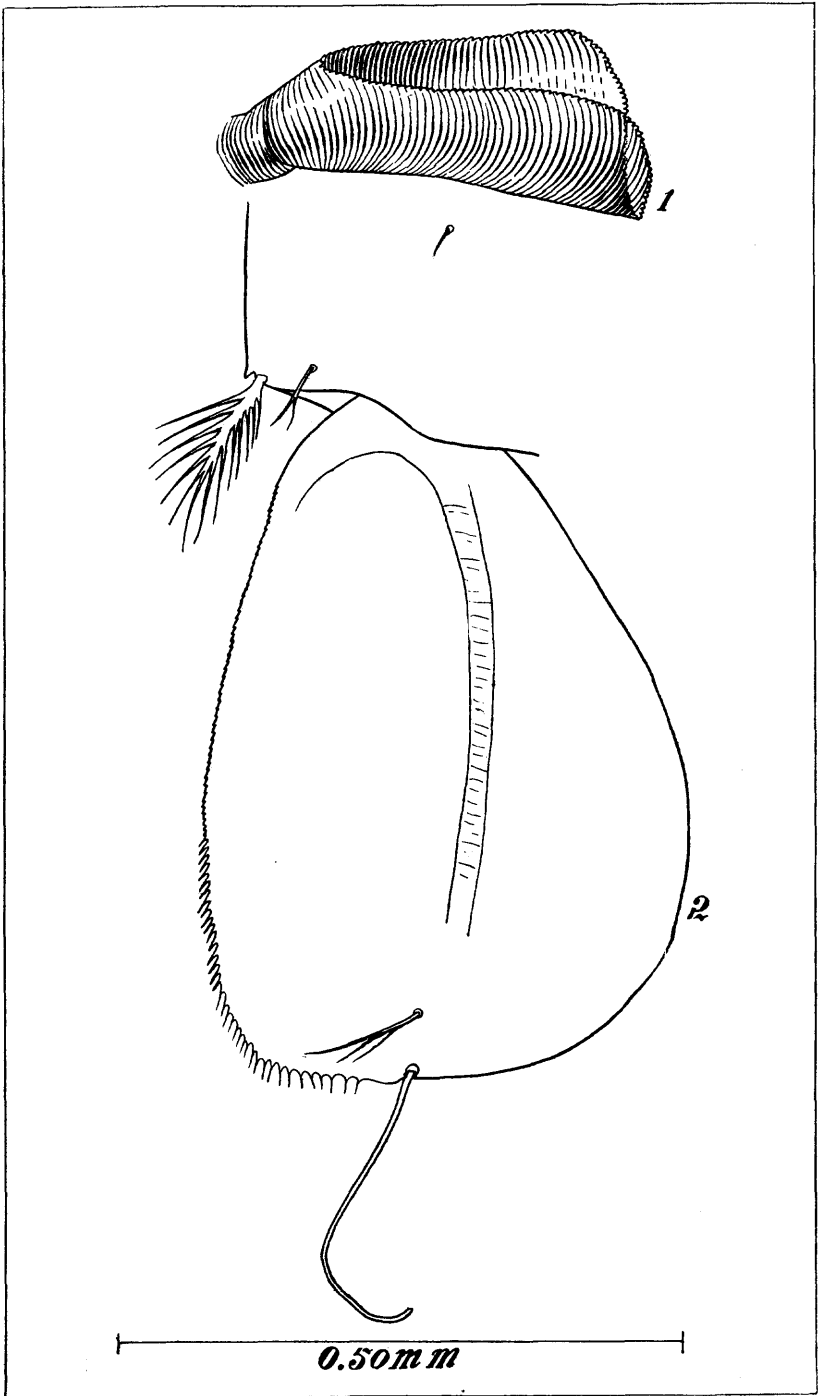


PLATE 15. A. PHILIPPINENSIS

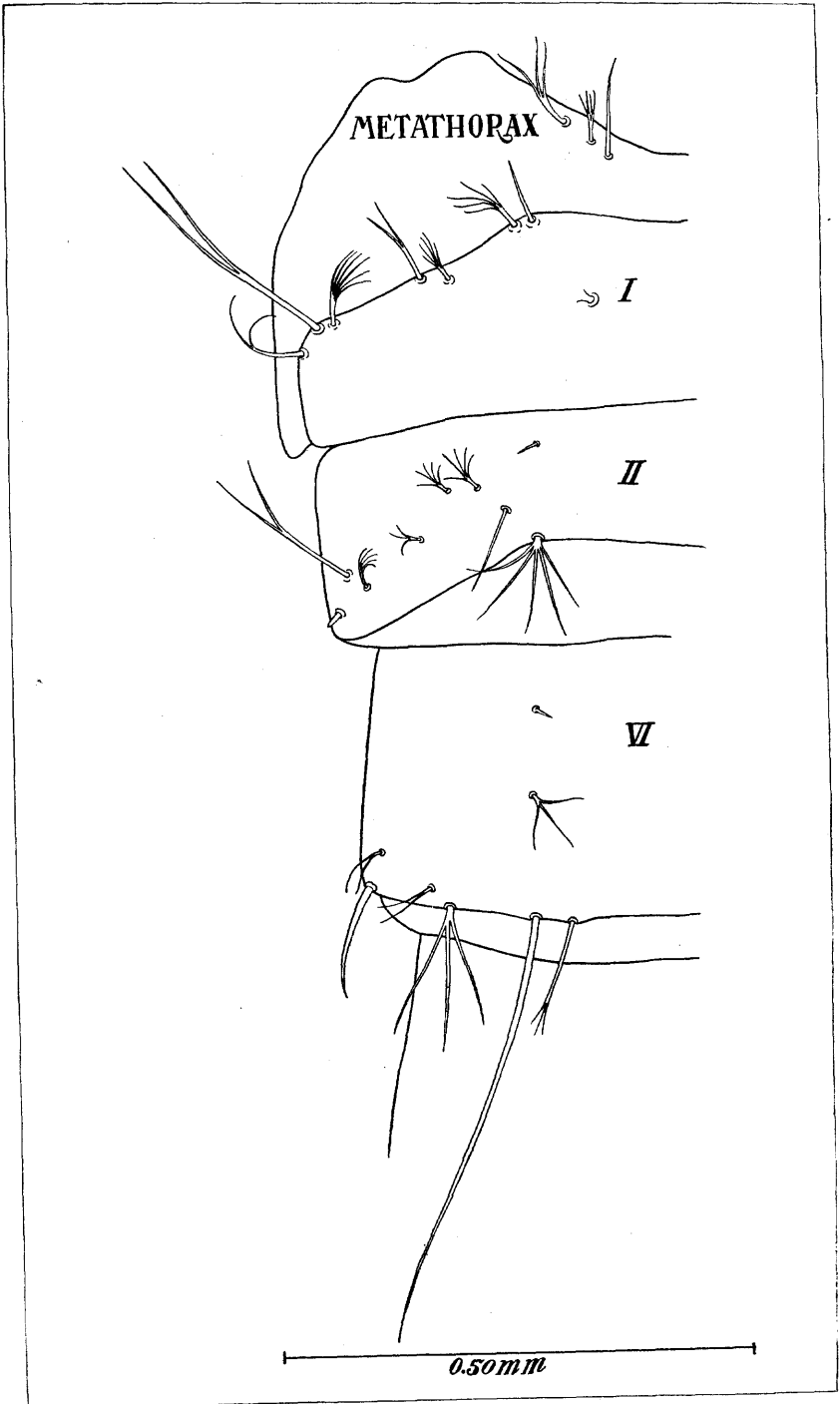


PLATE 16. A. PHILIPPINENSIS

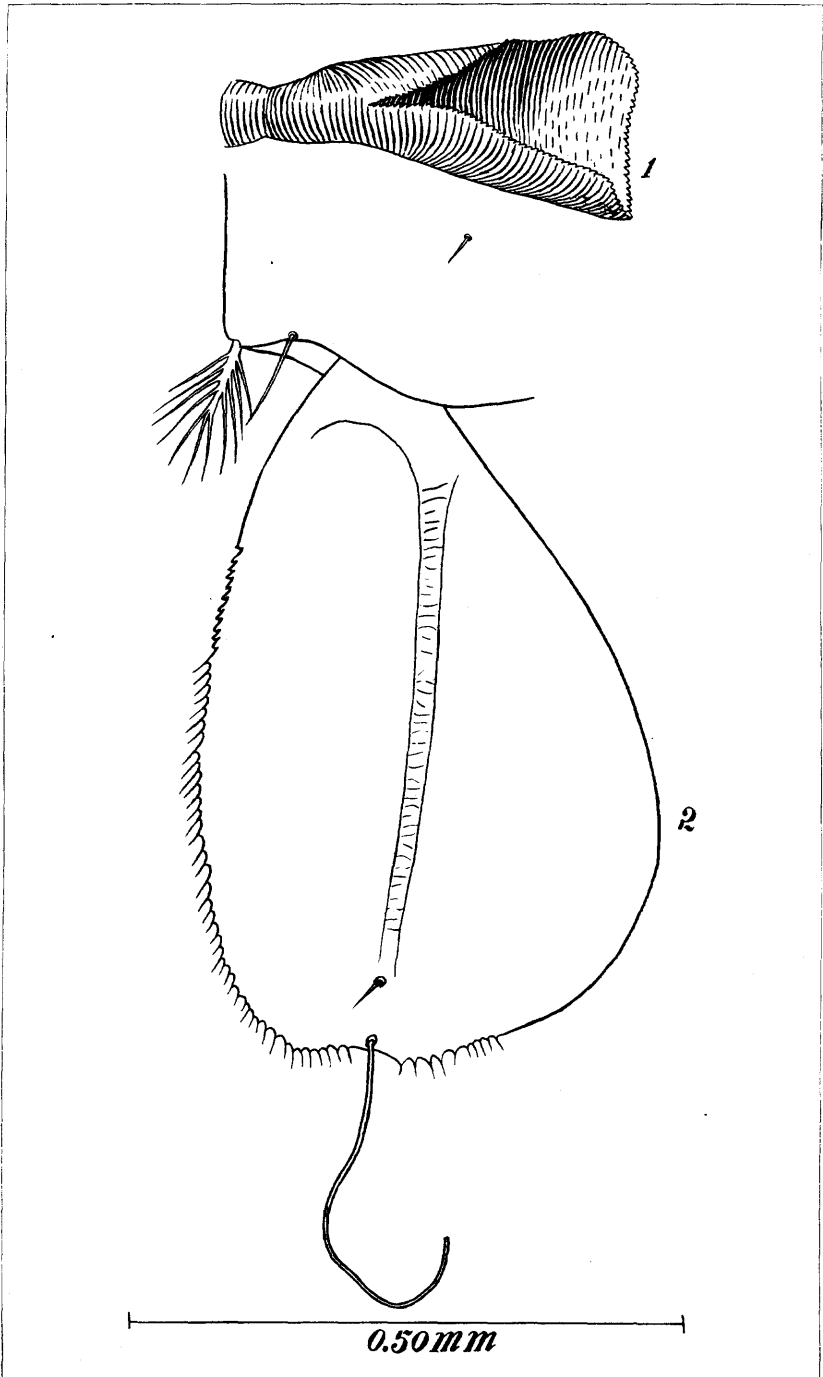


PLATE 17. A. KARWARI

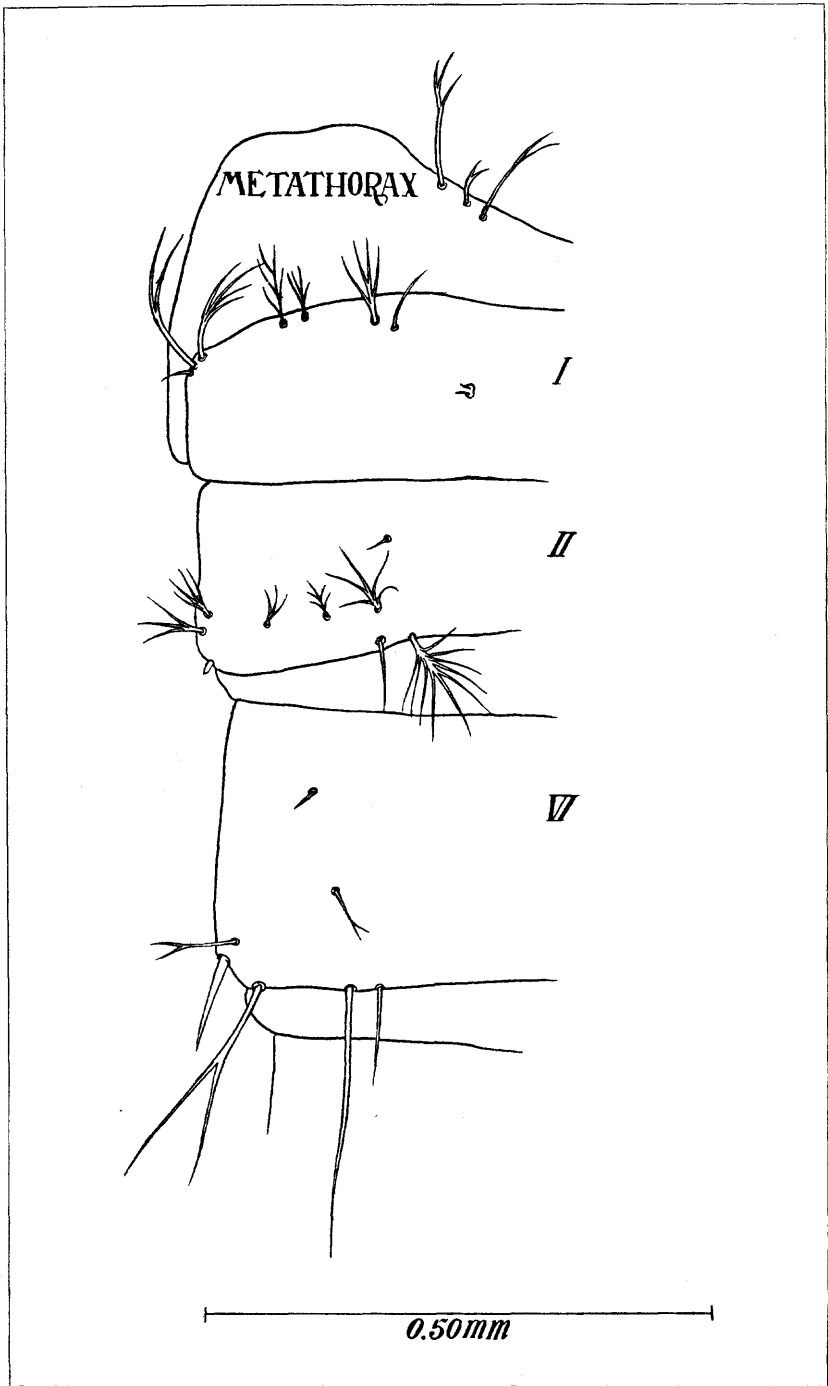


PLATE 18. A. KARWARI

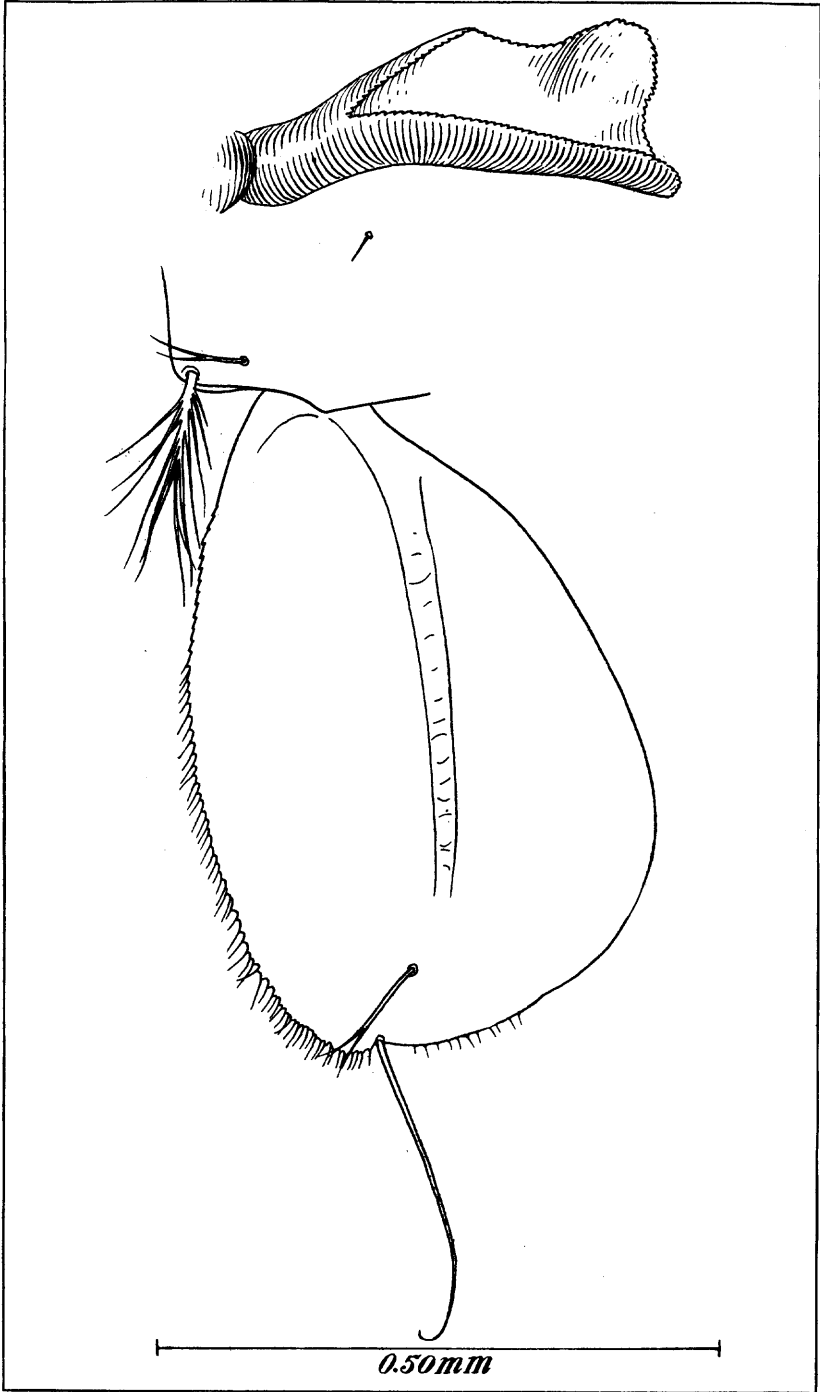


PLATE 19. A. MACULATUS

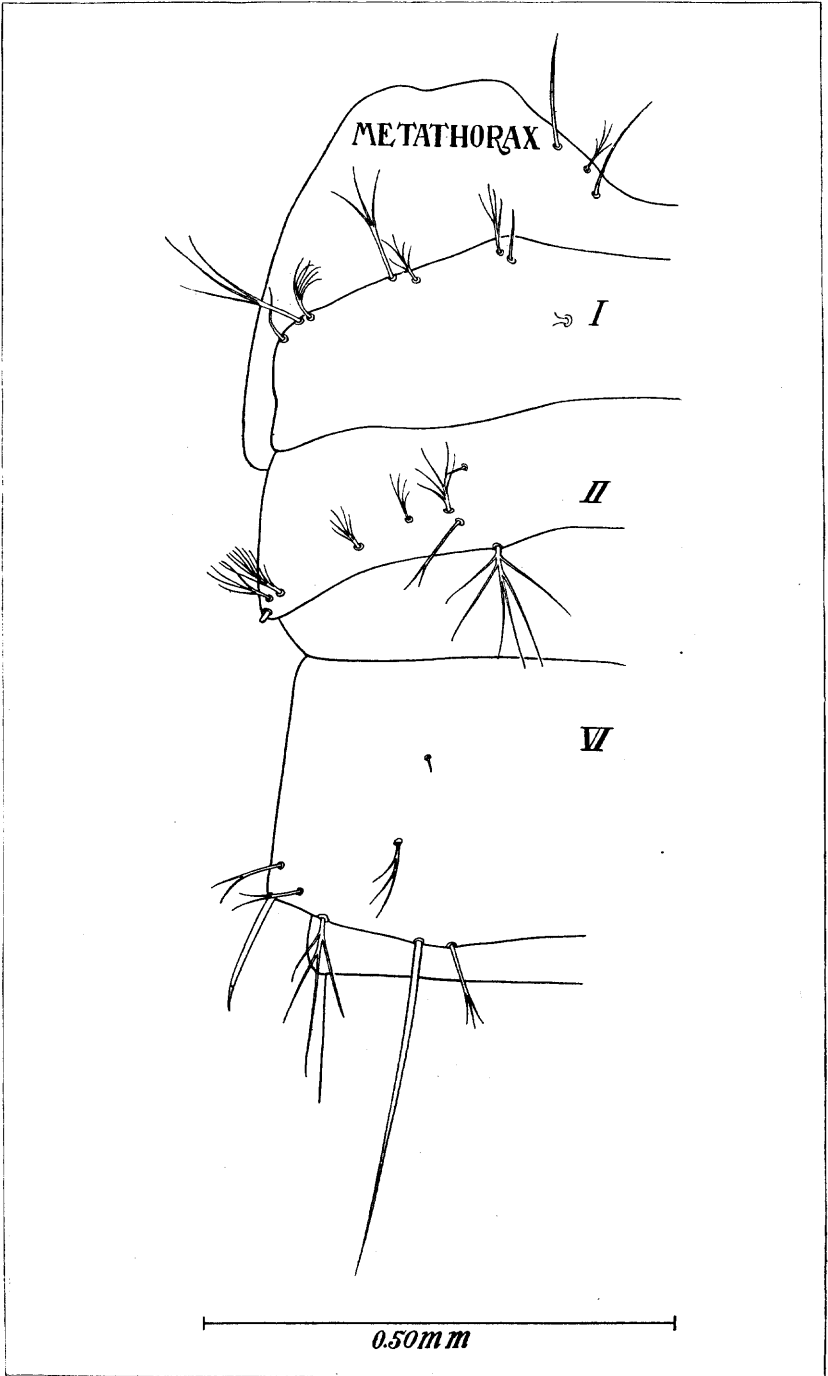


PLATE 20. A. MACULATUS

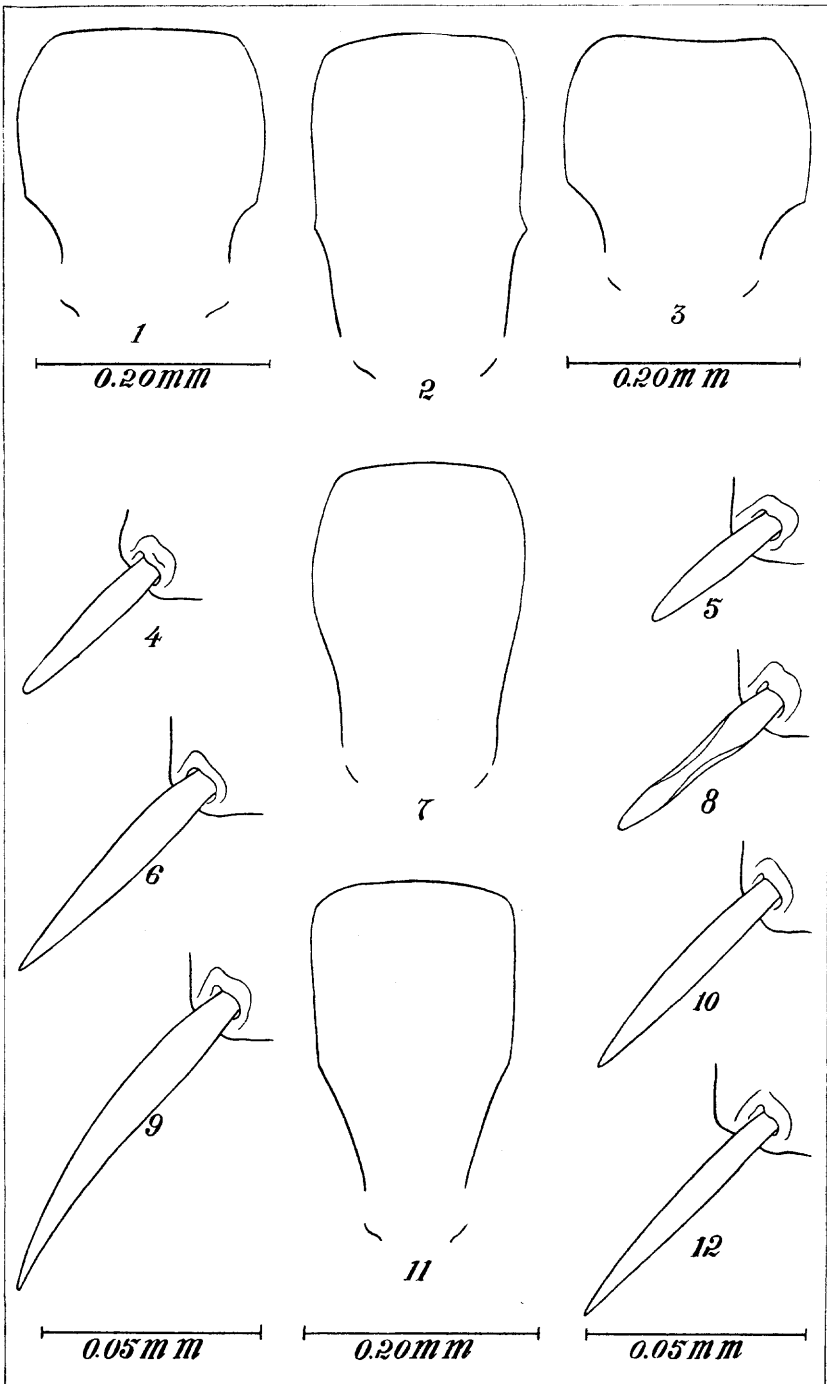


PLATE 21. CLYPEUS & SPINES

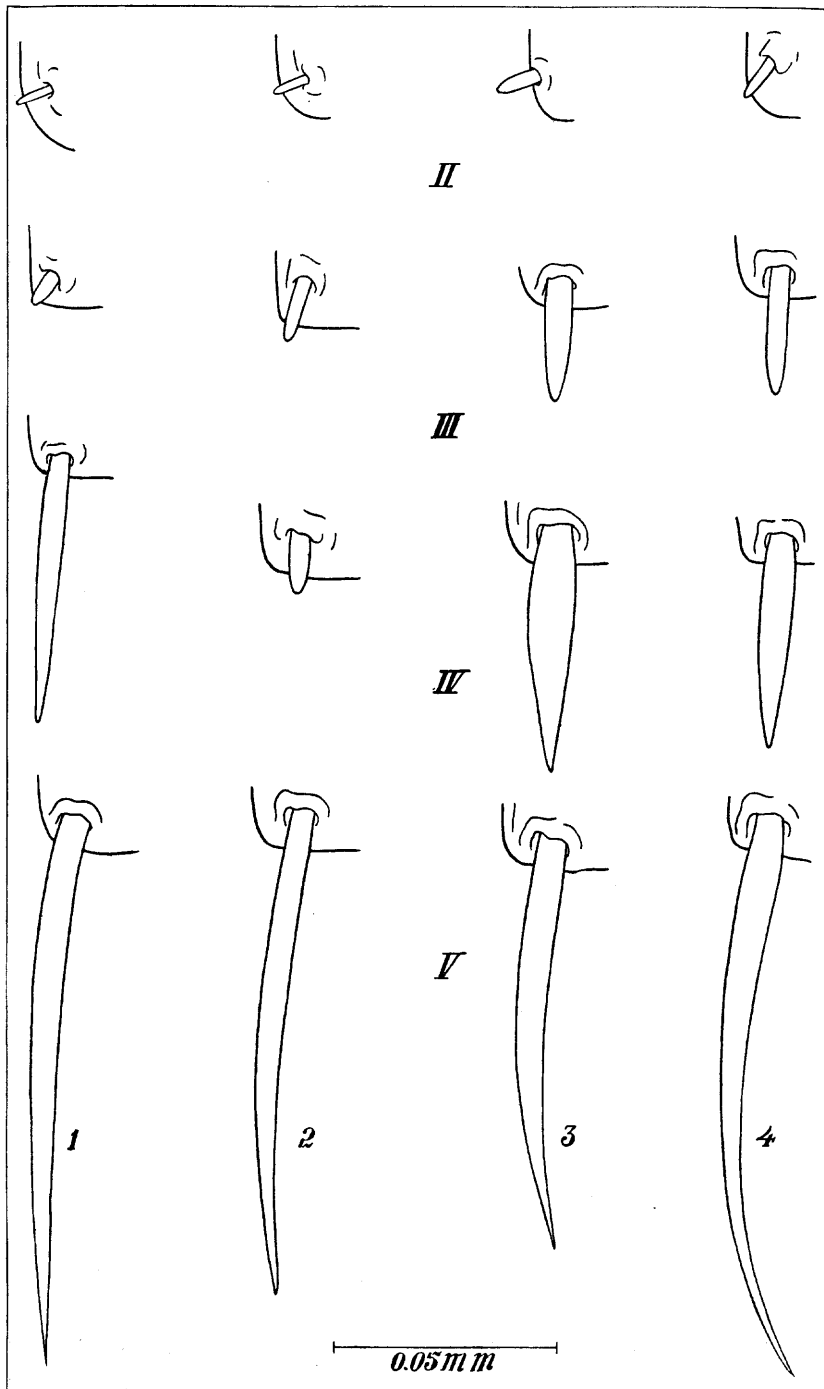


PLATE 22. SPINES II-V

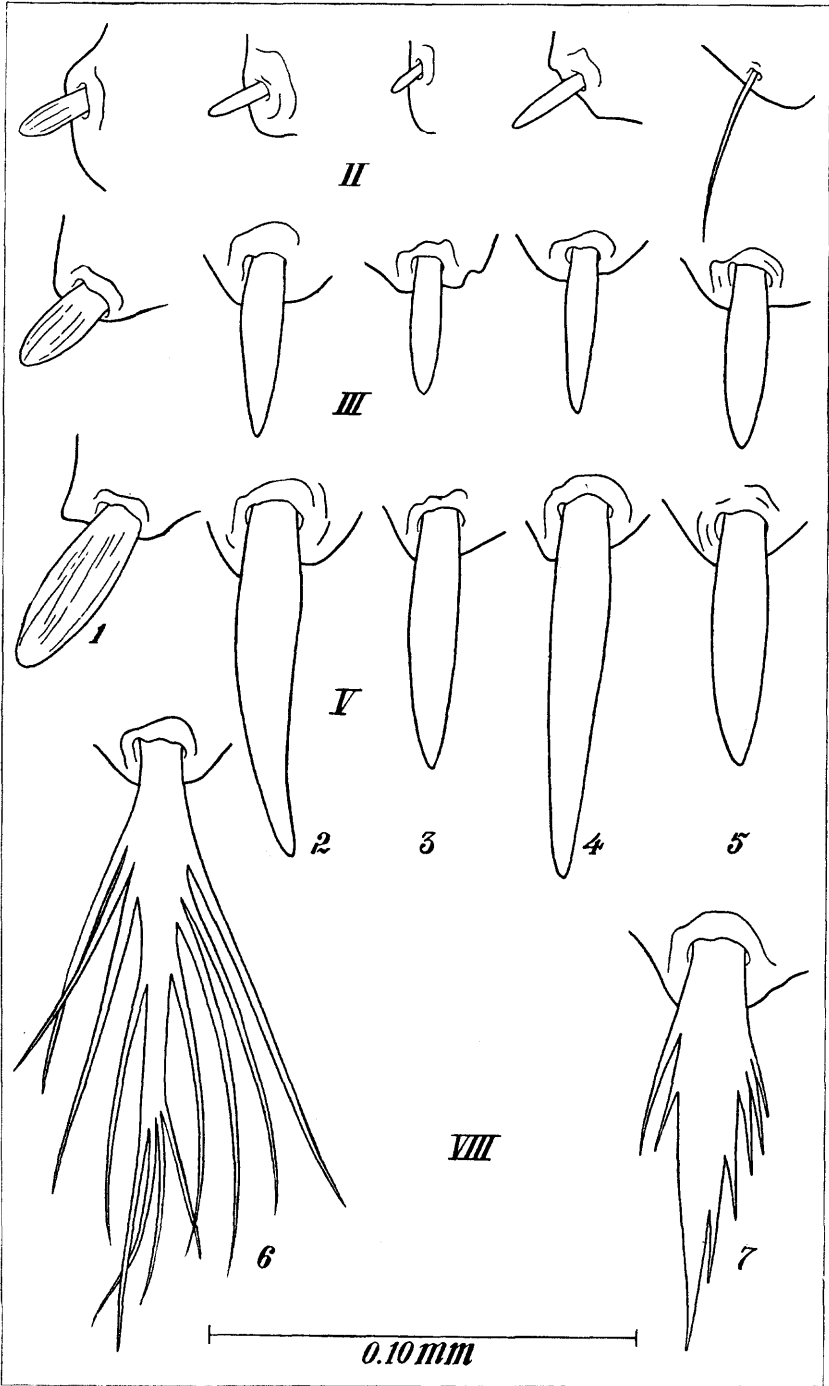


PLATE 23. SPINES II, III, V AND VIII

