THE EVOLUTION OF THE EXCRETORY SYSTEM IN CERTAIN GROUPS OF THE FURCOCERCOUS CERCARIAE.

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(Plates IX—XII.)

Within the last few years numerous workers have added very materially to the sum total of our knowledge of the detailed structure of a number of furcocercous cercariae and we are now in a position to attempt a systematic grouping of the various species based on the characteristics of their excretory systems.

In 1922 I attempted a classification of the furcocercous cercariae and created a number of groups in accordance with the number of flame-cells in the body and tail-stem. Since the publication of this paper, Miller (1926 and 1927) has attempted a further subdivision of certain of these groups and has created others to accommodate new species. This author now sub-divides the furcocercous cercariae into two main divisions according as a pharynx is present or absent. These two main divisions, Pharyngeal and Apharyngeal, are again split up into (*a*) those that possess long furcal rami, these being longer than one-half the length of the tail-stem, and this group he terms the Longifurcate group; and (*b*) those that have short furcal rami, the Brevifurcate group, the furcal rami in these instances being shorter than one-half the length of the tail-stem. This latter group, however, in the light of more recent discoveries requires modification, for, as Miller himself has shown in a recent paper (*vide infra*, p. 363), certain cercariae, that in all other characters agree with and belong to the Brevifurcate group, actually possess furcal rami that are slightly longer than half the tail-stem. Finally, a further subdivision of these groups is based on the presence or absence of an acetabulum; we thus have Monostome and Distome groups, but it must be borne in mind that the absence of an acetabulum in the larval stage may be due merely to a retarded development of this organ and does not necessarily imply that such a form will develope into a Monostome adult. We can thus recognise the following main divisions :—

- Pharyngeal
  - Brevifurcate
    - Distomes
    - Monostomes (no known representatives)
  - Longifurcate
    - Distomes
    - Monostomes
- Apharyngeal
  - Brevifurcate
    - Distomes
    - Monostomes
  - Longifurcate
    - Distomes
    - Monostomes

Each of these last sub-groups can be still further sudivided by the presence or absence of some other organ, such as eyes, by differences in the number or the staining reactions of the so-called Salivary or Penetration Gland cells, the character of the digestive system or by the different number and arrangement of the flame-cells in the excretory system. Miller himself (1926) in his classification of the Brevifurcate Distomes made use of the number of flame-cells present in the body and tail to distinguish between the various sub-groups; but I would here emphasise that a similar number of flame-cells in the body and tail does not necessarily indicate a close relationship. It is also necessary to know the exact manner in which the ducts unite with each other and with the anterior and posterior collecting tubules. As Cort and Brooks (1928, p. 203) have pointed out "The definite determination of the connections of each capillary becomes of the greatest importance in interpreting the pattern of the system", and only when the pattern of the whole system is identical are we justified in placing different species of cercariae in the same sub-group of the whole series. Faust (1926, pp. 106-107) in his study of the South African Larval Trematodes, and especially of those cercariae that belong to the Apharyngeal Brevifurcate Distome series, has reached the conclusion that "the essential differentiating features of the Apharyngeal fork-tailed Cercariae consisted not in the digestive, excretory or genital organs but in the number or micro-chemical reactions of the secretory cells." While agreeing that this is so, so far as the specific identification of cercariae *belonging to the same sub-group* is concerned, it must not be overlooked that there are several distinct sub-groups among the Apharyngeal Brevifurcate cercariae and that these sub-groups are distinguished from one another by the pattern and number of flame-cells in the excretory system.

In the following pages I have attempted to trace the evolution of the excretory system in certain groups of the furcocercous cercariae. It has not been possible to include all the known furcocercous cercariae in the schemes of evolution that I have drawn up; a case in point is *Cercaria indica* II, in which the anterior collecting tube receives capillaries from three flame-cells, while the posterior tubule is connected with seven flame-cells in the body and an eighth in the tail-stem, all of which, if my original observations were correct (*vide* Sewell, 1922, p. 271, pl. xxix, fig. 4), open separately; it is, however, possible that I was mistaken, and until further observations have been made the position of such a form must remain a matter of doubt. A similar case in point is *Cercaria bombayensis* No. 9 in which Soparkar (1921, p. 26, pl. iv, figs. 1, 3) has indicated the presence of an excretory system in which there are six flame-cells opening independently into the anterior collecting tubule and six into the posterior collecting tubule, two of these latter being situated within the tail-stem. *Cercaria gigas* Faust also appears to differ from most other cercariae of the Brevifurcate series by a similar independent connection of some of the flame-cells with the collecting tubules. In this species there are six flame-cells opening into the anterior and three into the posterior tubule, while, in addition, there is a single flame-cell that opens into the main collecting tube and another in the tail that is directly connected with the caudal

excretory canal. Faust himself (1919, p. 331) remarks that so far as the excretory system is concerned this species appears to be unrelated to any of the other species with which he was dealing in the paper under consideration. The presence of flame-cells that are not in any way connected with the anterior or posterior collecting tubules but open either into the main collecting tube, as mentioned above, in *Cercaria gigas* or into the caudal excretory canal, as in *Cercaria gigas*, *C. allahabadii* Chatterjee and *Cercaria* sp. Hesse, seems to indicate that in certain cases the original primary connection of these flame-cells may be lost and secondary connections be established. The occurrence of isolated examples of this phenomenon does not, however, in any way invalidate the suggestion that the usual line of development occurs by and through the successive division of individual pairs of flame-cells.

In all the series that I have examined we appear to start with a primitive form in which there are four flame-cells on each side of the body, three being in the distome body itself and the fourth in the tail-stem; these four cells are so arranged that two open into the anterior collecting tube and two into the posterior. Faust (1919) has attempted to represent graphically by means of letters the various systems present in certain groups of the cercariae; thus for the excretory system of the cercaria of *Schistosoma japonicum* Kats., in which the system is of the primitive type and consists of four pairs of flame-cells, two connected with each anterior collecting tube and two with the posterior, his formula is $\alpha+\beta$. In the same group he places *Cercaria douthitti* Cort and *Cercaria elephantis* Cort, in which the system is more elaborate. Each of these letters thus stands either for a pair of flame-cells or for a group of three, but whereas all the flame-cells connected with the anterior tubule are contained in the distome body, one of the posterior set lies outside the body in the tail-stem. For *Cercaria furcicauda* Faust gives the formula $\alpha+\beta+\gamma$, but here the pairs of flame-cells denoted by α and β respectively are connected with the anterior tubule and only the pair included under letter γ is connected with the posterior tubule. This method is thus inconsistent and, moreover, cannot be applied to show the gradual evolution of the excretory system by the successive division of certain flame-cells into two or more. Faust (*loc. cit.*, p. 333) remarks "present knowledge not only preponderates in favour of the view that the number of flame-cells in the species is constant, but establishes the belief also that the same basic number and arrangement of flame-cells exist within families and sub-families." In 1924 he deals with this subject more fully and emphasises the great importance of a study of the excretory system as a guide to the correct systematic position of any cercaria. He remarks (*loc. cit.*, p. 261) "it is not too much to state that all members of a natural adult group possess the same basic excretory pattern." He also gives (*loc. cit.*, Table II) a very extensive survey of the different groups of cercariae, showing the fundamental type of the excretory system in each group and the excretory formulae, derived from this fundamental type, in the various sub-groups. He does not, however, attempt to show how this fundamental pattern in each sub-group is reached; and yet if it can be shown, as I believe it can in many instances, that the flame-cell pattern in one sub-group can be

derived by a simple process of fission in individual pairs of flame-cells in the fundamental or basic pattern of the group, we ought to be able to arrive at certain conclusions, that will, I anticipate, prove to be fairly trustworthy, regarding the process and mode of evolution. A study of the evolution and development of the system tends to show that every flame-cell pattern is reached by the division of an original single-pair flame-cell system. Such a system is, at present, only known in certain Miracidia belonging to the genera *Amphistomum, Azygia, Bunodera, Echinochasmus, Echinostomum, Fasciola, Gastrodiscus, Gorgodera, Hapalotrema* and *Sphaerostomum.* The next stage in evolution is represented by the excretory system of the Miracidia of the genera *Hemistomum, Holostomum, Notocotyle* and *Schistosoma*, in which the originally single flame-cell has divided into two, there thus being four flame-cells in all in the body. A further division of each of these flame-cells would give us a system in which there are four flame-cells on each side of the body, and it is such a system that seems to be the starting point in several different lines of evolution in the furcocercous cercariae. As La Rue (1926, p. 273) has pointed out this difference in the number of flame-cells in the excretory system of the Miracidium denotes a division of the Digenea into two main groups, those Miracidia with the excretory formula of (1+1) belonging to the group that includes the Strigeidae and the Schistosomatidae. Cort and Brooks (1928, p. 202) have called attention to the manner in which flame-cells divide into two as development proceeds. In comparing the two accounts of the excretory system in *Cercaria douglasi*, namely that originally given by Cort (1917, p. 53, fig. 2*c*) and that given by themselves (*loc. cit.*), they suggest that in all Holostome cercariae there is first established a primary fundamental excretory system having a pattern in which single flame-cells are found on each side of the body and tail at definite levels. The first stage of evolution or development of this system consists in the division into pairs of the flame-cells at a certain level; "This," they remark, "may occur in the cercaria stage in some species." One of the daughter-cells would become dorsal and the other ventral in position. They suggest that the primary pattern of the excretory system of *Cercaria marcianae* La Rue has three flame-cells connected with the anterior collecting tubule and a similar number with the posterior, one of these latter flame-cells being in the tail-stem. They point out that such a system has been shown by me to be present in *Cercaria indica* I, and starting with this system the subsequent stages are, according to these authors, represented firstly by Cort's earlier account of *Cercaria douglasi* and Mathias' account of the cercaria of *Strigea tarda*, while the second stage is represented by the condition found in the mature *Cercaria douglasi.* In this assumption they entirely ignore the presence of a cross-connection between the main excretory tubules of the two sides of the body in *Cercaria douglasi* and its absence in *Cercaria marcianae* and, as I hope to show, this is quite unjustified.

As I have already mentioned, in each evolutionary series we appear to commence with a simple system, such as is met with in the true Schistosomes, in which there are four pairs of flame-cells, three pairs being in the distome body and the fourth in the tail-stem, and of these

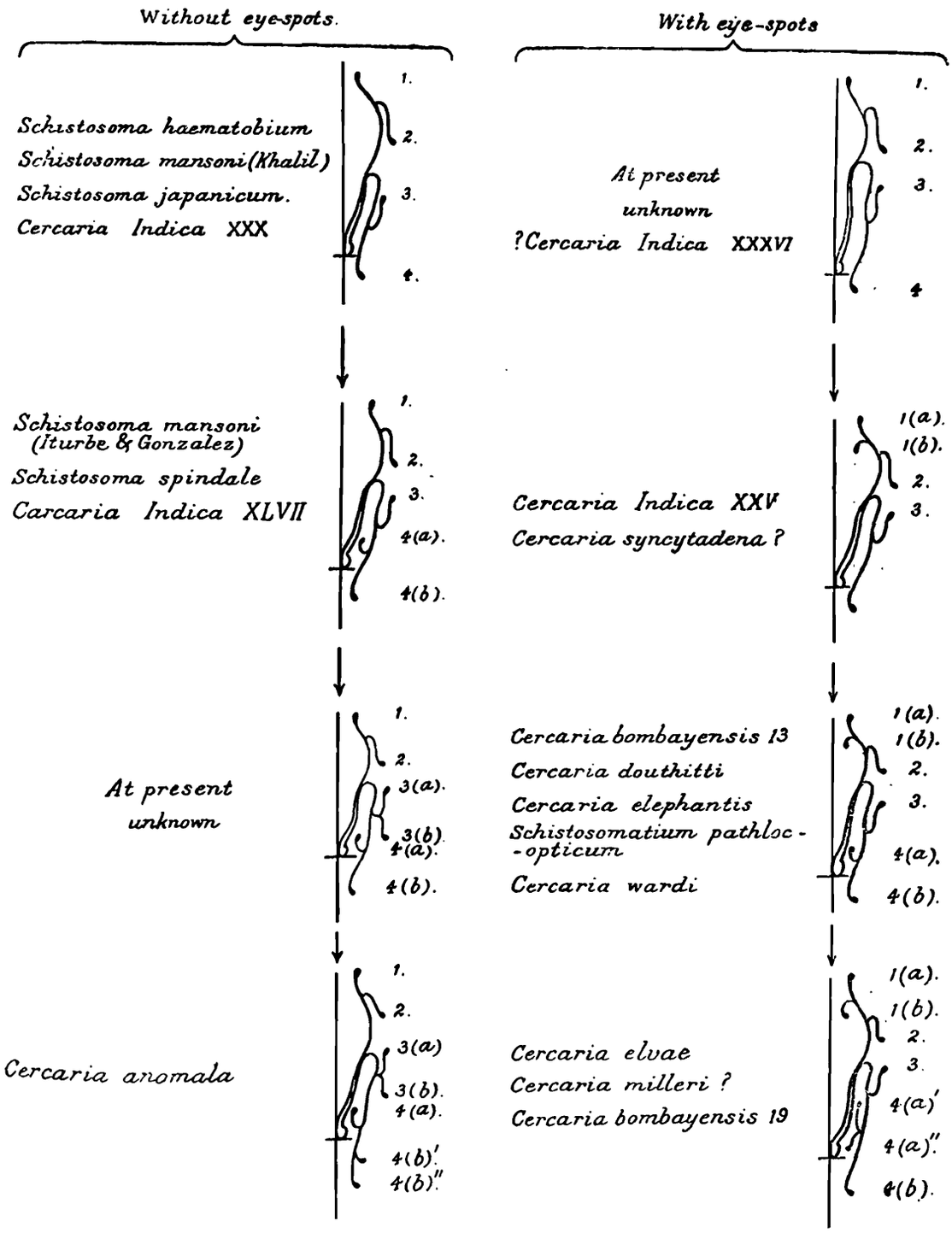
two are connected with each collecting tube. These flame-cells I have numbered from 1 to 4 respectively, commencing from the most anterior. When any of these primary flame-cells divide to give rise to two daughter flame-cells, these are denoted by 1*a* and 1*b*, 2*a* and 2*b*, etc., respectively. When any of the daughter cells undergo division the product are denoted by the addition of a comma (') or two (''), so that we should from flame-cell No. 1 get flame-cells 1*a* and 1*b* and from 1*a* get 1*a*′ and 1*a*.″ Finally those cells connected with the anterior and posterior collecting tubules are enclosed within round brackets, thus ( ), while those that are situated within the tail-stem are further enclosed in a square bracket [ ]. Both Miller (1927, p. 28) and Cort and Brooks (1928, p. 202) have pointed out that it is, in certain cases, difficult to be certain of the correct location of the flame-cells and Miller concludes that "it does not seem feasible to construct a classification of the furcocercous cercariae based only on the excretory system." While recognising the difficulty, I am convinced that the excretory system is the most important of all for the correct determination of the systematic position of any given species in the evolutionary series, and the possibility of faulty or incomplete observation does not seem to be an adequate reason for disregarding it; further study may necessitate the transference of a species from one group to another but that is equally the case in any scheme of classification and with any class of animal.

The Apharyngeal Brevifurcate Distome Series.

Commencing with the Apharyngeal Brevifurcate Distomes, I have in text-fig. 1 traced the manner in which the excretory system appears to have been evolved in the two series of forms that are included in the main group, namely those that possess eyes and those in which these organs are absent. The former of these two series includes those cercariae that develop into the true Schistosomes, while the members of the second series probably all develop into closely allied forms, to one of which the generic name *Schistosomatium* has been given. In the *Schistosomatium* series, in which eyes are present, the primitive condition, namely that in which there are three flame-cells in the body and one in the tail-stem on each side, has not yet been definitely demonstrated in any species. No cercaria with this system is definitely known, but it seems probable that the form described by me under the name *Cercaria indica* XXXVI (Sewell, 1922, p. 263) may be such a form; as I then pointed out, I could detect only three pairs of flame-cells in the body and one in the tail of this species. The formula would thus appear to be $2\times(1+2)+(3+[4])$. Commencing with an excretory system of this type, the first stage in the process of evolution appears to be the division of the most anterior flame-cell, No. 1, into two daughter-cells, so that we now get three flame-cells connected with each anterior collecting tubule and two with each posterior, the formula now being $2\times(1a+1b+2)+(3+[4])$; such a system has been shown to be present in *Cercaria indica* XXV Sewell and it is in all probability also present in *Cercaria syncytadena* Faust.

Progressing a stage further, we next find that the most posterior flame-cell, No. 4, which is situated within the tail-stem, has divided into

The excretory system in the Apharyngeal brevifurcate distome group of Furcocercous Cercariae.



Text-fig. 1.

two, namely 4*a* and 4*b*, and of these No. 4*a* apparently migrates into the distome body, while 4*b* remains within the tail-stem. This type of system is represented by the formula $2\times(1a+1b+2)+(3+4a+[4b])$. The next stage in the evolution of the system is again brought about by the division of one of the posterior flame-cells, namely the most posterior cell in the distome body, No. 4*a*, as a result of which we get two daughter flame-cells, which I term Nos. 4*a*′ and 4*a*″ ; we thus get the formula $2\times(1a+1b+2)+(3+4a'+4a''+[4b])$. We thus appear to have a series of groups in which the number of flame-cells in the excretory

system increases from three pairs in the body and one pair in the tail-stem to six pairs in the body and one in the tail. Miller (1926, p. 66) orginally recognised the two latter groups, with five and six pairs of flame-cells in the body respectively, as being separate and distinct and he named them Groups D and E in the Apharyngeal Brevifurcate Distome series. Subsequently, however, he (1927, p. 66) combined the two into a single " Elvae " group ; but in so doing I think he has made a mistake. In his account of this combined group he gives as one of the characters, " Large Apharyngeal *Longifurcate* distome Cercariae "[1] ; but in a foot-note he adds that " These cercariae, in four of which the furcae are only slightly greater than half the tail-stem length, are so much more like those of the brevifurcate groups that they are classed among them rather than with the longifurcates." Although the various species that Miller includes in this single group are closely related, differences in the excretory systems render it desirable, in my opinion, to retain the two groups. The first group, which Miller (1926) terms the " Bombayensis No. 13 " group and Faust (1924) the " Wardi " group, possesses five flame-cells in the body and one in the tail on each side, arranged according to the formula $2\times(1a+1b+2)+(3+4a+[4b])$; in this group we can place the following species :—

Cercaria bombayensis No. 13 Soparkar.
Cercaria douthitti Cort.
Cercaria elephantis Cort.
Cercaria tuckerensis Miller.
Cercaria variglandis Miller and Northup.
Cercaria wardi Miller,

and the Cercaria of *Schistosomatium pathlocopticum* Tanabe.

On the basis of certain differences in the penetration glands Miller (1926, p. 67) separates off from the others *Cercaria elephantis* and *Cercaria echinocauda* and places these two by themselves in a group which he terms Group G (*Elephantis*). Although the life-history of only a single example of this ' Bombayensis ' No. 13 group is known, namely that of *Schistosomatium pathlocopticum* Tanabe, it seems safe for us to assume that all the other forms in this group will ultimately be found to belong either to the same or to a very closely related genus.

In the second group " Elvae " (*sensu stricto*), in which there are six pairs of flame-cells in the body and one in the tail, arranged according to the formula $2\times(1a+1b+2)+(3+4a'+4a''+[4b])$, we can include the following species :—

Cercaria elvae Miller.
Cercaria bombayensis No. 19 Soparkar, and probably
Cercaria milleri Faust.

It seems probable that *Cercaria ocellata* La Val. also falls within this group ; Ssinitzin stated that it possesses seven flame-cells on each side and, as Miller (1927, p. 68) remarks, these are probably so arranged

[1] The italics are mine. *R. B. S. S.*

that there are six pairs in the body and one in the tail-stem. Dubois (1929, p. 96, pl. ii, fig. 8) has recently redescribed the species and has figured the excretory system : in his figure he shows that there are three flame-cells connected with the anterior collecting tubule and four with the posterior, one of these four lying in the tail-stem ; unfortunately his figure does not show clearly the connection of the three most posterior flame-cells in the body, all three apparently being connected with capillaries that arise close together. Miller also included in his conjoint " Elvae " group the species *Cercaria macrosoma* Brown ; he declines to accept Brown's statement that this cercaria possesses a pharynx, and in a foot-note he remarks " In the case of *Cercaria gigantea* and *C. macrosoma* the assumption may be made that the alimentary canal of each is of the same type as that present in the other members of the group." Such an assumption is, I think, unwarranted. Moreover Miller ignores the fact that the caudal excretory canal in *C. macrosoma* opens on the sides of the furcal rami and not at the tips, as in all other members of the Brevifurcate series. Although the number of flame-cells in the excretory system is identical in *Cercaria elvae* and *C. macrosoma*, it seems probable that this number is reached in a different manner. In the " Elvae " group, as I have pointed out, it is flame-cell No. 4*a* that has undergone division into 4*a*′ and 4*a*″ ; but in *Cercaria macrosoma*, if we may judge from the figure given by Brown (1926, pl. iii, fig. 27) it is flame-cell 4*b* that has divided into 4*b*′ and 4*b*″, while No. 4*a* remains single (*vide infra* p. 374).

In the non-eyed Apharyngeal Brevifurcate Distome series, which appears to constitute the true *Schistosoma* series, we get a very similar process of evolution. Commencing again with the simplest system of four pairs of flame-cells, two in the anterior region of the body and two, of which one is in the tail-stem, in the posterior, we find that this type is characteristic of the human-infesting Schistosomes and occurs in the following species :—

The Cercaria of *Schistosoma haematobium*,
the Cercaria of *Schistosoma japonicum* and, according to Khalil,
the Cercaria of *Schistosoma mansoni*.

It is also found in *Cercaria indica* XXX, the adult stage of which is not yet known. In this group, which I (1922, p. 250) termed the " Japonicum " group and which Miller (1926, p. 64) calls Group A of the Apharyngeal Brevifurcate Distomes, the excretory formula is, as before, $2\times(1+2)+(3+[4])$. From this stage the first step in the evolution of the series is represented by my " Spindale " group and Miller's Group B ; this step is reached by the division of one pair of flame-cells, but in this instance it is not, as in the *Schistosomatium* series, the most anterior that divides first, but the most posterior, No. 4 giving rise to 4*a* and 4*b*, of which 4*a* apparently migrates into the distome body and only 4*b* remains in the tail-stem ; there are thus still two flame-cells connected with the anterior collecting tubule, but three with the posterior. The formula for this stage is thus represented by $2\times(1+2)+(3+4a+[4b])$. This type of excretory system has been shown by Soparkar to be present in the cercaria of *Schistosoma spindale* and by me in *Cercaria indica* XLVII ; Iturbe and

Gonzales (1919) claim that the cercaria of *Schistosoma mansoni*, which they investigated in Venezuela, also possesses this type of excretory system. It is possible that the cercariae investigated by Khalil and by Iturbe and Gonzales respectively, although in each case supposed to be that of *Schistosoma mansoni*, may in reality not have been identical; on the other hand, it is interesting to note that this latter stage in the evolution of the excretory system of this series agrees exactly with the condition found by Faust and Melleny (1924, p. 85, pl. v, fig. 23) in a very early stage of development, which they term stage B, of *Schistosoma japonicum* within its final host. These authors (*loc. cit.*, p. 49) have called attention to this additional flame-cell in the species of cercariae that I have included in the present group; they consider that "this supernumerary cell may be explained as a precocious development, anticipating the time when the caudal flame-cell is pinched off along with the tail and a new unit is formed by the division of the anterior unit of this group, thus producing the original symmetry of the system." It seems to me, however, that one should distinguish between the various stages in the process of evolution of the system in the various groups and the developmental changes that occur in any given type of excretory system as we pass from the larva to the adult. If ontogeny repeats phylogeny the processes should theoretically be the same but this additional flame-cell in the posterior end of the body in the larva of the "Spindale" group appears to arise by the division of the flame-cell No. 4 and not of No. 3. A similar though somewhat greater difference in the number of flame-cells has been noted in the excretory systems of the immature and mature examples of *Cercaria douglasi*. In the original description of the flame-cell pattern given by Cort (1917) it was stated that there were five flame-cells on each side in the body and two in the tail-stem, and of these three were connected with the anterior collecting tubule and four with the posterior; these cercariae were taken from crushed snails and Cort and Brooks (1928) now suggest that they were not quite mature. In the mature cercariae these latter authors give the number of flame-cells as eight in the body and two in the tail on each side; four of these are connected with the anterior collecting tube and six with the posterior. It thus seems clear that there may be a certain degree of development of the system in the larval stage, so that it is important for observers to make certain that the specimens under examination are fully developed and this can only be done by allowing the cercariae to complete their development and be set free naturally from their mollusc host.

The next stage of evolution in this series, following the "Spindale" group, is at present unknown, but it is probably represented by the formula $2\times(1+2)+(3a+3b+4a+[4b])$, flame-cell No. 3 now having undergone division.

Finally, we reach the type of system present in *Cercaria anomala* Rao (1929) in which the most posterior flame-cell, No. 4*b*, has undergone division, giving rise to 4*b*′ and 4*b*″, both of which remain in the tail-stem. The formula thus becomes $2\times(1+2)+(3a+3b+4a+[4b'+4b''])$.

Since the first two groups in this series are known to belong to the true Schistosomes, it seems reasonable to conclude that the form dis-

covered by Rao will eventually prove to belong to the same genus, *Schistosoma*, or to one very closely related to it.

The exact relationships of the Monostome Furcocercous cercariae to the Distome groups of the series is still a matter for speculation. In my account of the Indian cercariae (1922) I put forward the view that the Distomes had been evolved from the Monostomes ; at that time the number of Monostome cercariae known to me were comparatively few and in all known cases presented a simple and primitive type of excretory system. The subsequent discovery of several Monostome forms with more complicated systems renders this view untenable. The occurrence among the Monostome larvae of both Longifurcate and Brevifurcate forms seems to indicate, as Miller (1926, p. 59 *et seq.*) has suggested, that these forms have been derived from the Distome series by the suppression of the acetabulum and the fact that the forms now known, while possessing excretory systems of varying degrees of complexity, can all be fitted into the same scheme of evolutionary development as the Distome cercariae, indicates that this suppression of the acetabulum has occurred on more than one occasion.

Dubois (1929, pp. 142, 144) has recently put forward the view that the " Lophocerca " Monostome group is not related to the Furcocercous cercariae, such similarities as exist between them being, in his opinion, due, in all probability, to the similarity of their life-histories. He apparently does not regard the similarity of their life-histories as being in itself, in all probability, evidence of their close relationship. Among the differences that he believes to exist between the two groups he cites :—

(1) The presence of a crest,
(2) The absence of an acetabulum,
(3) The differences in the excretory systems and
(4) The presence in the miracidia of the " Lophocerca " group of only one pair of flame-cells, whereas there are two pairs in the Furcocercous Group.

In his " Lophocerca " group Lühe (1909) included two forms, *viz.*, *Cercaria cristata* La Val. and *C. microcristata* Ercol. and in 1919 I included in the group four additional species, namely *Cercariae indicae* IX, XIII, XXXIX and LV. In the previous year Soparkar (1921) published his description of *Cercaria bombayensis* No. 8 ; while exhibiting certain differences in structure, this cercaria is clearly closely related to the other Indian forms. A further species closely related to the Indian forms was described and figured by Faust (1926, p. 102, pl. vi, figs. 1*a-c*) from material sent to him from South Africa by Cawston ; this species he has kindly named *Cercaria sewelli*. Finally, in the early part of last year McCoy (1929) published the account of yet another species that agrees closely with the Indian forms, *Cercaria brevifurca*. So far as it is possible to judge all these forms present the same salient features in the structure of the excretory system ; there is a small excretory bladder at the posterior end of the body, from which arise two main tubules that pass forwards on each side of the body to about the middle of its length, where they bifurcate into anterior and posterior collecting

tubules. Posteriorly there arises from the bladder a caudal excretory canal, that passes down the tail-stem and then bifurcates into two, one branch passing along each furcal ramus and opening at its tip. This much of the system has been traced in *Cercariae indicae* IX, XIII, XXXIX and LV, *Cercaria bombayensis* No. 8, *Cercaria sewelli* and *Cercaria brevifurca*. We know but little regarding the internal structure of either *Cercaria cristata* or *C. microcristata*, but Ercolani (1881, p. 275) describes the presence in the latter form of a small excretory bladder of a triangular form. As regards the number and distribution of the flame-cells most Indian forms, *Cercaria sewelli* and *Cercaria brevifurca*, agree in the possession of three pairs of such cells in the body, two being connected with the anterior collecting tubule and one with the posterior. *Cercaria bombayensis* No. 8 differs from these forms by the presence of an additional pair of flame-cells in the body and a pair at the base of the tail, there thus being two pairs of flame-cells connected with the anterior collecting tubule and three pairs with the posterior.

In 1922 Scheuring published his account of the life-history of *Sanguinicola inermis*, the cercaria of which closely resembles, but according to this author is probably not identical with *Cercaria cristata*, and in 1925 Ejsmont[1] described two other cercariae belonging to the same genus. In the account that he gives of the cercaria of *Sanguinicola inermis* Scheuring describes and figures the excretory system as possessing two independent canals that appear to commence at the anterior region of the body and run back through the whole length of the body and tail-stem, each eventually passing along the furcal ramus of the same side to open at the tip. Scheuring figures no excretory bladder and was apparently unable to locate any flame-cells. Dubois (1929) gives a brief description of an additional species that he names *Cercaria helvetica* XVI, but he confines himself almost entirely to the external characters and with the exception of the salivary or penetration gland cells he neither makes any mention of nor figures the internal anatomy. If the observations of Scheuring and Ejsmont are correct there is a marked difference between these two forms and the others that have been included in the " Lophocerca " group. In this connection Dubois remarks " Tout d'abord, nous devons constater que les observations de Sewell ne nous paraisent pas toujours très prècises et peut-être quelquefois subjectives : c'est ainsi que les résultats de l'étude anatomique des espèces du groupe ' Lophocerca ' ne correspondent pas aux données des spècialistes de ces formes Ejsmont et Scheuring." I may, perhaps, be allowed to take exception to this remark ; I will, however, merely point out that my studies are in complete accord with those of Soparkar, Faust and McCoy. In attempting to form an estimate of the value of this distinction in the characters of the excretory system it must be borne in mind that it has been definitely shown, *vide* the work of Johnson (1920) on the development of *Echinostomum revolutum* (Froelich), of Looss (1900) on *Cercaria distomatosa* Sons. and *Cercaria vivax* Sons., and of Faust and Mellany (1924) on the cercaria of *Schistosoma japonicum*, as well as the work of Ssinitzin (1911), that during the early

[1] I have not been able to refer to this paper. *Author.*

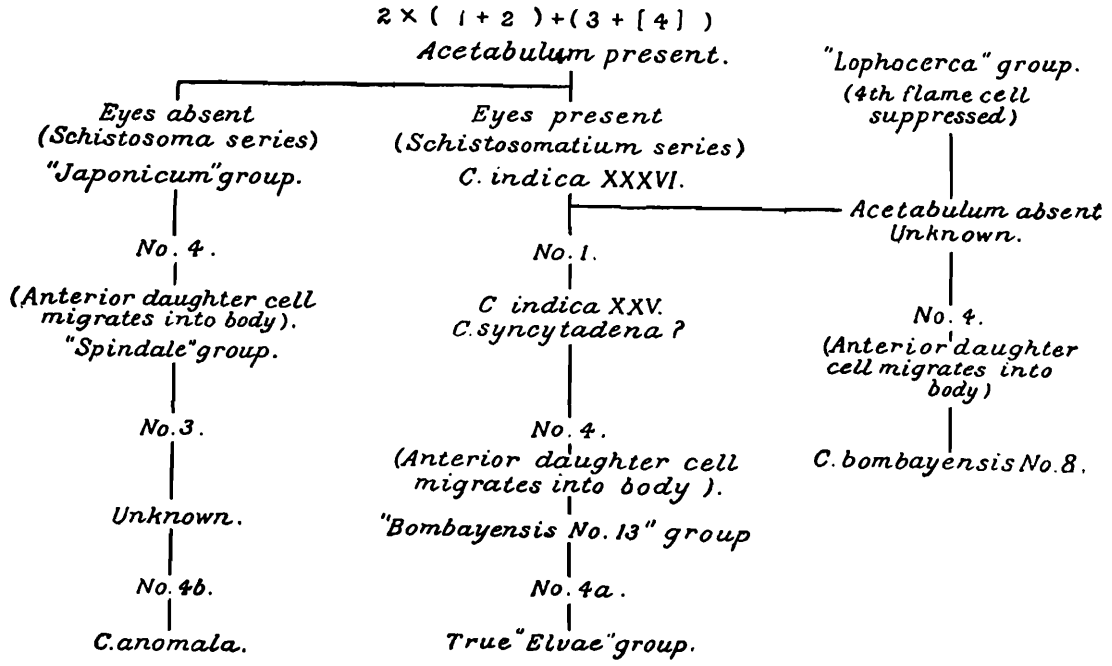
development of cercariae the excretory ducts of the two sides of the body are separate and that these ducts run independently down the length of the developing tail. The presence of two independent ducts in the tail-stem of the cercariae of the genus *Sanguinicola* may thus be due merely to the retention of an early developmental character.

Differences also exist between the various members of this group in the character of the alimentary canal. In no case have I been able to detect any oesophagus or intestinal caeca in the Indian forms that I have studied. Soparkar, however, in *Cercaria bombayensis* No. 8 describes this system as follows: "the alimentary system is simple, and, as in Schistosome cercariae, consists of a mouth which opens a little behind the anterior end, a long oesophagus passing through the oral sucker, and a dilated caecum which is situated about 80μ from the anterior end. There is no trace of any muscular pharynx." A similar digestive tract exists in *Cercaria brevifurca* McCoy; but Faust was unable to trace any intestine in *Cercaria sewelli*. Scheuring in the case of the cercaria of *Sanguinicola inermis* describes an oesophagus that terminates in a bulky 4-pointed gut; "der schlund fuhrt in einen plump 4-zipfeligen Darm." This latter he very obscurely figures as being situated about the junction of the anterior and middle thirds of the body length, in the region where one would except the brain mass to be (*vide* Sewell, 1922, pl. iv, fig. 5) and much more anterior than the position of the caecum in either *Cercaria bombayensis* No. 8 or *Cercaria brevifurca*, and I am inclined to wonder whether he was not mistaken in his interpretation. Another feature in which some of these species differ from others lies in the character of the Parthenita. In the majority of species development occurs in small oval or rounded sporocysts, that contain only a single mature cercaria; this type of development is found in *cercariae indicae* XIII, IX and LV, *Cercaria sewelli* Faust and the cercaria of *Sanguinicola inermis*. Others, however, develop in elongate and thread-like sporocysts, if we can trust the statement made by Ercolani (*vide* Sewell, 1922, p. 47). Finally, both *Cercaria bombayensis* No. 8 Soparkar and *Cercaria brevifurca* McCoy develop in rediae.

From the above it seems clear that the group "Lophocerca" is not strictly homogeneous and probably consists of several smaller subgroups. The only reason for separating these forms completely from the other furcocercous forms might lie in the presence in the Miracidium of only two flame-cells, instead of two pairs, but here again we are ignorant of the miracidia of all the cercariae of this group except those of the genus *Sanguinicola*, and until we know more about the various forms I prefer to regard them as being the larval forms of either the genus *Sanguinicola* or nearly allied genera and together, with the exception of *Cercaria bombayensis* No. 8, constituting the group "Lophocerca."

I have previously (1922, pp. 45, 350-1) called attention to the great degree of similarity that exists between the "Lophocerca" group of the Brevifurcate Monostomes and the Schistosomes, but the presence of eyes in the members of this group seems to indicate that they are more nearly related to the *Schistosomatium* series. At the present day the known forms of the Brevifurcate Monostomes, with a single exception,

fall within the limits of this single group, every member of which is characterised by the presence of eyes and in all probability by the possession of an excretory system that has only three pairs of flame-cells in the distome body and none at all in the tail-stem, similar to the condition shown by me to be present in *Cercariae indicae* IX and LV: a similar system has been shown to be present in *Cercaria brevifurca* McCoy. The formula for such a system can be represented by $2\times(1+2)+(3)$ and it is probable that the group has been derived from the primitive Brevifurcate Distome form with an excretory system having the formula $2\times(1+2)+(3+[4])$ by the suppression of the acetabulum and the reduction of the fourth pair of flame-cells in the tail. The only Brevifurcate Monostome form that does not belong to the "Lophocerca" group, namely *Cercaria bombayensis* No. 8 Soparkar, appears to have been derived from the same primitive parent stock, in which the acetabulum has been suppressed but which possessed the full complement of flame-cells as expressed by the formula $2\times(1+2)+(3+[4])$. In the process of evolution flame-cell No. 4 has undergone division into two daughter-cells, Nos. 4*a* and 4*b*, and of these the most anterior has migrated into the distome body, leaving only a single flame-cell in the tail-stem; the excretory formula, which is in complete agreement with the condition figured by Soparkar (1921) in this species, is thus $2\times(1+2)+(3+4a+[4b])$.



Text-fig. 2 showing the probable lines of evolution of the Brevifurcate Furcocercous Cercariae.

In the accompanying text-figure 2, I have attempted to show the manner in which the evolution of the two series of Apharyngeal Brevifurcate Distomes and the Brevifurcate Monostomes has been brought about. At the top I have given the primitive excretory formula from which all the others appear to have evolved and at each stage I have noted the flame-cell that undergoes division. Since the order in which the various flame-cells successively undergo division is different throughout the two series, *viz.*, the *Schistosoma* and *Schistosomatium* series,

it seems probable that each series has been evolved by independent processes from the common ancestor that possessed the primitive excretory formula $2\times(1+2)+(3+[4])$ and further that the *Sanguinicola* series, *i.e.*, "Lophocerca" group of the Brevifurcate Monostomes, represents a branch line of evolution that has arisen from the *Schistomatium* series by the suppression of the acetabulum, followed by changes in the character of the excretory system.

The Pharyngeal Longifurcate Distome Series.

Evolutionary processes, very similar to those that I have just been discussing, can also be traced in the excretory systems of the Pharyngeal Longifurcate Distomes. There seems to be but little doubt that the cercariae of this division are the larval stages of the Holostomes; and they are all now regarded as being larval forms belonging to the family Strigeidae. Larvae of this type have been shown experimentally "to encyst (usually) and undergo metamorphosis into Strigeid larvae (Diplostomum, Tylodelphys, Tetracotyle and Codonocephalus)" (*vide* La Rue, 1928, pp. 269, 271). The cercariae can, however, be divided into two groups by the presence or absence of a transverse connection across the distome body, either just in front or just behind the acetabulum, uniting the main collecting tube of one side with that of the other. As I have already pointed out (*vide supra*, p. 360) Cort and Brooks (1928, p. 202) have called attention to the degree of similarity that exists in the excretory systems of certain of these Holostome larvae but they compare forms that possess this cross-connection with others in which it is absent, thus ignoring what I believe to be an important structural difference. That the two series are closely related is not questioned, but as we trace the probable course of evolution of the excretory system we find that, although the main line of evolution is identical in the two groups, the subsidiary lines appear to be different. Cort and Brooks (1928, p. 188) have called attention to the relationships that appear to exist between certain Holostome cercariae. In one group they place *Cercaria flexicauda*, *C. laruei*, *C. modicella*, "Cercaria C" Szidat, and tentatively *Cercaria* sp. Hesse and *C. chrysenterica* Miller. Of these forms *Cercaria flexicauda*, *C. laruei* and "Cercaria C" Szidat are known to penetrate into fish and become localised in the lens of the eyes, while the last named form developes ultimately into *Hemistomum spathaceum* Rud., which La Rue has made the type of his genus *Proalaria*. In the second group they place *Cercaria douglasi*, *Cercaria Strigeae tardae* Steenstrup; Mathias; *Cercaria indica* I and *Cercaria fissicauda* La Val.; Brown, and tentatively include *Cercaria tenuis* Miller, *Cercaria indica* XXII Sewell and *Cercaria marcianae* La Rue, though this latter species they regard as an aberrant form. Dubois (1929) added *Cercaria helvetica* XIII (possibly identical with *Cercaria* C. Szidat), and *C. helvetica* XV to the *Proalaria* group, and in addition described certain other forms that appear to provide connecting links in the general evolutionary series of the Longifurcate Furcocercous Distomes.

The "Tetis" and "Vivax" groups of Furcocercous cercariae (*vide* Sewell, 1922, pp. 280, 291) appear from their excretory systems to form

a separate evolutionary series. Dubois (1929, p. 150) regards them as forming a transitional series between the " Monostome " and " Distome " Furcocercariae. As I have shown later Monostome forms appear to have been evolved on several occasions and from different sub-groups and at present we know too little of the connections of the flame-cells to enable us to form any opinion regarding the line of evolution of these aberrant forms.

Group I; *The " Strigea " Series.* (Plate IX).

Taking first the series in which a cross-connection between the two main excretory tubes is present, the most primitive type of excretory system would appear to be composed, as in the series that we have been previously considering, of four pairs of flame-cells, two pairs connected with the anterior collecting tubule and the other two with the posterior, the most posterior pair of flame-cells being situated in the tail-stem. As we have seen, such a system has the formula $2\times(1+2)+(3+[4])$; but at present no cercaria belonging to this series has been discovered with this simple type of system. The first step in the process of evolution that appears to have taken place is the division of the most posterior flame-cell, No. 4, into two daughter-cells, Nos. 4*a* and 4*b*, of which 4*a*, as in the Brevifurcate series, migrates into the distome body and only 4*b* remains in the tail-stem. The formula thus becomes $2\times(1+2)+(3+4a+[4b])$, and this type of system is known to be present in *Cercaria hirsuta* Miller and is, possibly, also present in *C. granula* Miller, though in a few cases additional flame-cells were detected (*vide* Miller, 1927, p. 73).

At this stage it seems probable that there have been two lines of evolution, differing in the position of the flame-cell that next undergoes division. In one series the next cell to divide is the most anterior, namely No. 1. This would give rise to the formula $2\times(1a+1b+2)+(3+4a+[4b])$. At the present time there is no known cercaria with this system but a subsequent stage, that is reached by the division of the most posterior flame-cell in the distome body, namely No. 4*a*, brings us to the formula $2\times(1a+1b+2)+(3+4a'+4a''+[4b])$ and this type of system is present in both *Cercaria bulbocauda* Miller and *C. absurda* Miller, two forms that possess a dilated tail-stem somewhat similar to that of *Cercaria anomala* Rao (1929). In spite of their abnormal type both these forms appear to belong to this series. In *Cercaria absurda* the furcal rami are remarkably short and more nearly resemble the condition present in the Brevifurcate series; but *Cercaria bulbocauda* possesses long furcal rami. This condition of the excretory system is apparently followed by a further subdivision of the most posterior flame-cell, No. 4*b*, the anterior daughter-cell, No. 4*b'*, migrating into the distome body. This change gives rise to a system having the formula $2\times(1a+1b+2)+(3+4a'+4a''+4b'+[4b''])$, which agrees with the condition present in certain examples of *Cercaria fissicauda* La Val; Brown. Brown (1926, p. 31) records that in certain examples of this species the number of flame-cells in the tail-stem was only one pair and it is probable that these examples were immature. In the majority of individuals, however, the system showed two pairs of flame-

cells in the tail-stem ; we thus would have a system represented by the formula $2\times(1a+1b+2)+(3+4a'+4a''+4b'+[4b''*+4b''**])$. This would appear to represent the excretory formula of the adult *Cercaria fissicauda* and has been reached from the immature stage by the subsequent division of the pair of flame-cells in the tail-stem, No. $4b''$

In an alternative route, the successive divisions of the two posterior pairs of flame-cells is reversed and in the first stage of evolution from the condition represented by the formula $2\times(1a+1b+2)+(3+4a+[4b])$ it is flame-cell No. $4b$ that divides into two, prior to the division of No. $4a$. At this stage the excretory system is represented by the formula $2\times(1a+1b+2)+(3+4a+[4b'+4b''])$. This formula is characteristic of the early or immature stage of development of *Cercaria douglasi*, as described originally by Cort (1917), and of the cercaria of *Strigea tarda* Streenstrup described by Mathias (1925). The subsequent division of flame-cell No. $4a$ would bring us to the condition represented by the formula $2\times(1a+1b+2)+(3+4a'+4a''+[4b'+4b''])$,which presents the same total number of flame-cells as in the immature *Cercaria fissicauda* Brown, but differs in having two flame-cells in the tail-stem ; no form, however, is at present known with this type of system. The next intermediate stages appear to be brought about by the division of flame-cells Nos. 3 and 2 each into a pair, but at present we have no evidence as to which of the two is the first to undergo division. The final stage of evolution is represented by the formula $2\times(1a+1b+2a+2b)+(3a+3b+4a'+4a''+[4b'+4b''])$ and this is the condition present in the mature *Cercaria douglasi* Cort and *Cercaria sanjuanensis* Miller, and possibly also in Cercaria A (Szidat). A further stage in the evolutionary series is represented by *Cercaria helvetica* XIV Dubois. In this species there are twelve flame-cells on each side of the body, as in *Cercaria marcianae* La Rue, but in this latter form there is present a cross-connection between the main excretory tubes, which places it in the " Strigea " series. The actual connections of the flame-cells are not known, but it is probable that the excretory system is represented by the formula $2\times(1a'+1a''+1b'+1b''+2a+2b)+(3a+3b+4a'+4b''+[4b'+4b''])$ and that this condition is reached from that present in the mature *Cercaria douglasi* Cort and *Cercaria sanjuanensis* Miller by the division of flame-cells $1a$ and $1b$ each into two.

Cercaria burti Miller appears to be an aberrant member of the series under consideration and is closely related to *Cercaria hirsuta* Miller. In this species there are only two flame-cells connected with the anterior collecting tubule and five with the posterior ; of these five, four are situated within the distome body and only one in the tail-stem. The manner in which this type of system has been evolved appears to have been from the formula, characteristic of *Cercaria hirsuta*, $2\times(1+2)+(3+4a+[4b])$ by the successive divisions of flame-cells Nos. $4a$ and 3, though which of the two is the first to divide cannot be stated, as no intermediate stage has as yet been discovered. The formula, representing the excretory system of *Cercaria burti*, is $2\times(1+2)+(3a+3b+4a'+4a''+[4b])$. So far as the distribution and connections of the flame-cells are concerned, an exactly similar excretory system is present in *Cercaria helvetica* XXXI Dubois (1929, pl. iv, fig. 14). In this latter

species, however, instead of a single cross-connection between the main excretory canals there are two, one lying just behind the acetabulum, as in *C. burti*, while a second crosses the body a little in front of the bifurcation of the intestinal caeca. A further stage of development along this line of evolution is probably represented by *Cercaria helvetica* XXIX Dubois (1929) in which species there are 12 flame-cells on each side, ten pairs being in the distome body and two pairs in the tail-stem. Unfortunately Dubois was unable to trace the connections of the flame-cells with the collecting tubules : it is, therefore, impossible to give a definite formula, but the arrangement as shown by him points to its being as follows, $2\times(1a+1b+2a+2b)+(3a'+3a''+3b'+3b''+4a'+4a''+[4b'+4b''])$. This stage can be reached from the condition present in *Cercaria burti* by the division of flame-cells 4*b*, 3*a*, 3*b*, 2 and 1, but in what order these cells divide is unknown.

There seems to be little doubt that all the species of cercariae in this evolutionary series will ultimately be found to belong either to the genus *Strigea* or to a very closely related genus.

Group II ; *The "Proalaria" Series.* (Plate X.)

The second series of the Pharyngeal Longifurcate Distome Cercariae is characterised by the absence of any connecting vessel across the distome body between the two main collecting tubules. As in the previous series, the most primitive stage in the evolutionary series is as yet unknown, but it would almost certainly possess the same excretory formula, namely $2\times(1+2)+(3+[4])$, two flame-cells being connected with each of the collecting tubules and the most posterior flame-cells being situated within the tail-stem. Starting from this simple type, the first stage in evolution appears, as in the "Strigea" series, to be brought about by the division of the most posterior flame-cell, No. 4, into two daughter-cells, Nos. 4*a* and 4*b*. Two cercariae seem to exhibit this type of system, so far as the actual number of flame-cells is concerned, but they show, *inter se*, a very interesting difference. In one, namely, *Cercaria modicella* Cort and Brooks, both the daughter cells remain within the tail-stem, and this species thus possesses the formula $2\times(1+2)+(3+[4a+4b])$ and, so far as is at present known, evolution along this line has not proceeded further. I have placed *Cercaria modicella* Cort and Brooks here provisionally. In their account of this species these authors figure only three flame-cells in the body, which is all that they were able to detect with certainty ; they, however, in the text (1928, p. 188) state that "the digestive system, penetration glands and excretory system as far as it could be worked out offer no points of difference from *C. flexicauda* and *C. laruei*." It is possible, therefore, that *C. modicella* should be grouped with these latter forms, but until the complete system has been traced its position must remain doubtful. In the other case only the posterior daughter-cell remains within the tail-stem and the anterior apparently migrates into the distome body. The formula thus becomes $2\times(1+2)+(3+4a+[4b])$. This type of excretory system is found to be present in *Cercaria micromorpha* Brown.

From this latter stage the evolution of the excretory system may, apparently, proceed along one of two lines. In the first, which appears

to be of the nature of a branch line, the first stage can only be conjectured, since there is no known form whose excretory system fits with the theoretical formula. In this line the flame-cell system of the anterior collecting tubule remains unaltered and consists of only two flame-cells on each side of the body; in the posterior system flame-cell No. 4*b* divides into 4*b*′ and 4*b*″, and of these the anterior daughter-cell migrates into the distome body. The formula thus becomes $2\times(1+2)+(3+4a+4b'+[4b''])$. The next stage, brought about by the division of flame-cell No. 4*b*″ in the tail-stem, brings us to the condition expressed by the formula $2\times(1+2)+(3+4a+4b'+[4b''*4b''**])$. In this way we ultimately get a condition in which there are five pairs of flame-cells within the distome body and two pairs in the tail-stem. This number agrees exactly with the condition present in the excretory system of *Cercaria tenuis* Miller. Miller (1927, p. 46, pl. vii, fig. 74) figures the flame-cells and their connections in this species but he remarks that their actual distribution is " not known beyond all possible question." The arrangement that he shows, however, agrees exactly with the formula given above, and, if this be correct, this line of evolution may be an alternative route by which the flame-cell system may have evolved to reach the condition found in *Cercaria chrysenterica* Miller, in which the excretory formula is $2\times(1a+1b+2)+(3+4a+4b'*+4b'**+[4b''*+4b''**])$, the necessary intermediate stages being brought about by the division of flame-cells Nos. 4*b*′ and 1.

In the second possible line of evolution and, so far as one can judge, the main line, the next stage of development following on the condition found in *Cercaria micromorpha*, is again similar to the corresponding change in the " Strigea " series, in which a cross-connection between the main collecting tubes is present; following the division of the posterior flame-cell, No. 4, the most anterior cell, No. 1, now divides into 1*a* and 1*b* so that in this line the third stage of evolution possesses the formula $2\times(1a+1b+2)+(3a+4a+[4b])$. This represents exactly the condition shown by me to be present in *Cercaria indica* I Sewell.

At this stage we again find that the course of evolution may take one of two directions. In both lines of evolution it is the most posterior flame-cell that divides, No. 4*b* giving rise to 4*b*′ and 4*b*″, and in one of the branches we find once again that the anterior of these two daughter-cells appears to migrate into the distome body, leaving only the most posterior cell in the tail-stem. The formula thus becomes $2\times(1a+1b+2)+(3+4a+4b'+[4b''])$, which is characteristic of *Cercaria macrosoma* Brown. As I have already mentioned (*vide supra*, p. 364) Miller has included this species in his " Elvae " group of the Apharyngeal Brevifurcate Distomes, but Brown describes and figures a perfectly definite pharynx, although he could detect no further trace of the alimentary canal, and it seems to me that the species fits, so far as the excretory system is concerned, much more naturally into the present series. The final known stage of evolution in this line is reached by the division of both the posterior flame-cells, Nos. 4*b*″ and 4*b*′, into two daughter-cells each, thus reaching the condition shown by the formula $2\times(1a+1b+2)+(3+4a+4b'*+4b'**+[4b''*+4b''**])$, which is again the exact expression of the excretory system present in *Cercaria chrysenterica* Miller.

In the second line of evolution both daughter-cells remain in the tail-stem, thus giving us the formula $2\times(1a+1b+2)+(3+4a+[4b'+4b''])$ and it is this type of excretory system that is found to be present in *Cercaria emarginatae* Cort. Exactly the same excretory formula is present in *Cercaria indica* XXII Sewell (1922, p. 276, pl. xxx, figs. 1-3). Although this latter species differs from most of the forms in this series, especially in the absence of any apparent pharyngeal bulb, it seems probable that, in reality, it should be grouped here with the pharyngeal forms. In *Cercaria indica* XXII, as I pointed out, there is a triangular dilatation of the oesophagus just behind the penetrating organ; in *Cercaria allahabadii* Chatterjee (1930, p. 65) this dilatation takes the shape of "a bulbar enlargement of the oesophagus. Unlike that of other cercariae and adult Trematodes it is not provided with muscle fibres." Finally in *Cercaria* sp. Hesse (1923, p. 227) there is a cluster of cells opening into the oesophagus in the position of the pharynx and Hesse (*loc. cit.* pl. 1, fig. 8*a*) labels this organ the pharynx in his illustration. These three cercariae appear to form a branch line of evolution in which the flame-cells in the tail lose their original connection with the posterior collecting tubule and acquire a secondary connection with the central caudal canal. Chatterjee does not appear to have been acquainted with Hesse's paper; but there can be little doubt that all three forms are closely related and probably form a progressive series. So far as the excretory system in *Cercaria indica* XXII is concerned, this, as mentioned above, agrees exactly with the condition present in *Cercaria emarginatae*. In *Cercaria allahabadii* Chatterjee there is an additional flame-cell in the distome body, produced, apparently, by the division of flame-cell 4*a*, and the formula for the whole system can be represented by $2\times(1a+1b+2)+(3+4a'+4a'')+[4b'+4b'']$; if Chatterjee's observations are correct, the two flame-cells on each side of the tail-stem, re-represented, as before, in the formula by the figures in square brackets, have completely lost their original connection with the posterior collecting tubule and have acquired a secondary connection with the central caudal canal and this is indicated by the altered position of the brackets. The exact relationship of *Cercaria* sp. Hesse, unfortunately, cannot be definitely stated. The division of flame-cell No. 3 into two, *viz.*, 3*a* and 3*b*, would give us the theoretical formula $2\times(1a+1b+2)+(3a+3b+4a'+4a'')+[4b'+4b'']$, and according to this there would be in all seven flame-cells in the distome body, as in Hesse's species, but it is impossible from his figure to determine the connections of these cells with the collecting tubules. In the tail-stem, however, he definitely shows, as Chatterjee has shown in *Cercaria allahabadii*, two flame-cells connected directly, with the central caudal canal.

Two other cercariae, *viz.*, *C. helvetica* XIII and *C. letifera* (Fuhrm.), which appear to be closely related to *C. emarginatae* Cort., have recently been described by Dubois (1929). In both instances the excretory system can be derived from the formula, characteristic of *C. emarginatae*, $2\times(1a+1b+2)+(3+4a+[4b'+4b''])$ by the division of a single flame-cell. In the case of the former species it appears to be flame-cell No. 3 that has divided, giving rise to the formula $2\times(1a+1b+2)(3a+3b+4a+[4b'+4b''])$, three flame-cells on each side of the body being connected

with the anterior collecting tubule, and five, of which two are in the tail-stem, with the posterior. In *C. letifera* Fuhrm., although the total number of flame-cells is the same, namely 8 pairs, their arrangement is different. The condition in this species is reached from that present in *C. emarginatae* Cort by the division of flame-cell No. 2 thus giving the formula $2\times(1a+1b+2a+2b)+(3+4a+[4b'+4b''])$.

Turning back once again to the condition present in *Cercaria emarginatae* the next stage in the main line of evolution of the system is, apparently, brought about by the division of the most posterior flame-cell in the distome body, No. 4*a*, into two, thus giving us a type of excretory system represented by the formula $2\times(1a+1b+2)+(3+4a'+4a''+[4b'+4b''])$. This type of system is present in *Cercaria flexicauda* Cort and Brooks and *Cercaria laruei* Cort and Brooks, and possibly also in *C. modicella* Cort and Brooks (*vide supra*, p. 372). The next stage in the process is, unfortunately, again unknown, but assuming that the process follows the same course as in the preceding series, the division of flame-cell No. 3 into 3*a* and 3*b* would give us the formula $2\times(1a+1b+2)+(3a+3b+4a'+4a''+[4b'+4b''])$, a condition that at present has no known representative ; the number of flame-cells agrees with those present in *Cercaria* sp. Hesse, but differs from that species in having the flame-cells in the tail connected with the posterior collecting tubule and not with the central caudal canal. This stage may, however, represent an alternative route in the evolution of *Cercaria* sp. Hesse. A further stage in the evolution appears to be reached by the division of flame-cell No. 2 into two daughter-cells Nos. 2*a* and 2*b*. The formula thus becomes $2\times(1a+1b+2a+2b)+(3a+3b+4a'+4a''+[4b'+4b''])$, a condition that is characteristic of *Cercaria longifurca* Cort and Brooks. The final stage in the series, so far as our present knowledge extends, is reached by the division of both the two anterior cells, namely 1*a* and 1*b* into two, the final formula thus being $2\times(1a'+1a''+1b'+1b''+2a+2b)+(3a+3b+4a'+4a''+[4b'+4b''])$, which represents the system present in *Cercaria marcianae* La Rue.

In 1922 I pointed out that, corresponding to the Longifurcate Furcocercous Distomes, there was a Monostome form, represented by *Cercaria indica* XXVII Sewell ; and since then three additional Monostome forms related to the same series have been described, namely *Cercaria bessiae* Cort and Brooks, *Cercaria multicellulata* Miller and *Cercaria hamata* Miller. If, as seems probable, the Monostome Longifurcate Cercariae have been derived from the Distome series by the suppression of the acetabulum, it becomes a matter of some importance to try and discover whether the four species mentioned above represent a single line of evolution or whether the Monostome type has been evolved from the Distome series on more than one occasion, in which case the disappearance of the acetabulum must be attributed to convergence, or, as it is sometimes called, parallelism in evolution.

In this Monostome series we appear to start, as in the Distome series, with the simple excretory formula $2\times(1+2)+(3+[4])$ representing a system in which there are four flame-cells on each side of the body, the most posterior being situated in the tail-stem and two flame-cells being connected with the anterior and posterior collecting tubules respectively. Such a system has been shown by me to be present in *Cercaria indica*

XXVII Sewell. *Cercaria bessiae* Cort and Brooks possesses in all eight pairs of flame-cells, six on each side in the distome body and two in the tail-stem. The full connections of these flame-cells have not been worked out, but, so far as it is possible to judge from their positions as shown (*vide* Cort and Brooks, 1928, pl. xxvii, fig. 1), and the distribution of the capillaries, the formula for the whole system would appear to be $2\times(1a+1b+2)+(3+4a+4b'+[4b''*+4b''**])$. The condition represented by this formula is exactly intermediate between the condition present in the excretory system of *Cercaria macrosoma* Brown and *Cercaria chrysenterica* Miller on the one hand, and between that of *Cercaria tenuis* Miller and *Cercaria chrysenterica* Miller on the other, but the complete absence of an acetabulum indicates that this form represents a branch line in the process of evolution and cannot be regarded as a direct stage between either of the above-mentioned forms. An excretory system of this type could be reached by a separate line of evolution commencing from the condition present in *Cercaria indica* I Sewell, in which, as noted above, the excretory formula is $2\times(1+2)+(3+[4])$. The first step in such a line of evolution would appear to be the division of flame-cell No. 4 into 4*a* and 4*b*, the anterior daughter-cell 4*a* migrating into the body; we should thus reach a Monostome form in which the excretory formula would be $2\times(1+2)+(3\ 4a+[4b\ ])$, as in *Cercaria micromorpha* Brown, and by the subsequent division of (*a*) flame-cell 4*b*, into 4*b'* and 4*b''*, 4*b''* migrating into the body, (*b*) flame-cell 4*b''*, both daughter-cells remaining in the tail-stem, and (*c*) flame-cell I, we arrive at the formula given above for *Cercaria bessiae*, but at the present time no monostome species with excretory systems corresponding to any of the intermediate stages have been discovered.

Two other Monostome forms, namely *Cercaria multicellulata* Miller and *Cercaria hamata* Miller, possess an excretory system that can be expressed by the formula $2\times(1a+1b+2a+2b)+(3a+3b+4a'+4a''+[4b'+4b''])$. They thus agree exactly with the condition present in *Cercaria longifurca* Cort and Brooks. Such a condition of the excretory system cannot be derived from that present in *Cercaria besiae* and it seems highly probable that both these forms have been evolved by the suppression of the acetabulum from a Distome ancestor that possessed this type of excretory system. Faust (1924, Table II) groups the "Rhabdocoela" and "Lophoides" groups together with the basic formula $2\ [(2)^n+2]$, and in the "Rhabdocoela" group he places together *Cercaria rhabdocoela*[1] and *C. multicellulata* Miller. While the total number of flame-cells is identical in these two species, their connections with the main excretory tubes are very different, and on this ground I think they should not be placed in the same sub-group. The evidence at our disposal thus certainly points to the monostome condition having arisen independently in the group of Holostome cercariae on three different occasions.

Group III. (Plate XI).

An additional line of evolution may possibly be represented by certain cercariae that Faust (1919, pp. 330-331, 336-339) described from Rome,

[1] The name of this species as given originally by Faust (1919, p. 338) is *C. rhabdocoela.*

Georgia and Urbana, Ill. in America. In this series Faust attributes to *Cercaria furcicauda* three basic groups of two flame-cells each, in *Cercaria quattuor-solenata* there are four such groups, and in *Cercaria rhabdocoeca*[1] there are five. A study of these forms shows clearly that they must be placed in different sub-groups but it also shows that the flame-cell system in each species and sub-group can be derived from a single fundamental 4 flame-cell system, such as we have seen to be present in the other groups of the Longifurcate Distome series, by the successive division of certain pairs of flame-cells, and, since there is no cross-connection between the main excretory tubes, the group would appear to be connected with the " Proalaria " series.

In this series we again start from the fundamental system of two flame-cells connected with both anterior and posterior collecting tubes, the most posterior flame-cell on each side being situated within the tail-stem; the formula is thus, as before, $2\times(1+2)+(3+[4])$. The next stage in evolution appears to be brought about by the division of the most anterior flame-cell, No. 1, into $1a$ and $1b$, thus giving a system having the formula $2\times(1a+1b+2)+(3+[4])$. At the present time no cercaria with this system is known but the next step in development, brought about by the division of flame-cell No. 2 into $2a$ and $2b$, gives us the formula $2\times(1a+1b+2a+2b)+(3+[4])$. It is possible that the order in which the successive divisions take place may be the reverse of that given above but the final state exactly represents the degree of development in *Cercaria furcicauda* Faust. From this stage it would appear that development may proceed along two lines. In the first the next flame-cell to divide is No. $1b$, giving the formula $2\times(1a+1b'+1b''+2a+2b)+(3+[4])$, which corresponds with the arrangement of the flame-cells, as given by Faust (1919, p. 329, fig. 7), in *Cercaria robusticauda* Faust. As Faust points out, the size of the anterior flame-cell in this species, which is considerably larger than the others, points to its undivided character or, as he expresses it, its " double nature; " if this be the correct view, one would have expected the flame-cells in the posterior end of the body to be equally large, but this is not the case, if one may judge from Faust's figure, though the 2nd and 3rd pairs of flame-cells in the anterior end of the body seem to be intermediate in size between the 1st pair and those at the posterior end.

The second possible line of evolution proceeds from the condition present in *Cercaria furcicauda* Faust by the division of flame-cell No. 4 into $4a$ and $4b$, giving the formula $2\times(1a+1b+2a+2b)+(3+[4a+4b])$, both the daughter-cells remaining within the tail-stem; and then by the division of flame-cell No. 3 into two we reach the stage represented by $2\times(1a+1b+2a+2b)+(3a+3b+[4a+4b])$, which exactly expresses the condition of the excretory system in *Cercaria quattuor-solenata* Faust so far as the number of the flame-cells is concerned, but the character of the connections of these flame-cells is very different from those of other members of the series. As Faust (1919, p. 331) points out, in this species " the main collecting tubule has been shortened to a minimum,

[1] Faust (1924, Table II) refers to this species and the group in which he places it by the specific name *rhabdocoela*.

while the four secondary tubules have been lengthened accordingly." The resulting pattern is so different that one may be justified in doubting whether the species should rightly be included in the series. Finally, the successive divisions of flame-cells 1*b* and 1*a*, each into two daughter-cells, gives us a system, expressed by the formula $2\times(1a'+1a''+1b'+1b''+2a+2b)+(3a+3b+[4a+4b])$, which closely corresponds with that in *Cercaria rhabdocoeca* Faust. In this species Faust (1919, p. 330) figures five pairs of flame-cells arising independently from the main excretory canal, *i.e.*, ten flame-cells on each side, and of these the posterior pair is situated in the tail-stem and the other 4 pairs in the Distome body. There is no actual division of the main excretory tube into anterior and posterior branches; the condition could, however, be reached if we suppose that the pair of flame-cells $(3a+3b)$ have shifted their position from their original point of origin from the posterior collecting tube to the anterior collecting tube—this would give a formula $2\times(1a'+1a''+1b'+1b''+2a+2b+3a+3b)+[4a+4b]$. At the same time in this species the acetabulum has been suppressed, and this and the characters of the alimentary canal show a resemblance to the "Lophoides" group, near which Faust classes it. Its exact position in the evolutionary series must, however, for the time being be left uncertain.

The order of division of the flame-cells in this series would thus appear to be Nos. 1, 2, 4, 3, 1*b* and 1*a*, which is entirely different from the order in the other series of Longifurcate Distomes that we have studied.

In the accompanying Plate XII I have shown the probable course of evolution among the Pharyngeal Longifurcate Furcocercous Cercariae, both Distomes and Monostomes. As before I have started with the primitive ancestral form, possessing an excretory formula of $2\times(1+2)+(3+[4])$ and have noted the order in which the various flame-cells have undergone division. It will be seen that at the outset there was a division into two main lines of evolution, distinguished from one another by the presence or absence of a cross-connection between the main collecting tubules of opposite sides of the body. It is interesting to note that in two of the main lines of these evolutionary series, namely the Douglasi-helvetica XIV line of the "Strigea" and the Emarginatae-marcianae line of the "Proalaria" series, the order in which the flame-cells undergo division appears to be identically the same, namely Nos. 4, 1, 4*b*, 4*a*, 3, 2, 1*b* and 1*a*. This suggests the possibility that this order of division had been impressed upon the ancestral series prior to the change that gave rise to the two sub-divisions, namely the development of the cross-connection between the collecting tubules.

Throughout both series there is a marked tendency for the more posterior flame-cells to undergo division before those that are situated more anteriorly and, as we have already noted in the Brevifurcate cercariae, there is also a tendency for the anterior daughter-cell produced by the division of the flame-cell in the tail-stem to migrate into the distome body.

Finally, it seems clear that the suppression of the acetabulum and the consequent production of a monostome form has occurred on more than one occasion and in different lines of evolution.

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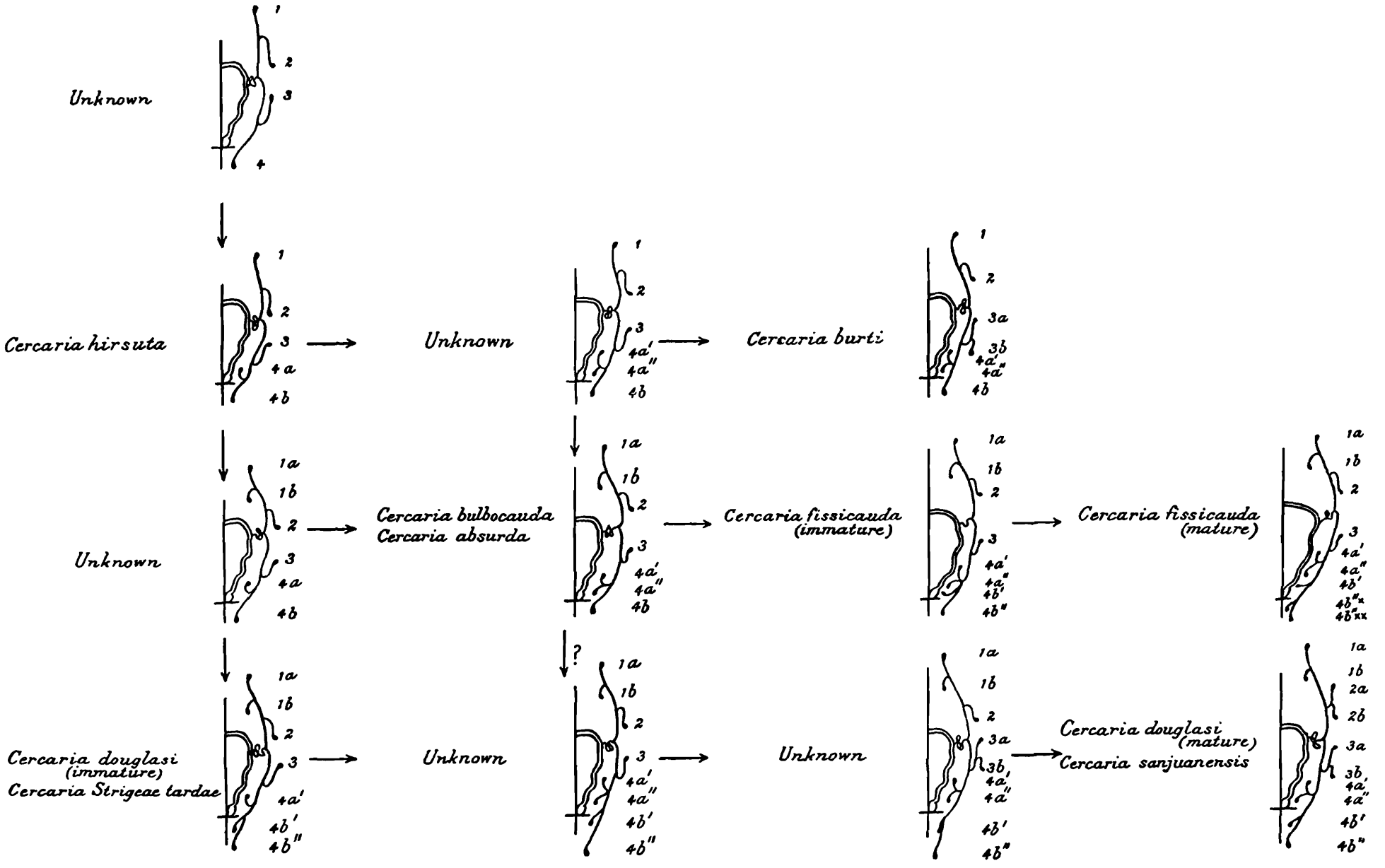
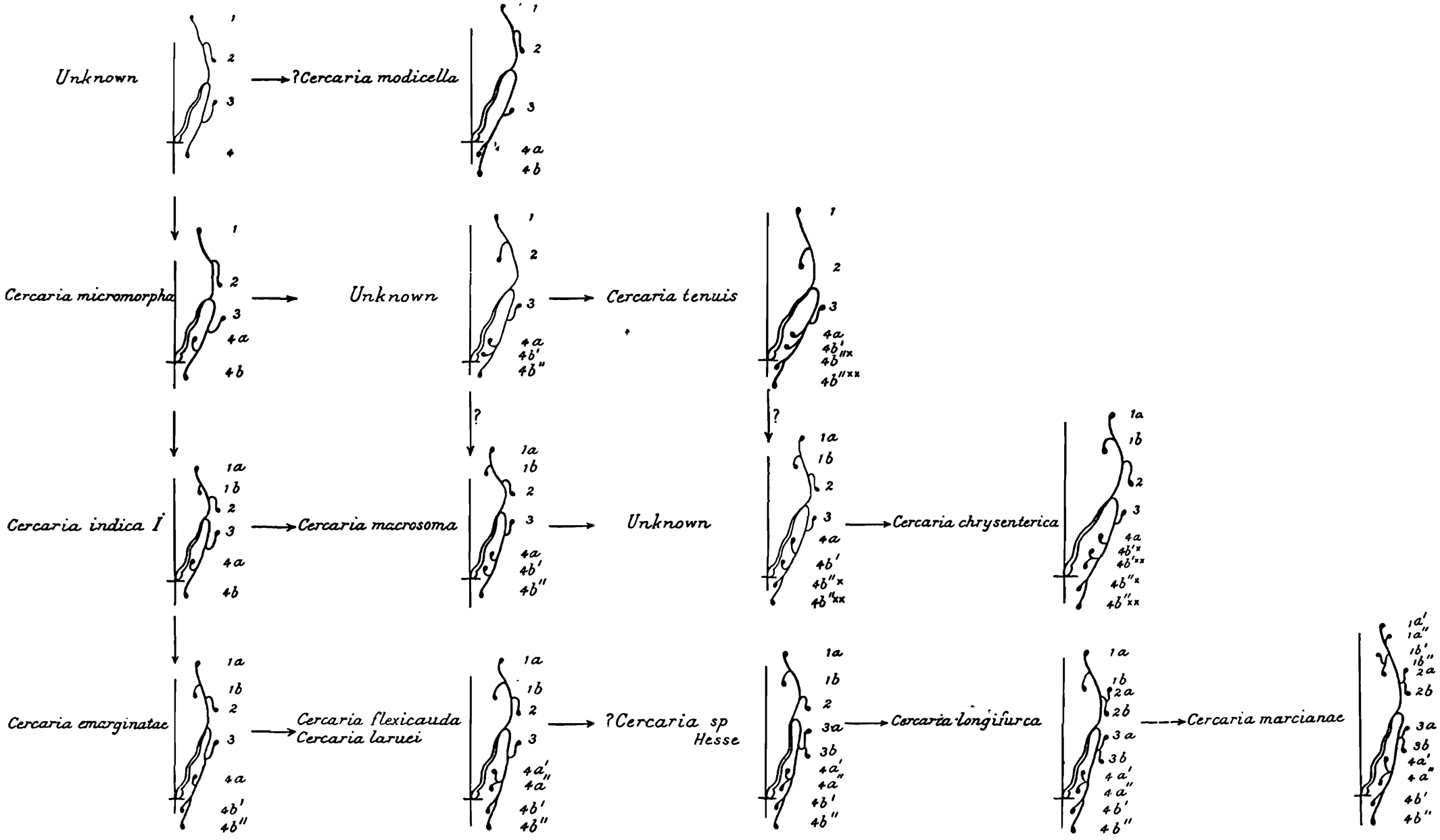


R. B. S. S. del.

The excretory system in the STRIGEA division of the Longifurcate Distome group of the Furcocercous Cercariae.



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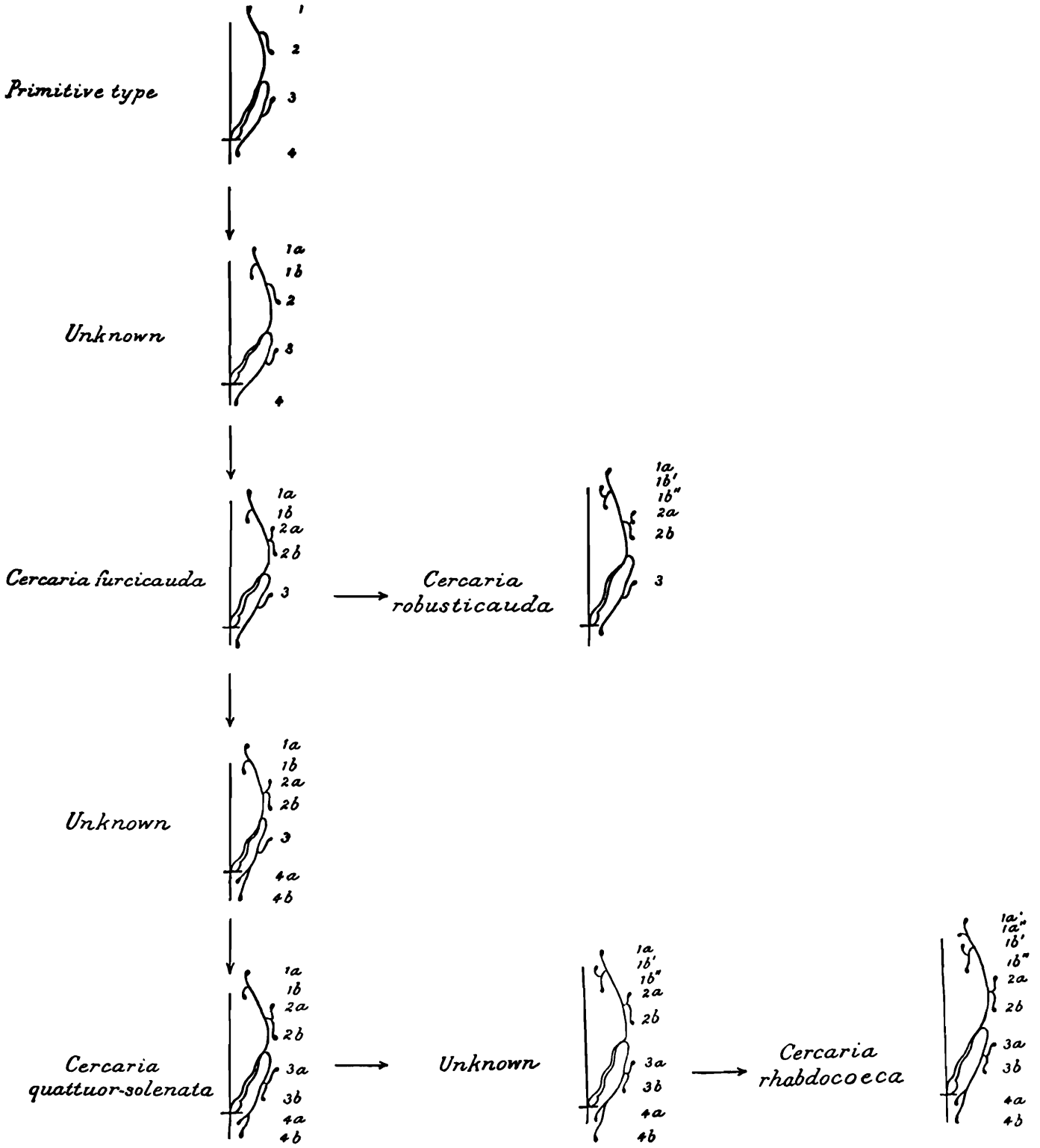
The excretory system in the PROALARIA division of the Longifurcate Distome group of the Furcocercous Cercariae.



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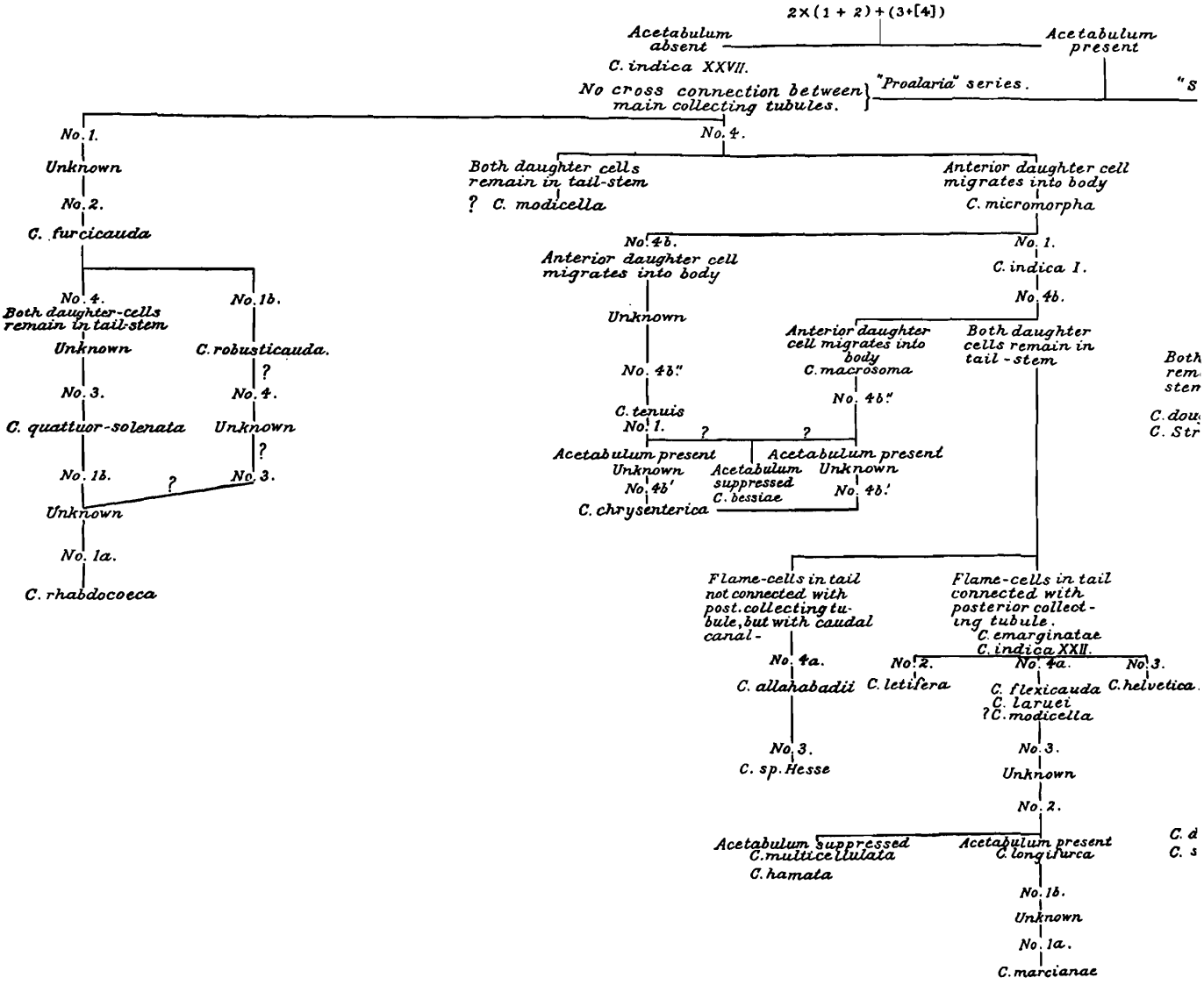
The evolution of the excretory system in GROUP III of the Furcocercous Cercariae.



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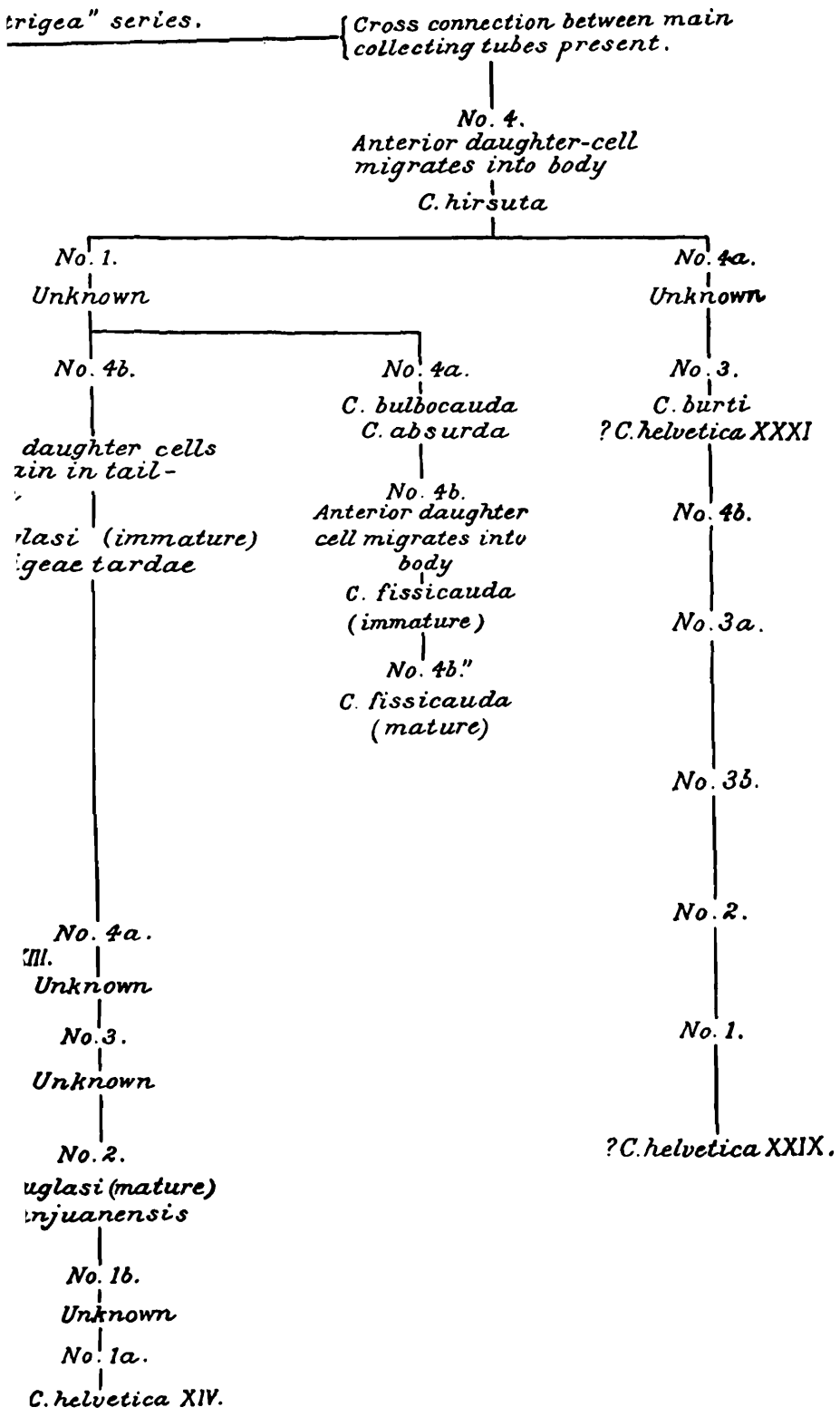
The probable lines of evolution of the Longifurcate Furcocercous Cercariae.


trigea" series.
Cross connection between main collecting tubes present.
No. 4.
Anterior daughter-cell migrates into body
C. hirsuta
No. 1.
Unknown
No. 4a.
Unknown
No. 4b.
No. 4a.
No. 3.
daughter cells
zin in tail-
rlasi (immature)
igeae tardae
C. bulbocauda
C. absurda
C. burti
?C. helvetica XXXI
No. 4b.
Anterior daughter cell migrates into body
C. fissicauda (immature)
No. 4b."
C. fissicauda (mature)
No. 4b.
No. 3a.
No. 3b.
No. 2.
No. 1.
?C. helvetica XXIX.
No. 4a.
III.
Unknown
No. 3.
Unknown
No. 2.
uglasi (mature)
njuanensis
No. 1b.
Unknown
No. 1a.
C. helvetica XIV.

PARASITIC NEMATODES OBTAINED FROM ANIMALS DYING IN THE CALCUTTA ZOOLOGICAL GARDENS.

Parts 1—3.

By P. A. Maplestone, *D.S.O., M.B., Ch.B., D.T.M.*

(From the Calcutta School of Tropical Medicine and Hygiene, Hookworm Research Laboratory).

Part 1. Nematodes from the Gharial.

Linstow (1906) described two Nematodes from the Gharial (*Gavialis gangeticus*, Geoffr.) *viz.*, *Micropleura vivipara* and *Typhlophoros lamellaris* These are interesting and characteristic parasites for they represent two genera, which have not been found in any other hosts.

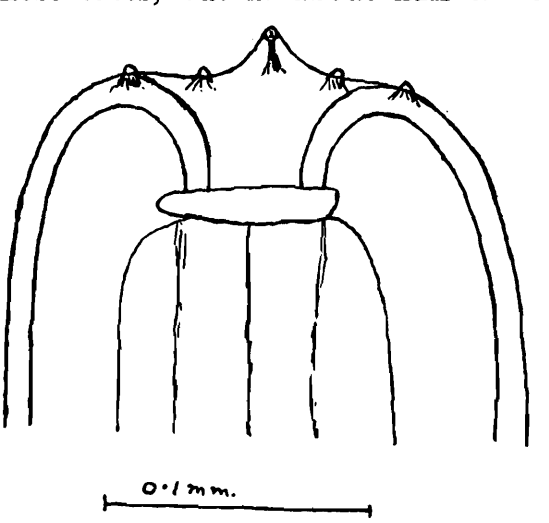
Baylis and Daubney (1922), and Baylis (1924) redescribed the female and male respectively of *M. vivipara*, which corrected Linstow's original description and made several additions to it. I have recently obtained collections of this worm from two Gharials, and have been enabled to modify the above descriptions to some extent, as the material is fixed in a well extended position.

Typhlophoros lamellaris has not been recorded since Linstow first found it. I have obtained a few females of this species, only one of which is mature, but from this I am able to elucidate certain characters missed or wrongly described by Linstow.

In an editorial note on Linstow's paper there is mention of an unidentified *Ascaris*. I have obtained from one of the Gharials examined a worm with the characters of the genus *Multicaecum*, Baylis, 1923 and from the other a single female also belonging to the Anisakinae but apparently a new genus, so it is probable that one of these species is the one referred to.

Micropleura vivipara.

The description given by Baylis and Daubney (1922) agrees with my material in most cases, but in about half the number, which are



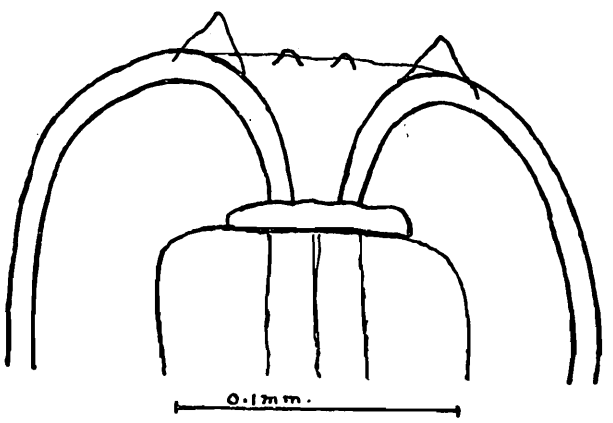
Text-fig. 1.—*Micropleura vivipara.* Anterior extremity, lateral view.

fixed in a well extended position, the large lateral papillae project beyond the anterior end of the worm, and in addition to the sub-dorsal and sub-ventral papillae on each side there are two more papillae close to the base of the lateral papilla (fig. 1). The figure of the female tail by Baylis and Daubney is obviously from a contracted specimen, as the tip of the tail is shown as an irregular knob, which forms an almost equilateral triangle with the two caudal papillae. In my material the tail is much longer and it ends in a rounded tip, over which the cuticle is thicker (fig. 3).

Typhlophoros lamellaris.

In the single mature specimen of this species available the ovaries are well developed although no eggs are yet formed, and as it is 15 mm. in length and 0·29 mm. in diameter it must be practically fully grown, as Linstow gives the length of the female as 16 mm. and the diameter as 0·32 mm.

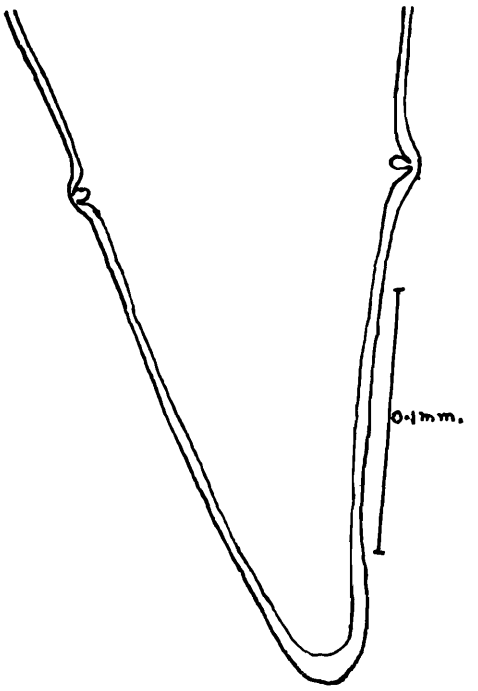
Linstow states that there is no excretory pore, but in all my specimens both the pore, which is 0·44 mm. from the anterior end, and the canal



Text-fig. 2.—*Micropleura vivipara.* Anterior extremity, dorsal view.

leading from it, are exceptionally distinct. The lips also vary somewhat from that shown in Linstow's figure. The dorsal lip is broad and is surmounted by a triangular cuticular prolongation (fig. 4), and the sub-ventral lips are broad (fig. 5). The mouth opening leads into a diamond-shaped buccal cavity. The oesophagus in the mature specimen is 1·78 mm. in length. Linstow describes an intestinal diverticulum lying dorsal to the oesophagus and reaching the anterior end of the worm. In my mature specimen this diverticulum ends 0·475 mm. from the anterior end, and in the immature example this distance is proportionately less. In addition to the diverticulum there is a complicated ventriculus arising from the ventral surface of the end of the oesophagus, which consists of two anterior and three posterior caeca similar to that seen in *Multicaecum agile* (Wedl., 1836), but it is much shorter than in this species, being only 0·128 mm. from the anterior end of the anterior caeca to the posterior end of the posterior caeca (fig. 6). The vulva is an inconspicuous opening 7·65 mm. from the anterior end, and in this respect agrees with Linstow's description. A muscular vagina, 0·99 mm in length, runs posteriorly from the vulva and the two uterine branche run anteriorly and posteriorly respectively. Linstow says the posterior

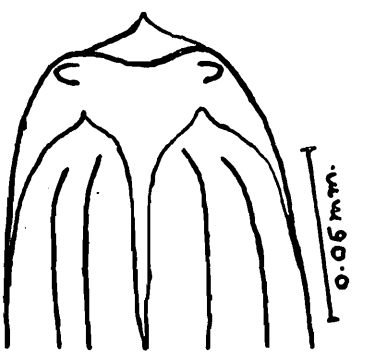
end of the female curves dorsally. In my material this portion of the worm curves ventrally and the sharp cuticular point makes a dorsal



Text-fig. 3.—*Micropleura vivipara.* Female tail, lateral view.

bend. The distance from the anus to the tip of the tail is 0·208 mm., which is the same as in Linstow's material (fig. 7). The two roundish projections in front of the anus mentioned by Linstow could not be made out.

Although certain differences from Linstow's description exist in my material these are slight, and there seems to be little doubt that it is the same species, and the remarkable cuticular ornamentation around the cephalic extremity is the same in both cases.



Text-fig. 4.—*Typhlophoros lamellaris.* Anterior extremity, dorsal lip.

The presence of an oesophageal ventriculus of the same character as in *Multicaecum* is of considerable interest, but this point alone is not sufficient to make advisable the inclusion of *Typhlophoros lamellaris* in the former genus, for it differs in many other points. For example the lips are not divided from the rest of the body, dentigerous ridges and interlabia are absent, and the distinctive cuticular cordons on the anterior end of the worm are present.

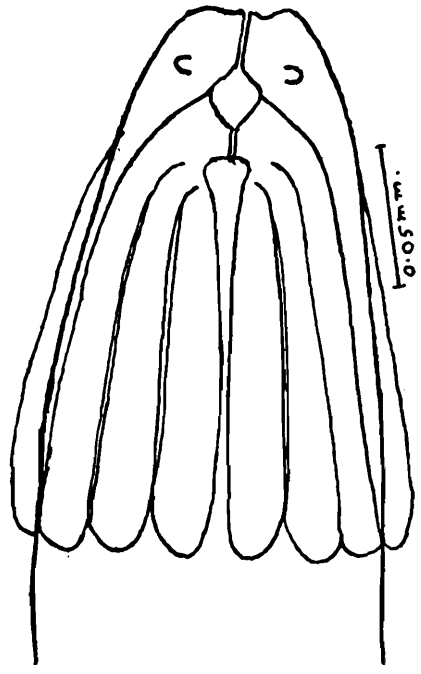
It is proposed to alter the generic definition of *Typhlophoros* as follows, to agree with the additional characters noted in the present instance.

Typhlophoros. Anisakinae. Mouth with simple lips, not separated from the rest of the body by a grove, interlabia and dentigerous ridges absent. Behind the lips the anterior end is furnished with longitudinal cuticular ridges. Intestinal caecum running forward from the oesophago-intestinal junction. Oesophageal ventriculus, consisting of two anterior and three posterior caeca, present. Vulva a little in front of the middle of the body.

Multicaecum sp.

Baylis (1923) redescribed *Ascaris agile* Wedl, 1862, from *Crocodilus niloticus*, and made it the type of a new genus, *Multicaecum*.

I recently recovered a number of immature male and female worms from the stomach of a Gharial. Although they are only about half the size of Baylis' material they appear to agree in all essential points



Text-fig. 5.—*Typhlophoros lamellaris.* Anterior extremity, ventral view.

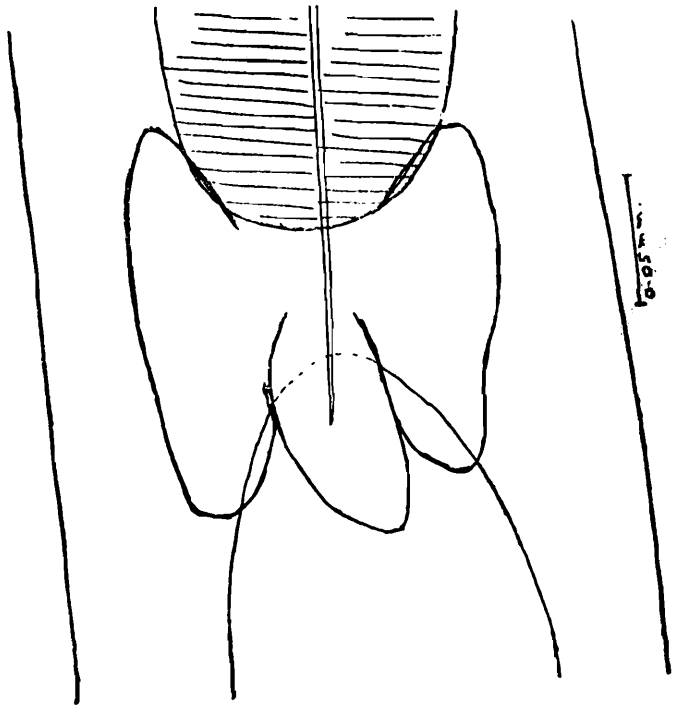
with *Multicaecum agile* as described by him. It is possible that the present specimens may represent a new species of *Multicaecum*, but in the absence of mature worms it is not possible to be definite on this point. Therefore, pending the discovery of fully grown worms of this species in a Gharial, it is proposed to merely record the presence in this host of a species of the genus *Multicaecum*.

Polycaecum gangeticum, n. g., n. sp.

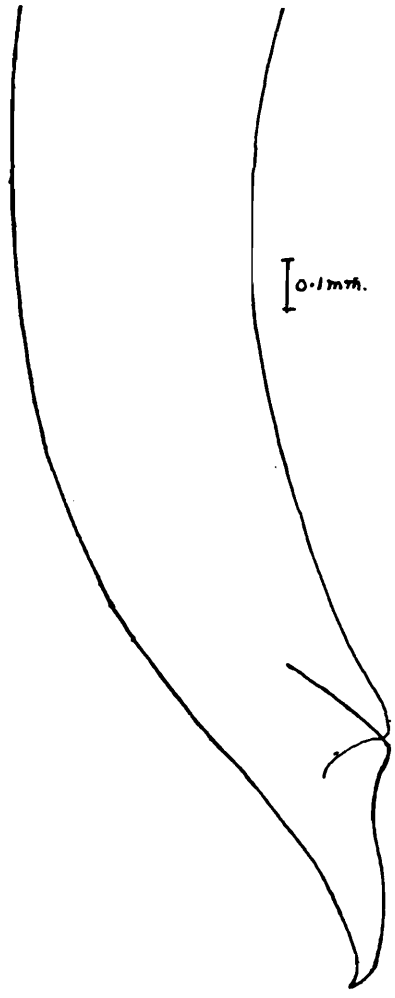
A single immature female, apparently the representative of a new genus, was found in the intestine of a Gharial.

Although the ovaries are not fully formed, other characters are sufficiently clear to enable a description being given. The worm is

11·5 mm. in length and 0·226 mm. in greatest diameter. The mouth is surrounded by three lips not marked off by a groove from the body,

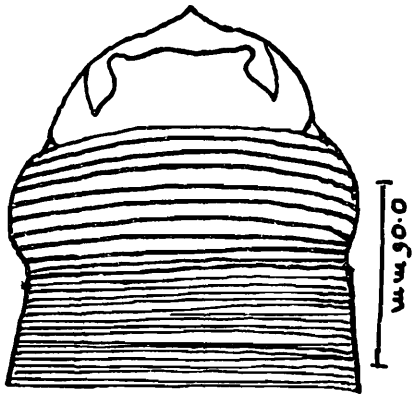


Text-fig. 6.—*Typhlophoros lamellaris.* Region of oesophago-intestinal junction showing oesophageal ventriculus and caeca.



Text-fig. 7.—*Typhlophoros lamellaris.* Female tail, lateral view.

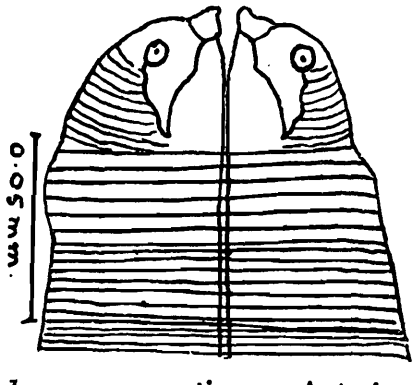
and there are no interlabia. The dorsal lip is triangular in shape and the sub-ventral lips are broad and crescentic, the tips being formed by clear cuticular caps (figs. 8 and 9). Immediately behind the lips there is a circular swelling, which is more pronounced dorsally and laterally than it is ventrally. The whole cuticle is covered by transverse striations, which are distinctly coarser on the cephalic swelling than they are on the rest of the body (fig. 8). The excretory pore opens 0·416 mm. from the anterior end. The oesophagus is long and straight and measures 2·675 mm. in length. It ends in a short ventriculus, which gives off five caeca; the two anterior caeca are very unequal, and of the three posterior caeca the central one is much shorter than the other two (fig. 10). The longer anterior caecum and the two longer posterior caeca are about 0·396 mm. in length. There is also a long



Text-fig. 8.—*Polycaecum gangeticum*. Anterior end, dorsal view.

intestinal caecum running forward dorsal to the oesophagus and about 1·98 mm. in length. The vulva opens exactly in the middle of the body, being 5·75 mm. from the anterior end. The vagina runs posteriorly from the vulva. The tail is straight and ends in a blunt tip surmounted by a fine cuticular point. The distance from the anus to the tip of the tail is 0·176 mm., and there is a long cuticular rectum connecting it with the termination of the intestine (fig. 11). No eggs are present.

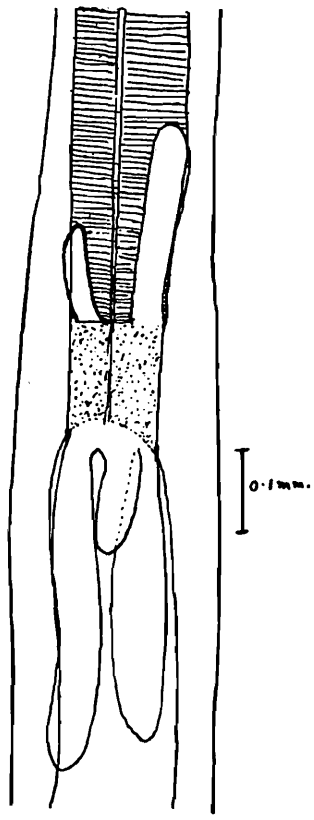
This worm differs from the two other genera which have an oesophageal ventriculus giving off five caeca, and both of which occur in the



Text-fig. 9.—*Polycaecum gangeticum*. Anterior end, ventral view.

Gharial, it is therefore considered necessary to create for it a new genus for which the name *Polycaecum* is proposed, and the name of the type-species is *P. gangeticum*, n. sp.

Definition of the genus *Polycaecum*. Anisakinae. Mouth surrounded by three lips not separated from the rest of the worm by grooves, and without interlabia. Immediately behind the lips there is a cuticular collar bearing coarser striations than the rest of the body. The oesophageal ventriculus gives off two anterior and three posterior caeca, and



Text-fig. 10.—*Polyaecum gangeticum*. Region of the oesophago-intestinal junction showing the oesophageal ventriculus and caeca.

there is an intestinal caecum running forward dorsal to the oesophagus. The vulva opens near the middle of the body. Male unknown.

NOTE.—As only a single immature female of this species is known it is probable that the dimensions of the worm given above are less than they would be in fully grown specimens.

The type-specimen is in the Indian Museum, Calcutta.

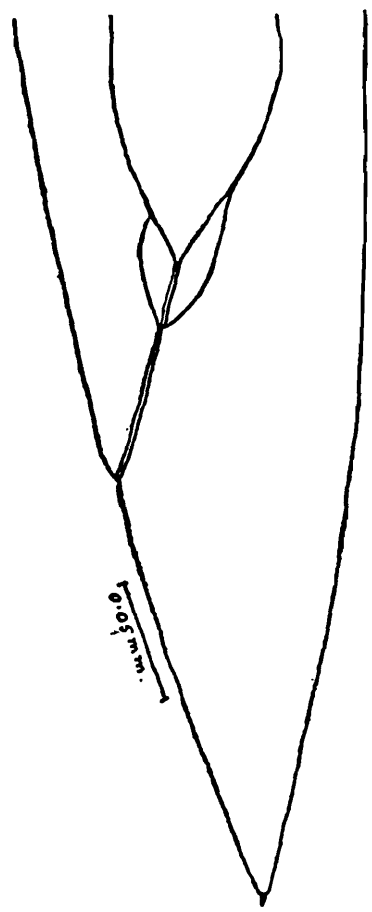
Goezia gavialidis, n. sp.

A single female specimen of this worm was found in the stomach of a third Gharial, which was examined recently.

The worm is 6·6 mm. in length, and 0·6 mm. in maximum diameter, which is well behind the middle of the worm. The anterior end is bluntly rounded and it is surmounted by three large lips (figs. 12 and 13). The dorsal lip appears as a large oval pulpy mass surrounded by thick cuticle, and two pointed papillae arise from its inner surface. The subventral lips each have a prominent angle which curves outwards and backwards (fig. 12).

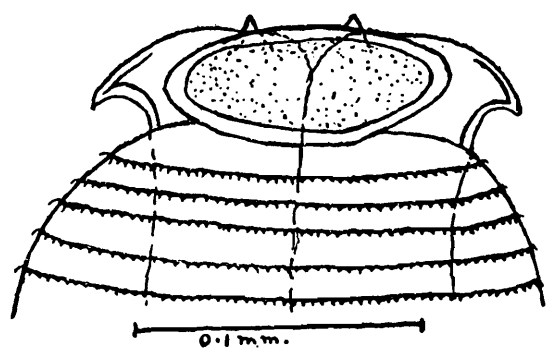
The cuticle is covered with prominent circular striations about 0·048 mm. apart and which bear on their posterior borders rows of

finely pointed spines directed backwards. These striations and spines extend for the whole length of the worm, and are of approximately



Text-fig. 11.—*Polycaecum gangeticum.* Female tail, lateral view.

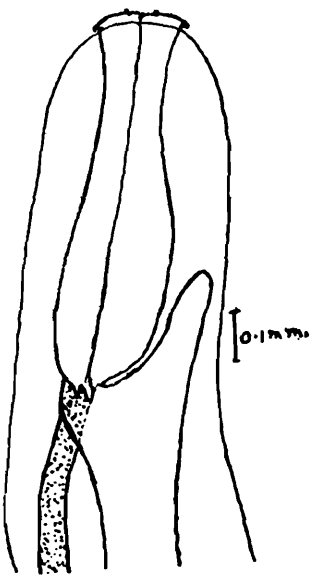
the same size, except on the tail itself where the striations are closer together and the spines are very minute. The vulva opens 2·8 mm.



Text-fig. 12.—*Goezia gavialidis.* Anterior extremity, dorsal view.

from the anterior end. The vagina is a much convoluted tube which curves forward only a little distance in front of the vulva, it then bends backwards and divides into the two uteri. These tubes pursue a posterior course and finally enter the ovaries, which run a very convoluted course almost to the posterior end of the worm. The oesophagus is 0·75 mm. in length with a very slightly marked posterior bulb. There is a long thin glandular appendix, which arises from the posterior end of the oesophagus and is 1·5 mm. in length. There is also a short diverticulum, which arises from the intestine at its junction with the oesophagus

and which runs forwards for about 0·2 mm. (fig. 13). The intestine is thin-walled with a very wide lumen. It ends in an anus which is 0·2 mm.

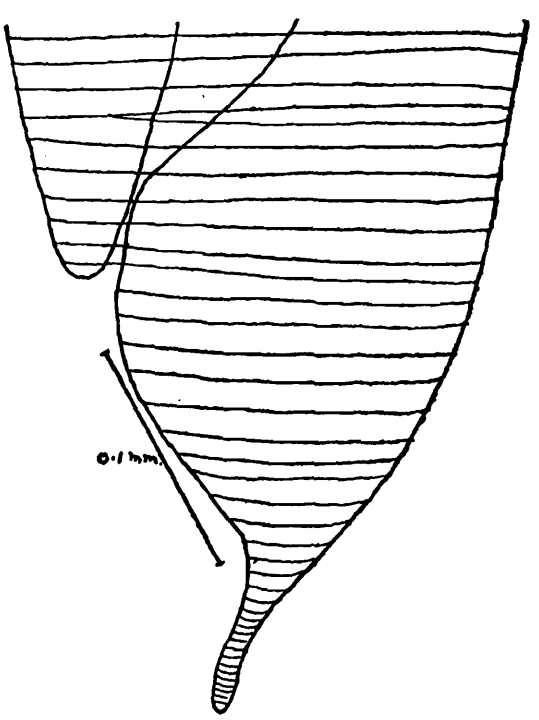


Text-fig. 13.—*Goezia gavialidis.* Anterior extremity, low power to show intestinal appendages. Spines not shown.

from the tip of the tail. The worm is broad to behind the anus, a little distance posterior to which it suddenly becomes narrower to end in a relatively long thin point (fig. 14).

Male unknown.

The large lips, the circular rows of cuticular spines, the shape of the tail, and the characteristic appendages to the intestinal tract place this worm in the genus *Goezia*.



Text-fig. 14.—*Goezia gavialidis.* Posterior extremity of female, lateral view. Spines not shown.

The existing members of this genus are four in number *viz.*, *G. ascaroides* (Goeze, 1782), *G. annulata* (Molin, 1860), *G. kollari* (Molin,

1858), and *G. spinulosa* (Diesing, 1839). They originally existed under many different generic names, and they were placed in the genus *Goezia* Zeder, 1800, by Railliet and Henry (1915), who did this on the published descriptions of the worms, and without examining any material. These worms do not appear to have been described since their original discovery so the descriptions are naturally incomplete according to modern standards. It is therefore not possible to say with absolute certainty that the present worm is a new species, but it is considered probable that it is so, in view of the different host and locality in which it has been found. At the same time it must be remembered, that although all the members of this genus hitherto described have been found in fish, the present worm is in a fish eating animal, and it is possibly a true parasite of a fish, which has only been liberated by digestion from its true host in the stomach of the Gharial in which it was found.

The type-specimen is in the Indian Museum, Calcutta.

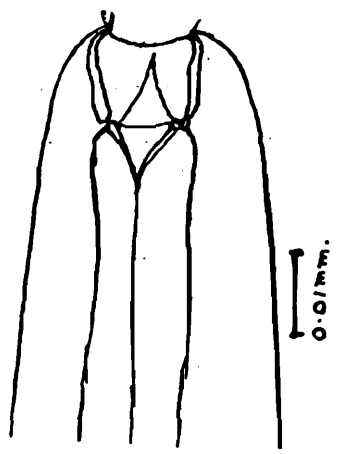
PART 2. THE SUBFAMILY AMIDOSTOMINAE TRAVASSOS, 1919.

Baylis and Daubney (1926) raised this sub-family to family rank without making any change in it, but this seems an unnecessary elevation of a small group of Nematodes, which show sufficiently close affinities with the Trichostrogylinae to be classed in the family Trichostrongylidae.

Amidostomum fuligulae, n. sp.

This worm was found on the first occasion in the gizzard of a Golden-Eyed Pochard (*Fuligula cristata*). It has since been recovered from *Aythya ferina*, and several ducks, which were not identified.

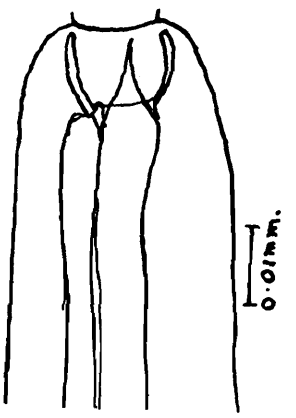
The worms are slender and slightly attenuate anteriorly, and they have fine transverse cuticular striations. The head is narrow and rounded, with four fine hair-like sub-median papillae projecting anteriorly. There is a relatively large thin-walled buccal capsule. There



Text-fig. 15.—*Amidostomum fuligulae.* Anterior end, dorsal view.

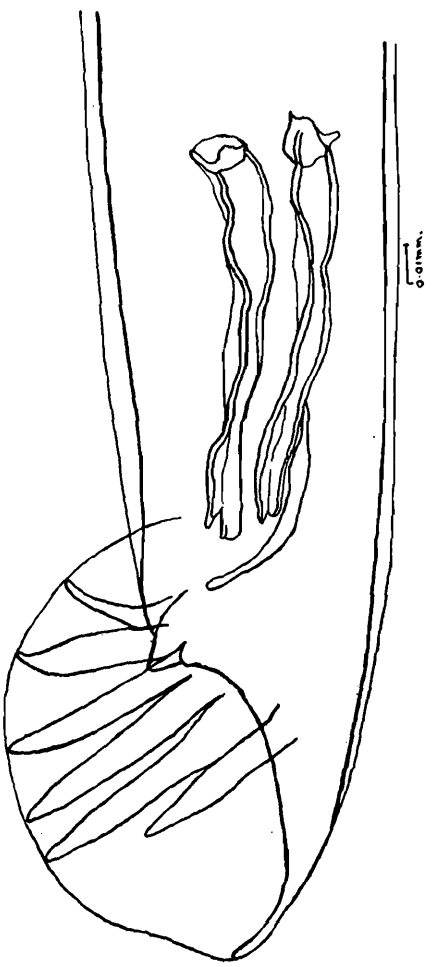
is a large triangular dorsal tooth, which extends forwards from the oesophagus almost to the mouth of the capsule, and in addition there are two small knob-like accessory sub-ventral teeth. These latter teeth really appear to be the thickened anterior ends of the two sub-dorsal

plates, which form with the dorsal plate the tri-radiate oesophagus (figs. 15 and 16). Male :—The male is 7·6—9 mm. in length, and 0·11—0·12 mm. in diameter. The oesophagus is 0·65—0·69 mm. in length and it ends in a slight bulbar enlargement. The nerve ring is near the



Text-fig. 16.—*Amidostomum fuligulae.* Anterior end, lateral view.

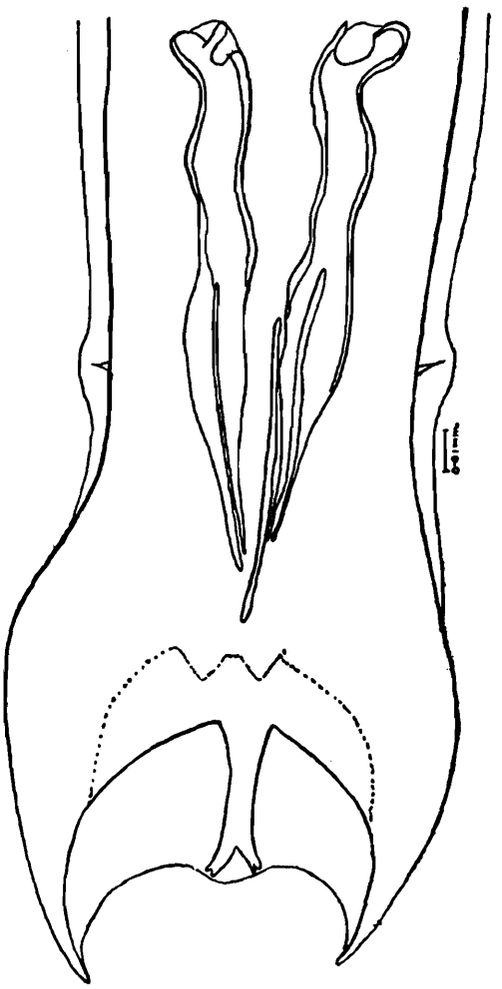
middle of the oesophagus, and the cervical papillae are 0·37—0·39 mm. from the anterior end. The bursa consists of two large lateral lobes and a small dorsal lobe. The ventro-ventral ray is much finer than



Text-fig. 17.—*Amidostomum fuligulae.* Posterior end of male, lateral view.

the latero-ventral ray, from which it is separated. The lateral rays are approximately equal and parallel. The externo-dorsal rays are

short and stout, and they arise separately from the dorsal ray. The dorsal ray is divided only at its tip end and each branch ends in two points (figs. 17 and 18). Prebursal papillae are present. The ventral lip of the cloaca is surmounted by two mammilate papillae (fig. 18). The spicules are stout and equal; they are 0·13—0·15 mm. in length, and they end in two points, being divided for about half their length (fig.18). A straight gubernaculum is present. Female :—The female is 10—13·5 mm. in length, and 0·12—0·14 mm. in diameter. The oesophagus is 0·73—0·78 mm. in length, and the cervical papillae are 0·37—0·42 mm. from the anterior end. The vulva is not prominent and it opens 2·65 mm. from the tip of the tail. A short vagina leads inwards from the vulva, and from it the ovejectors diverge at right angles. The anus is 0·26 mm. from the tip of the tail, and immediately behind this opening the worm becomes suddenly narrower. The tail tapers

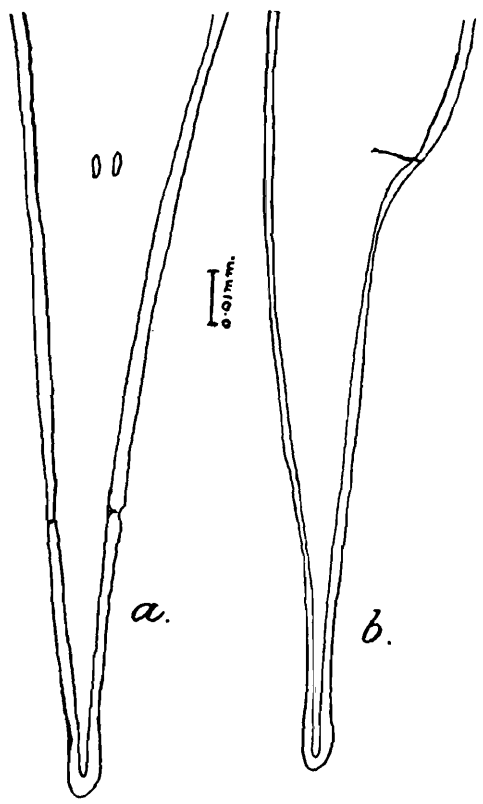


Text-fig. 18.—*Amidostomum fuligulae.* Posterior end of male, dorsal view.

gradually to end in a fine rounded tip and there are two sensory papillae on the sub-ventral surface a little more than half way between the tip of the tail and the anus (fig. 19, *a* and *b*). The eggs are 0·080—0·082 × 0·050—0·052 mm.

The dorsal tooth is similar to that of *A. chevreuxi* Seurat, 1918, but this species has not the small accessory teeth. The bursa is also different, as in *A. chevreuxi* the only rays which reach the edge of the bursa are the medio-lateral and postero-lateral, whereas in the present species the only ray which does not reach the edge of the bursa is the

externo-dorsal. The worm differs quite distinctly from the other species of the genus so it is proposed to name it *Amidostomum fuligulae*, n. sp.



Text-fig. 19.—*Amidostomum fuligulae.* Posterior end of female. *a.* ventral view. *b.* lateral view.

Type-host. *Fuligula cristata.*
Type-specimens are in the Indian Museum, Calcutta.

Epomidiostomum Skrjabin, 1916.

There seems to be considerable confusion regarding the characters of the head in this genus, this is brought out by comparing the following descriptions.

Yorke and Maplestone (1926). " ..... on the dorsal and ventral surfaces of the head is a pair of posteriorly directed nodules (epaulettes) with blunt extremities, on each side is a pair of lateral papillae."

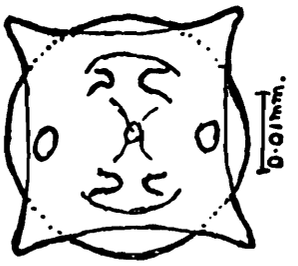
Baylis and Daubney (1926). " Head distinct, with a pair of backwardly directed " *nodules* " or epaulettes dorsally and ventrally, hooked or blunt at their tips."

Boulenger (1926) in his description of *E. querquetulae* says. " Head provided with a pair of laterally situated cuticular expansions reflected backwards and, although less devloped, obviously corresponding to the " epaulettes " described by Skrjabin in the type-species. Mouth surrounded by six head-papillae, four submedian and two lateral in position."

Cram (1927). " Head distinct, bearing on its dorsal and ventral surfaces a pair of nodules (also referred to as lips or papillae) which are directed posteriorly, and are either uncinate or obtuse at their extremity. According to Seurat the head bears a pair of lateral papillae on each side. Cephalic cuticle ornamented with a pair of epaulettes or festoons, which, according to Skrjabin, have zig-zag incisions in their posterior portion."

In these descriptions the terms nodules, epaulettes, lips, papillae, and cuticular expansions seem to have been applied to the same structures by the different workers. The reason for this confusion is probably

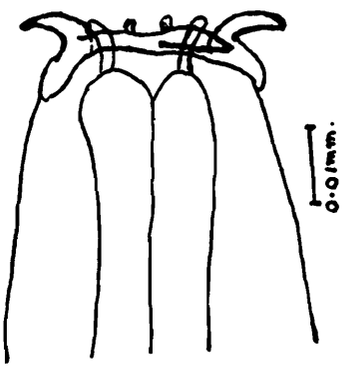
because the real nature of the structures surrounding the mouth have never been properly understood, and Skrjabin's original figure, which has been the only one available, is not at all clear.



Text-fig. 20.—*Epomidiostomum uncinatum.* Anterior end, end-on view.

I have recently obtained a number of worms of this genus from the following ducks, *Dafila acuta*, *Fuligula nyroca* (4), *Querqedula circia*, *Sarcidiornis melanonota*, *Tadorna casarca*, and several others which were not identified. All of my specimens appear to belong to the type-species *E. uncinatum*.

An end-on view of the head (fig. 20) explains the difficulty that has existed, for the structure has never been recognised for what it is. There are four cuticular or chitinous structures projecting horizontally beyond the edge of the head, in the sub-median fields, and there are four long sub-median papillae more centrally placed and projecting forward. These surround the small mouth opening. In addition there is a pair of oval pulpy papillae placed laterally, they do not project, and are only visible in an end-on view. A common position for the worm to

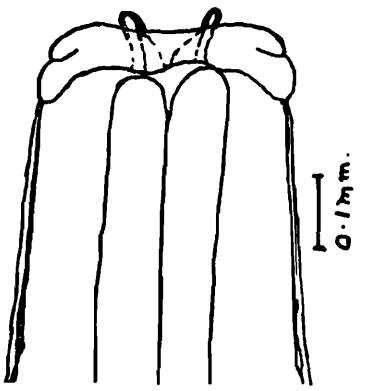


Text-fig. 21.—*Epomidiostomum uncinatum.* Anterior end, semi-lateral view.

take up on a slide is a semi-dorsal or semi-ventral one, and then the appearance shown in fig. 21 is seen. The two cuticular projections that are in profile appear as two outwardly curving projections of varying degrees of length and sharpness of their tips depending on the angle from which they are viewed, and the cuticular projection, which is lying uppermost, is pressed to one or other side by the coverslip. In fig. 21 it is lying to the right. When seen in this position the four oral papillae are all visible.

When the worm is accurately rolled dorsally or laterally, the cuticular projections, being only the same diameter as the head in these directions, do not project but tend to lie flat against the anterior surface of the head, where they seem to have been mistaken for lateral papillae by some observers (fig. 22). Only two oral papillae are visible at a

time in this position as they overlie the corresponding papillae on the further side of the mouth. The structures which have been described as epaulettes by some and as cephalic expansions by Boulenger appear to be really a chitinous cap surmounting the anterior extremity, with



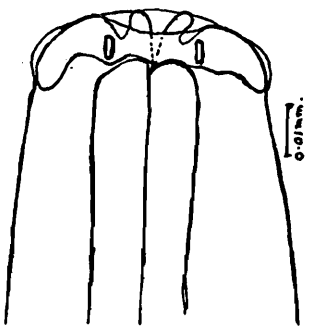
Text-fig. 22.—*Epomidiostomum uncinatum.* Anterior end, lateral view.

a more or less wavy posterior border. When seen in optical section through the mid-sagittal plane from any angle, the two sides, being in focus, appear to project backwards, and the parts nearer and further from the microscope, being out of focus, are not seen, so one gets the impression of two backwardly projecting structures. The wavy posterior border of the cephalic cap probably explains the notched border of the epaulettes described by Skrjabin.

Seurat said there is a short buccal capsule, which Skrjabin said was absent. I am inclined to agree with Seurat, but the small capsule is difficult to see, as it can only be viewed through the chitinous cap overlying the head.

Pseudamidostomum Boulenger, 1926.

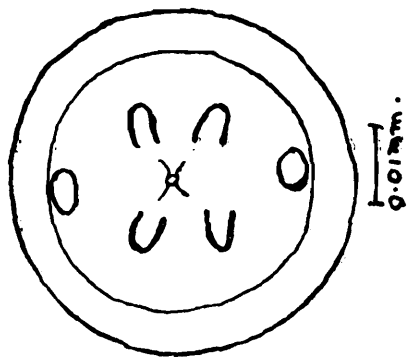
Boulenger (1926) made this genus on the description of three female worms. He says they could not be included in the genus *Amidostomum* on account of certain characters of the head, but they are in reality much closer to *Epomidiostomum*, especially as the posterior extremity is very similar to the females of this genus.



Text-fig. 23.—*Pseudamidostomum boulengeri,* Anterior end, dorsal view.

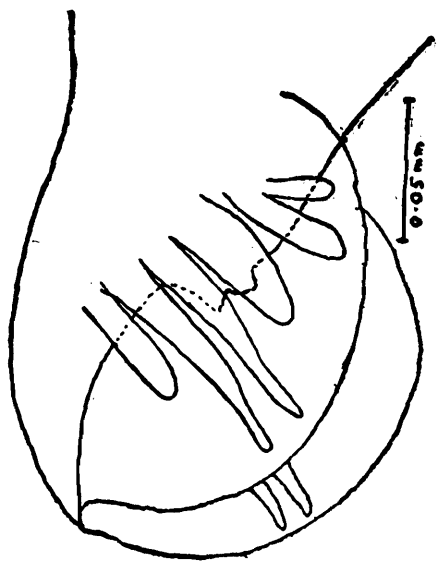
I have obtained several specimens, which I have referred to this genus. The hosts are several Cotton Teal (*Nettapus coromandelianus*), Cattle Agret (*Bulbulcus coromandus*), and one duck which was not identified.

These small worms are attenuate anteriorly and they have transverse striations on the cuticle. The anterior end of the worm is surmounted by a chitinous cap similar to that in *Epomidiostomum*, and which gives it an appearance of slight cuticular inflation (fig. 23). There is a large shallow funnel-shaped depression anteriorly, in which there are situated four long sub-median papillae, surrounding the small mouth opening. There are also two pulpy papillae, one on each side of the head, which do not project and which are only visible in an end-on view (fig. 24). The oesophagus is very slightly swollen at its posterior extremity, and there is a small very short buccal capsule, which is somewhat difficult to see.



Text-fig. 24.—*Pseudamidostomum boulengeri.* Anterior end, end-on view.

Male :—The males are 8·3—8·6 mm. in length with a maximum diameter of 0·18—0·21 mm. The diameter of the head is 0·040—0·044 mm., and the oesophagus is about 1 mm. in length. The bursa consists of two relatively broad semi-circular lateral lobes and a small barely-defined dorsal lobe. The ventral rays are separated, the ventro-ventral being the thinner of the two. The externo-lateral is short and stout, the medio-lateral and postero-lateral rays are somewhat more delicate and longer, being the only two rays which approach the edge of the bursa.

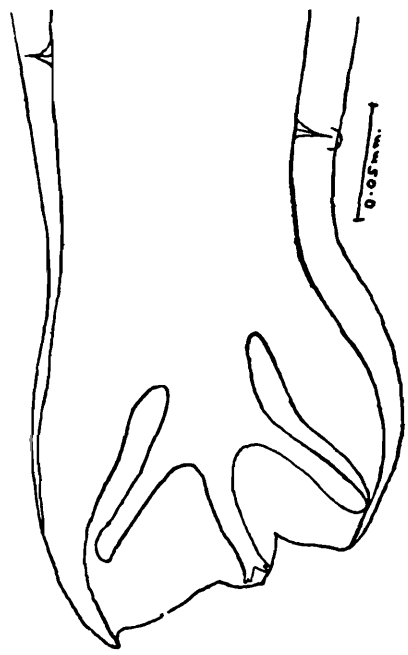


Text-fig. 25.—*Pseudamidostomum boulengeri.* Tail of male, lateral view.

The dorsal ray is stout at its base near to which the short stout externo-dorsal rays are given off. The tip of the dorsal ray is bifurcate and each

branch ends in two points (figs 25 and 26). There is a pair of asymmetrical prebursal papillae (fig. 26). There are two mammilate papillae on the ventral lip of the cloaca. The spicules are equal, being 0·120-0·124 mm. in length, they are stout and slightly curved, and have broad membranous alae. The tips are not divided though there appear to be double tips, which are fused (fig. 27).

Female :—The females are 11—11·5 mm. in length,and 0·22—0·24 mm. in maximum diameter. The oesophagus is 1·3—1·4 mm. in length. The nerve ring and excretory pore are 0·3 mm. from the anterior end, and the cervical papillae are 0·26 mm. posterior to them. The vulva is 2·7—2·8 mm. from the tip of the tail, and the uteri are divergent. The tail becomes narrower behind the anus which is 0·28 mm. from its tip, and there are two submedian sensory papillae a little more than halfway from the anus to the tip of the tail (fig. 28). The eggs are of the usual strongyle type and are 0·116—0·120 × 0·070—0·080 mm.



Text-fig. 26.—*Pesudamidostomum boulengeri.* Tail of male, dorsal view.

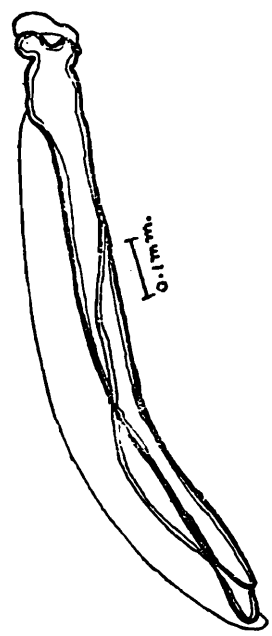
This worm is different from *P. loossi* Boulenger, 1926, as it is much bigger in all its dimensions and the eggs are much larger. It is therefore proposed to name it *Pesudamidostomum boulengeri*, n. sp.

Type-host. *Nettapus coromandelianus.*

Type-specimens are in the Indian Museum, Calcutta.

Boulenger in describing *P. loossi* gave no definition of the genus ; Cram (1927) has defined it as far as possible, but as she only had Boulenger's description of the females of his species to go on, her definition is naturally inadequate. The only real difference between *Epomidiostomum* and *Pseudamidostomum* seems to be that in the former there are four horizontal structures projecting from the anterior extremity, and that these are absent in the latter. The spicules of *Epomidiostomum* end in three branches and those of the only species of *Pseudamidostomum* which has been seen, end in two points which are fused together. The differences in structure of the head are sufficiently marked to

render the making of a new genus justifiable, though Boulenger apparently failed to recognise this striking character when making the

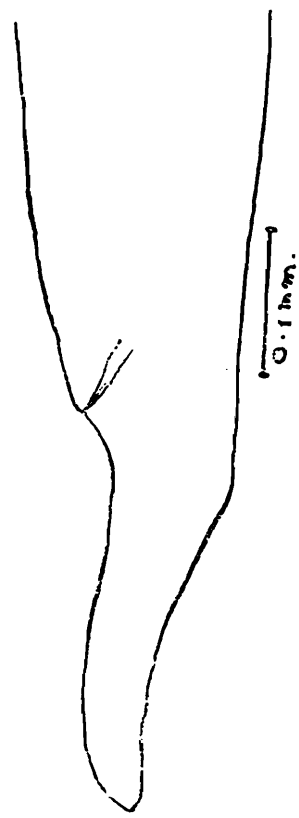


Text-fig. 27.—*Pseudamidostomum boulengeri.* Spicule.

genus *Pseudamidostomum.* It is proposed to define it as follows, using the males of *P. boulengeri* for the purpose.

Pseudamidostomum Boulenger, 1926.

Definition :—Amidostominae. Head with a chitinous cap giving the appearance of a cuticular inflation. Four large submedian papillae



Text-fig. 28.—*Pseudamidostomum boulengeri.* Female tail, lateral view.

surrounding the mouth, and a pair of lateral sessile papillae. The four horizontal projections seen in *Epomidiostomum* are absent. Short

wide buccal capsule present. Oesophagus tri-radiate. Male with bursal rays as follows. Ventral rays separated, externo-lateral short and stout, medio-lateral and postero-lateral rays parallel and nearly reaching the edge of the bursa. Dorsal ray thick at its origin, near to which it gives off the short externo-dorsal rays, tip of dorsal ray bifurcate and each branch bidigitate. Spicules equal, and end in a simple tip composed of two points fused together. Gubernaculum absent. Prebursal papillae present. Vulva in posterior half of body, uteri divergent, and diameter of tail dimished behind the anus.

PART 3. NOTES ON THE GENERA *HABRONEMA* DIESING, 1861, AND *CYRNEA* SEURAT, 1914.

The separation of the genera *Habronema* and *Cyrnea* is a matter of great difficulty, and Baylis and Daubney (1926) have indicated that they do not consider it possible, as they place *Cyrnea* as a synonym of *Habronema*, but they add the following footnote.

> " Seurat (1914) proposes the genus *Cyrnea* for a Spirurid parasite of a partridge which he says, differs from *Habronema* in the absence of lateral alae and usually in the presence of an egg-reservoir in the ovejector."

Yorke and Maplestone (1926) accept the two genera as distinct and so does Cram (1927). The following table (p. 404) has been compiled from the definitions of the above authors, and it gives the essential points whereby these genera are considered to be distinguished by them.

Lips.—There is nothing characteristic as they may be simple or tri-lobed, and they may or may not have teeth on their inner surfaces in either species. Yorke and Maplestone are not correct in stating that *Habronema* is without teeth, while *Cyrnea* has teeth, for many species of the former genus are described and figured with these structures.

Lateral flanges.—These are said to be always absent in *Cyrnea*, but their presence or absence as a diagnostic character disappears, when it is found that two, one, or none at all may be present in *Habronema*.

Cervical papillae.—Cram says that these papillae are far posterior to the nerve ring in *Cyrnea*, and " precervical" in *Habronema*. This may possibly be true in most instances, but in the type-species, *C. eurycerca*, Seurat's figure which Cram has copied, shows these structures so far forward as to be opposite the vestibule. Therefore this point appears useless in diagnosis.

Vestibule.—Yorke and Maplestone state that the vestibule is thick-walled in *Habronema* and thin-walled in *Cyrnea*. This is in any case only a relative character, and one which does not survive when individual species of the genera are examined.

Post-anal papillae in the male.—Cram says these are asymmetrical in *Habronema* but does not mention what they are like in *Cyrnea*. She gives drawings from various sources of the tails of eleven males of members of this genus, but examination of these figures shows that in six of them the post-anal papillae appear to be absolutely symmetrical, in four they are very slightly asymmetrical, and in only one, *viz.*, *H. leptoptera*, is the asymmetrical arrangement sufficiently pronounced to be considered definite. Therefore this character will not stand.

	Baylis and Daubney.	Yorke and Maplestone.		Cram.	
	Habronema.	*Habronema.*	*Cyrnea.*	*Habronema.*	*Cyrnea.*
Lips	Large, entire or trilobed. Sometimes with internal teeth, and overlapped dorsally and ventrally by shields of cuticle.	Two lateral lips usually trilobed and without teeth, sometimes dorsal and ventral lips in addition.	Two well-developed lateral lips, with dentiform thickenings internally and dorsal and ventral lips with the free border deeply notched.	Four lips	Four
Lateral flanges or alae	May be present	May be present on one or both sides.	Absent	Usually one or two	No lateral alae.
Vestibule or buccal capsule	Well-developed	Well-developed, strongly chitinized and cylindrical or funnel-shaped.	Cylindrical and not strongly chitinized.	....	....
Cervical papillae	....	In front of nerve ring	Far forward, anterior to oesophagus.	Precervical	Far posterior to the nerve ring.
Made caudal papillae	Four pairs preanal, variable number of postanal usually asymmetrically placed.	Four pairs pedunculated preanal, one or two pairs of postanal, and two or three pairs small near tip of tail.	Nine pairs of long pedunculated, of which 3 are preanal, and an additional pair of small preanal.	Postanal papillae asymmetrically disposed.	....
Vulva and female generative organs.	Vulva in middle region of body, occasionally displaced posteriorly.	Vulva near middle Uteri divergent.	Vulva near middle or a little in front of anus. Uteri parallel.	In median region but may be anterior or posterior of middle. Ovejector with vestibule not differentiated as an organ for storage of eggs. Uteri divergent.	Usually considerably posterior to middle. Ovejector with vestibule differentiated into an organ for storage of eggs. Uteri parallel.

Position of vulva.—In all but one species of *Cyrnea* the vulva is only a little anterior to the anus, but the value of this character is upset by *C. excisa*, in which it is said to be immediately in front of the middle of the body. This is approximately the position of the vulva in most species of *Habronema*. Another point is the presence of an egg-reservoir near the vulva and parallel uteri in *Cyrnea*, and its absence with divergent uteri in *Habronema*. But Seurat, who originally suggested the distinction between these two genera, and used these points among others in his differential diagnosis, describes the egg-reservoir of *C. parroti* as similar to some of the species of *Habronema* from birds. In both the species of the " Cyrnea " type which are described below, the uteri are at first parallel, running towards the anterior, and although their point of divergence could not be actually seen because all the specimens are crowded with eggs, there is no doubt it is present, because one of the ovaries ends anterior to the hinder end of the oesophagus, and the other ends just a little anterior to the anus.

The above examination of the diagnostic points between these two genera indicates that none are valid and a further similarity is that all the members of *Cyrnea* and the majority of *Habronema* species are found in birds, and they are always in the proventriculus or gizzard, and the few species of *Habronema* which occur in mammals are found in a corresponding position, *viz.*, in the stomach. It is therefore considered that Baylis and Daubney are correct in making *Cyrnea* a synonym of *Habronema*, and that any attempt to distinguish between them, in the light of present knowledge, is more likely to lead to confusion than to simplification.

THE LIPS.

In the above table it will be seen that Yorke and Maplestone do not describe the dorsal and ventral lips in *Habronema*, but merely mention their possible presence or absence in this genus. In *Cyrnea*, however, they follow Seurat (1914) in describing the dorsal and ventral lips with their free borders deeply notched. Cram does not describe the lips in either of the genera, but in her species *Cyrnea colini* she obviously follows Yorke and Maplestone and Seurat in their conception of the dorsal and ventral lips in this genus. Both Yorke and Maplestone and Cram also reproduce Seurat's figure of *C. eurycerca*, which appears to be obviously diagrammatic.

The lips of *C. eurycerca* and of *C. colini* both appear to resemble those of *Habronema indica* Maplestone, 1929 and of *Habronema euplocami* n. sp. described below. I have recently re-examined and redrawn on a large scale the anterior end of *H. indica*, making special note of the relations of the lips. A lateral view is given in fig. 29, and this shows a large semi-circular lip with ridges on its inner surface, and on its outer surface there is a prominent more or less quadrangular median structure (papilla), the borders of which are continuous with large conical papillae placed dorsally and ventrally to it. In fig. 30, which is a dorsal view the two large sub-dorsal papillae are seen connected by a fold of cuticle,

and between them the large lateral lips are seen curving posteriorly. In an end-on view, which is given in fig. 31, the lateral lips are seen to run dorsally and ventrally between the sub-dorsal and sub-ventral papillae. This is practically the same arrangement described and figured by Cram in *C. colini*, and she says the lateral lips bear two wing-like expansions, which project into the median groove of the dorsal and ventral lips, so that in some views they appear as processes of the latter lips. If one turns to fig. 33 of *H. euplocami* it is seen that the sub-dorsal papillae have prominent outwardly projecting angles, which in lateral view (fig. 32) appear as smaller accessory papillae towards the bases of the larger ones.

Seurat's idea that the sub-dorsal and sub-ventral papillae represent deeply notched dorsal and ventral lips does not seem to be in accord with the above observations, so it appears preferable and more in accord with the general conception of the Spirurida e, to consider that the genus *Habronema* has two large lateral lips. In some species the lips bear three well-developed papillae, a lateral broad papilla, and large, conical sub-dorsal and sub-ventral papillae with occasionally smaller accessory, papillae near their bases, and these papillae may be connected by small cuticular flaps on the dorsal and ventral sides of the mouth.

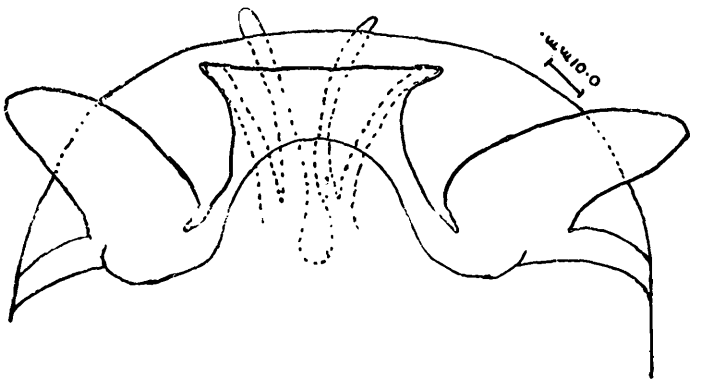
Habronema euplocami, n. sp.

Two female specimens of this worm were found in the gizzard of a Kalij Pheasant (*Euplocamus leucomelanus*).

There are two large lateral lips and a small dorsal and ventral cuticular flap surrounding the mouth. Each of the lateral lips consists of a central quadrangular portion, and two large pointed papillae, one lying dorsal and one ventral to it (fig. 32). When examined in the dorsal position the papillae are seen to have an outwardly projecting angle (fig. 33), which appears as an accessory papilla towards the base of the main papilla, when looked at from the side (fig. 32). The central portion of the lateral lips has four tooth-like ridges on its inner surface, the two central ones projecting beyond the anterior border. There is a strongly chitinized pharynx and the oesophagus is divided into two parts. The cervical papillae are very far forward, being about opposite the middle of the pharynx (fig. 33).

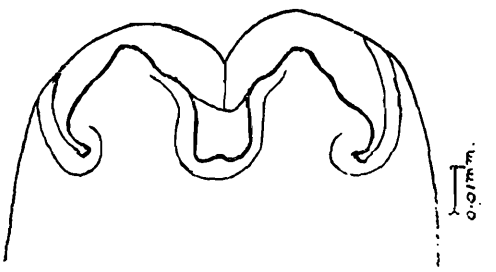
Female :—The female is 18·5—19·5 mm. in length, and 0·34—0·44 mm. in maximum diameter. The mouth is 0·050 mm. in depth and the pharynx or vestibule is 0·056 mm. in depth. The nerve ring is 0·35 mm. and the excretory pore 0·475 mm. from the anterior end. The anterior portion of the oesophagus is 0·46 mm. and the posterior portion 1·5 mm. in length. The vulva is situated 1·45 mm. from the posterior end, and it opens into a thick-walled ovejector (fig. 34). An unpaired trunk runs forward from the ovejector, but its length could not be determined as the worms are crowded with eggs. The uteri are, however, divergent,

as one ovary ends just behind the junction of the two parts of the oesophagus, and the other a short distance anterior to the rectum. The



Text-fig. 29.—*Habronema indica.* Anterior end, lateral view.

anus is 0·42 mm. from the tip of the tail, which ends in a blunt point, and there are two submedian sensory papillae about the junction of



Text-fig. 30.—*Habronema indica.* Anterior end, dorsal view.

the posterior and middle thirds of the distance from anus to tip of tail. There is a cuticle-lined rectum 0·7 mm. in length. The eggs are thick-shelled and contain embryos, they are 0·045 × 0·021 mm. with straight sides and rounded ends.

Male :—Unknown.

This worm differs from all other species of *Habronema* in which the vulva is placed near the anus, so it is proposed to name it *Habronema euplocami*, n. sp.

Host. *Euplocamus leucomelanus.*

The type-specimen is in the Indian Museum, Calcutta.

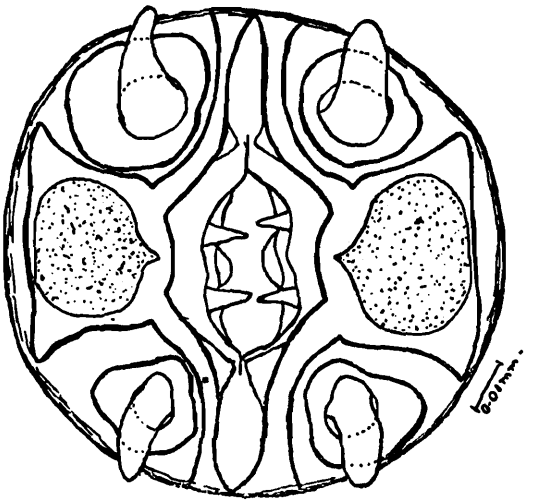
Habronema indica Maplestone, 1929.

Since my original description I have obtained a second and bigger collection of these worms from the same host. They are in a slightly better state of fixation, and the ovejectors contain eggs, which my original specimens did not have, so the second collection has obviously reached full maturity. They are one or two millimetres longer in both sexes, and the eggs in the ovejectors measure 0·045 × 0·026 mm., otherwise they are indentical.

Habronema imbricata, n. sp.

This species of worm was found in the gizzard of a Scops Owl (*Scops pennatus*).

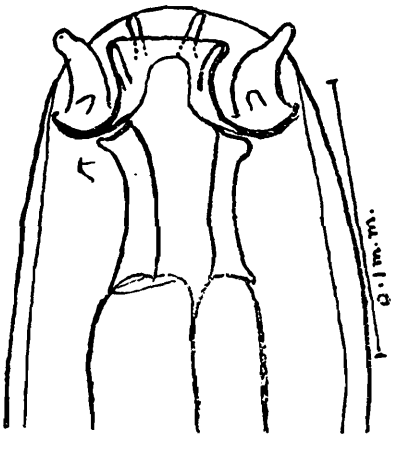
The cuticle is marked by coarse transverse striations which begin at a slight cuticular inflation about opposite the anterior end of the vestibule. In optical section the edges of the striations are sharp and backwardly projecting, giving the worm a segmented or imbricate appearance similar to that of *Habronema ficheuri* (fig. 35*b*).



Text-fig. 31.—*Habronema indica.* Anterior end, end-on view.

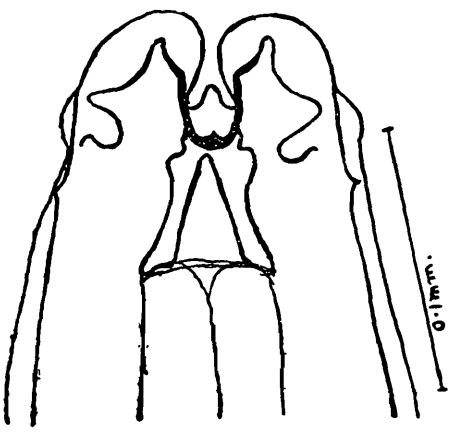
There are two large lateral lips which are divided into three large lobes superficially (fig. 35*a*) and do not appear to have any papillae. On the internal surface these lips are supported by outwardly curving anterior extensions of the vestibule, and there are three pointed teeth between them (fig. 35*b*). There are also small dorsal and ventral lips (fig. 36*a*).

There is a short lateral flange on one side of the body only, it begins about 0·4 mm. from the anterior end and extends posteriorly for a distance of about 1 mm. The vestibule is thick-walled and almost cylindrical, it is about 0·075 mm. in depth, and anteriorly it sends for-

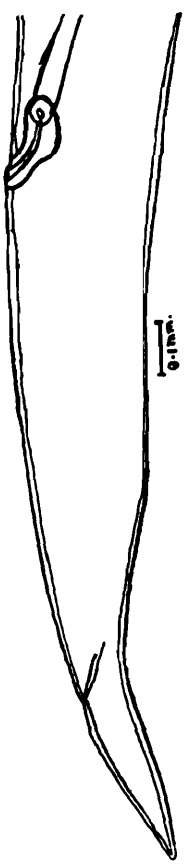


Text-fig. 32.—*Habronema euplocami.* Anterior end, lateral view.

wards into the lips, curving chitinous plates (figs. 35 and 36*b*). The oesophagus consists of two parts.



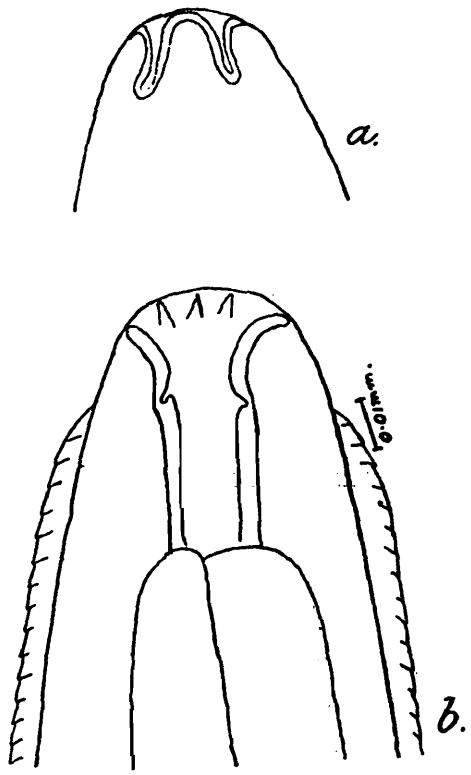
Text-fig. 33.—*Habronema euplocami.* Anterior end, dorsal view.



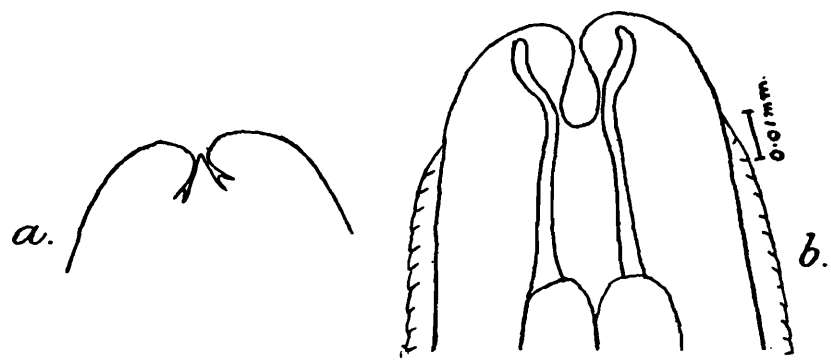
Text-fig. 34.—*Habronema euplocami.* Posterior end of female, lateral view.

Male :—The male is about 8·3 mm. in length, with a maximum diameter of 0·23 mm. The diameter of the head is only 0·44 mm. The nerve ring is 0·24 and the excretory pore 0·3 mm. from the anterior end. The anterior part of the oesophagus is 0·44 mm. and the posterior part 2·34 mm. in length respectively. There is a pair of broad caudal alae which meet in a point beyond the tip of the tail (fig. 37*b*). The alae are supported by five pairs of pedunculate papillae, four of which are precloacal and one behind the cloaca. The precloacal papillae are arranged in pairs on each side. There is a sixth pair of sessile papillae placed a little behind the cloaca (fig. 37, *a* and *b*). The distance from the cloaca to the tip of the tail is about 0·2 mm. The spicules are very

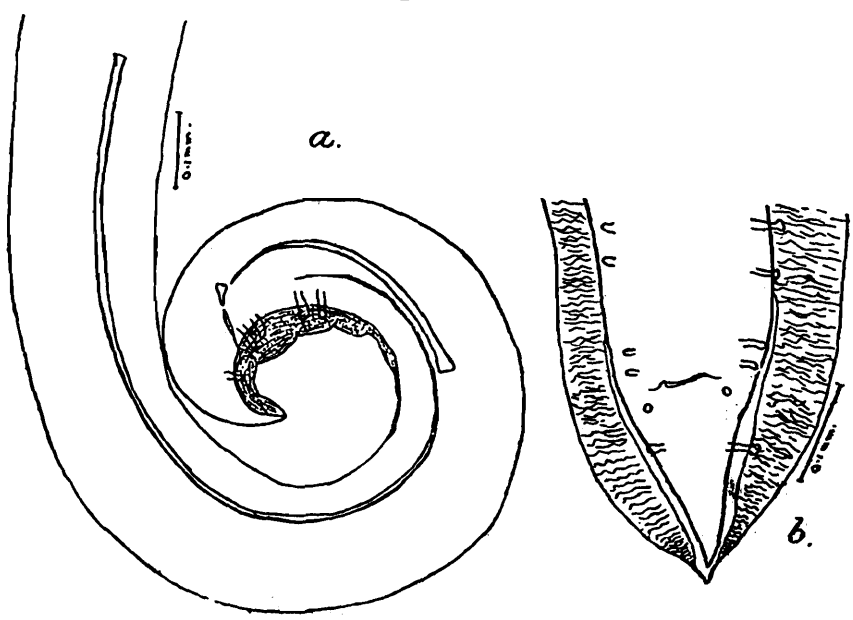
unequal, being 1·33 and 0·38 mm. in length respectively, and there is a short gubernaculum (fig. 37*a*).



Text-fig. 35.—*Habronema imbricata.* Anterior end, lateral view. *a.* superficial. *b.* deeper view.

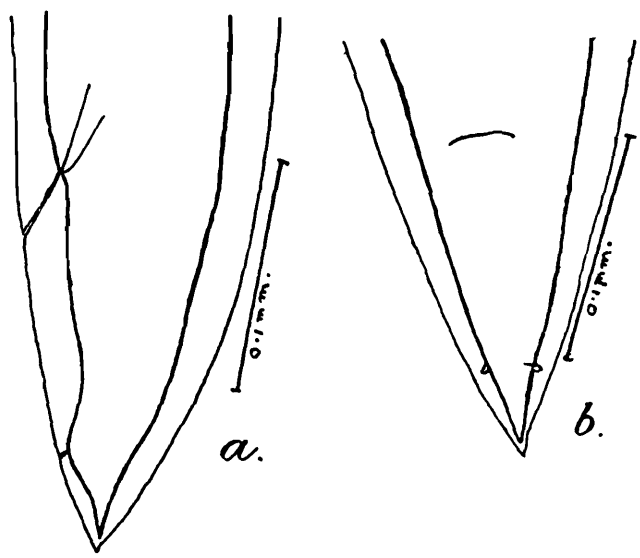


Text-fig. 36.—*Habronema imbricata.* Anterior end, dorsal view. *a.* superficial. *b.* deeper view.



Text-fig. 37.—*Habronema imbricata.* Male tail. *a.* lateral view. *b.* ventral view.

Female :—The female is 10·6 mm. in length and 0·26 mm. in maximum diameter. The oesophagus is 2·5 mm. in length. The vulva is 5·7 mm. from the anterior end, that is just behind the middle of the body, and the uteri are divergent. The tail is straight and it ends in a sharp point, and a little distance anterior to its tip there is a pair of small sensory papillae (fig. 38, *a* and *b*). The anus is 0·15 mm. from the tip of the tail. The eggs are thick-shelled and contain embryos; they measure 0·036 × 0·15-0·16 mm. with straight sides and rounded ends.



Text-fig. 38.—*Habronema imbricata.* Female tail. *a.* lateral view. *b.* ventral view.

This species clearly differs from all the described species of *Habronema* from birds, so it is proposed to name it *Habronema imbricata*, n. sp.

Host. *Scops pinnatus.*

Type-specimens are in the Indian Museum, Calcutta.

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FURTHER NOTES ON CRUSTACEA DECAPODA IN THE INDIAN MUSEUM.

I. On two new species of Hymenosomatid Crabs, with notes on some other species.

By B. Chopra, *D.Sc., F.L.S., Assistant Superintendent,* and K. N. Das, *M.Sc., Zoological Survey of India.*

[The series of papers entitled " Notes on Crustacea Decapoda in the Indian Museum " was started by Dr. S. W. Kemp, formerly Superintendent, Zoological Survey of India, and the first paper was published in volume V of the *Records of the Indian Museum* in 1910. Dr. Kemp contributed seventeen papers in this series, including one in collaboration with Lt.-Col. (then Captain) R. B. Seymour Sewell, and all were published in the *Records of the Indian Museum,* the last appearing in volume XXVII of 1925. In the last paper Dr. Kemp gave a list of all the papers that he had published in this series, along with a reference to the volume in which each had appeared. Owing to Dr. Kemp's departure from India in 1925 the series was brought to a close. A fresh series bearing the above title is now being commenced by Dr. B. N. Chopra, who has succeeded Dr. Kemp as officer in charge of the Crustacea collections.

Director,
Zoological Survey of India.]

Since the publication of Kemp's [1] revision of the Indian Hymenosomatidae, a number of specimens of this family have accumulated in the collections of the Zoological Survey of India. In the course of an examination of this small collection we have come across representatives of two species of *Rhynchoplax* so far unknown to science, along with some other specimens that appear remarkable either from the point of their provenance, or some peculiarity of structure, etc. Of the two new species of *Rhynchoplax* described in this paper one comes from Mesopotamia, and is remarkable for the fact that it was obtained in pure fresh water, considerably beyond the reach of tidal influences. Two species of the family are already known to have established themselves in fresh water: *Halicarcinus lacustris* (Chilton) [2] is known from lakes and streams in New Zealand and Australia, sometimes even at an altitude of 3,000 feet above sea-level, while *Rhynchoplax introversus Kemp* [3] was collected in the Tai Hu Lake in China. The other new species of *Rhynchoplax* appears to be common in the back-waters of Travancore and Cochin ; some of the specimens of this species differ so much from typical examples that a new variety has been set up for these. We have also redescribed in some detail Gravely's [4] *Elamena cristatipes*, that had so far been somewhat meagrely characterised.

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[1] Kemp, *Rec. Ind. Mus.* XIII, pp. 243-279 (1917).

[2] Chilton, *Trans. Proc. New Zealand Inst.* XIV, p. 172 (1882). Chilton described this species originally as *Elamena ? lacustris*, but later [*ibid.* XV, p. 69 (1883)] referred it to *Hymenosoma.* Tesch [*Siboga Exped. Rep.* XXXIX c, p. 12 (1918)] includes it under *Hymenicus*, while Kemp believes it is a *Halicarcinus.* Chilton has very fully discussed the distribution and habitat, etc. of this crab in *Trans. New Zealand Inst.* XLVII, pp. 316-319 (1915).

[3] Kemp, *Rec. Ind. Mus.* XIII, pp. 262-264 (1917).

[4] Gravely, *Bull. Madras Govt. Mus.* (n. s.) I, p. 150, pl. xxi, fig. 24 (1927).

Kemp has very ably discussed the position and the limits of the various genera included in the Hymenosomatidae, and has given a descriptive diagnosis of all the Indian species of the family till then known. In his account of the Hymenosomatidae in the Siboga Expedition Report series Tesch [1] has also discussed the position of the various genera, and in several instances has arrived at substantially the same conclusions as Kemp. In the arrangement of genera, etc., we have followed Kemp. Like him we consider *Trigonoplax* as only a subgenus of *Elamena*. Alcock [2] had already expressed this opinion, and though several eminent authors, including Tesch, consider the two as quite distinct,[3] we believe the differences between the two are not sufficiently important to warrant such a distinction.

There appears to be some confusion regarding the structure of the abdomen in the male of *Elamena* (*sensu stricto*). Kemp [4] believes that in all species of the genus the 3rd, 4th and 5th segments are completely fused, leaving no sutures between them, and the abdomen is thus formed of four pieces only. According to Baker's [5] description and figure of the abdomen in *E. truncata* (Stimpson), however, there appear to be five pieces, apparently the third and the fourth segments only being fused. As Kemp had not examined any male specimens of Stimpson's species, he seems to have taken Baker's account with reserve, but we have no reason to believe that it is in any way incorrect, as we have found an exactly similar condition in the male of *Elamena cristatipes* Gravely [6] from South India. In *Elamena sindensis* Alcock,[7] on the other hand, the abdomen of the male is formed of four pieces only and the same is true in all the species of *Elamena* (*Trigonoplax*) that we have examined in the collections of the Indian Museum.

The type-specimens of the new species are in the collections of the Zoological Survey of India, and are preserved in the Indian Museum at Calcutta.

Rhynchoplax alcocki Kemp.

1917. *Rhynchoplax alcocki*, Kemp, *Rec. Ind. Mus.* XIII, pp. 253-256.

Rhynchoplax alcocki was so far represented in the Indian Museum collection by a large number of specimens collected by Dr. Kemp in Portuguese India, and by a few specimens collected in the Cochin backwaters near Eranakulam by Dr. F. H. Gravely. We have now referred to this species a large number of additional specimens from the latter locality, as also from Travancore back-waters. These specimens were collected by Dr. H. S. Rao and Mr. M. Sharif.

We have nothing to add to Kemp's detailed and very accurate description of the species. Our specimens agree in all respects with the

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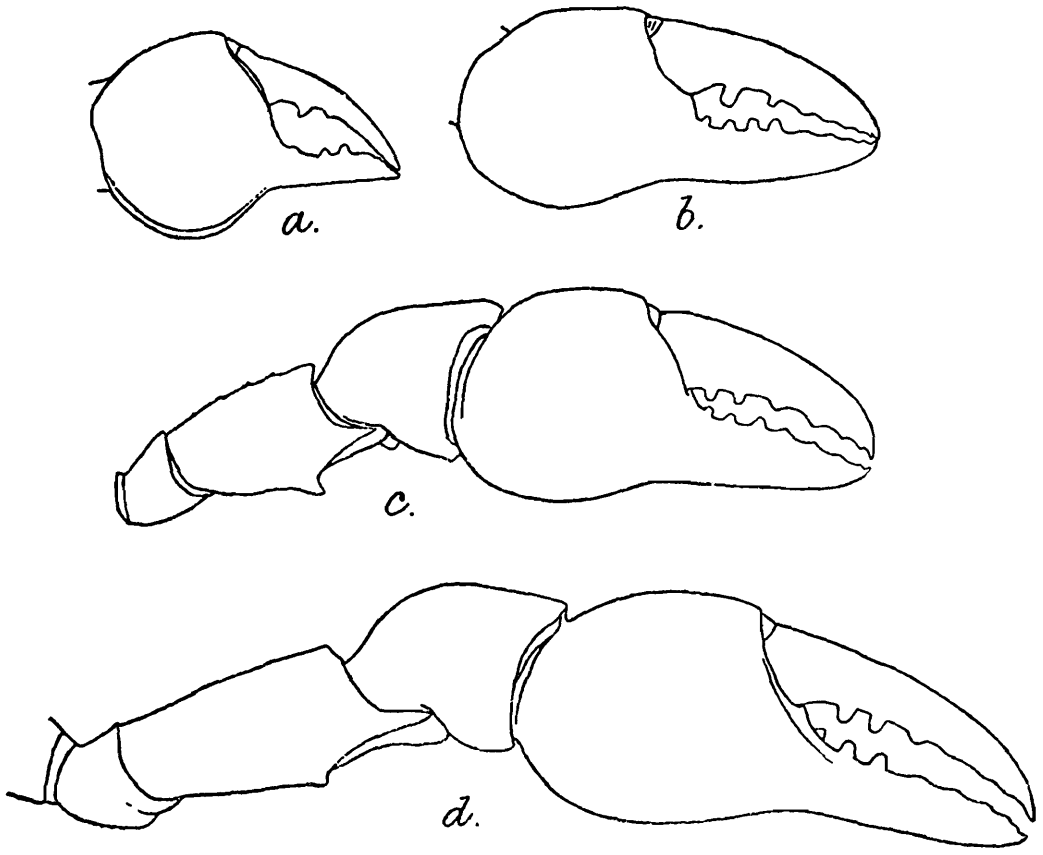
[1] Tesch, *Siboga Exped. Rep.* XXXIX c, pp. 3-28 (1918).
[2] Alcock, *Journ. As. Soc. Bengal* LXIX, p. 386 (1900).
[3] Mr. E. W. Bennett of the University of Western Australia, Perth, who is at present working on the Hymenosomatidae of the world, writes to inform us that in his opinion *Trigonoplax* should be upheld as a distinct genus.
[4] Kemp, *Rec. Ind. Mus.* XIII, p. 273 (1917).
[5] Baker, *Trans. Roy. Soc. S. Australia* XXX, pp. 112, 113, pl. ii, fig. 2b (1906).
[6] Gravely, *Bull. Madras Govt. Mus.* (n. s.) I, p. 150, (1927).
[7] Alcock, *Journ. As. Soc. Bengal* LXIX, p. 386 1900).

type-specimens, as also with the published account. There is one point, however, that needs special mention. The chela of a fully grown male



Text-fig. 1.—*Rhynchoplax alcocki* Kemp.
a. Chela of adult male.
b. Chela of a young male 3·8 mm. long.
c. Cheliped of a young male 2·5 mm. long.
d. Cheliped of an ovigerous female.

has been figured by Kemp; the palm is greatly compressed, the chela being about 1½ times only as long as high, the fingers are widely gaping near the base, and the dactylus is provided with one large and one small tooth near the base. In younger specimens, however, the condition is vastly different. The palm is not very much compressed, and is considerably less high than in older specimens, being in some cases even less than half the length of the chela. The dactylus is proportionately shorter and the fingers do not gape as much as shown in Kemp's figure. In very young males the fingers are more or less apposed throughout their length. There are also a larger number of teeth, regularly placed, and the tips of the fingers are somewhat sharply hooked. In somewhat older specimens the gap increases, and the number of teeth gets reduced. The condition of the male chela at different ages is clearly seen in the accompanying illustration. The figures have been drawn from specimens in the collection from Portuguese India, but the condition is identical in Cochin and Travancore specimens also. We have included a figure of a chela of a fully grown female also, to show the similarity between it and the chela of a young male.

The teeth on the upper border of the merus of the male cheliped also show considerable modification due to age. In the adult male there

are five well-formed teeth on this margin, while in very young males these are obscure.

In young specimens the median lobe of the rostrum also appears to be proportionately longer.

A large number of specimens, collected at different places in the back-waters of Cochin and Travancore, are referred to this species. Both the sexes are well represented in the collection, and both adults and young specimens are present. In some instances comparatively small males, with the carapace (including rostrum) a little over 3 mm. in length, have the adult type of chela, while in others, larger specimens, with the carapace over 4 mm. long, have their chelae resembling those of the young males.

Judging from the condition of the chela, it seems to us possible that the males of *Rhynchoplax alcocki* are dimorphic, as in the case of *Inachus scorpio*[1] and some other crabs, but we are unable to express any definite opinion in the matter at present.

C 1467/1	Pallurutti, Cochin.	H. S. Rao, Dec., 1927.
C 1468/1	East Kumblam, Cochin.	H. S. Rao, Dec., 1927
C 1469/1	Cheppanam, Cochin..	H. S. Rao, Jan., 1928.
C 1470/1	Back-water between Eranakulam and Edapatti, Cochin.	H. S. Rao, Jan., 1928.
C 1471/1	Vaikom, Travancore.	H. S. Rao and M. Sharif, Jan., 1928.
C 1472/1	Alleppey, Travancore	H. S. Rao and M. Sharif, Jan., 1928.
C 1473/1	Back-water between Paravur and Kappil, Travancore.	H. S. Rao, Feb., 1928.
C 1474/1	Shertallai, Travancore.	H. S. Rao and M. Sharif, Feb., 1928.

Rhynchoplax kempi, sp. nov.

The possession of a large forwardly-directed tooth on either side of the carapace at the base of the first walking leg places the present species in the group which includes *Rhynchoplax wood-masoni* (Alcock)[2], *R. alcocki* Kemp and *R. octagonalis* Kemp[3]. Another species characterised by the presence of a similar tooth is described in this paper under the name of *Rhynchoplax tuberculata*, sp. nov.

The carapace is ovate in outline and is widest a little behind the middle. The surface is sunken and the margins are somewhat up-turned ; they are continuous from side to side across the base of the rostrum. The surface is slightly tomentose and the grooves are fairly well marked. The length of the carapace, including the rostrum, appreciably exceeds its maximum breadth, while excluding the rostrum the breadth falls short of the length only very slightly.

The greater part of the eye is visible from above and the cornea is quite large. A prominent post-ocular tooth is seen just behind the eye and is clearly visible in the dorsal view. Placed close behind the

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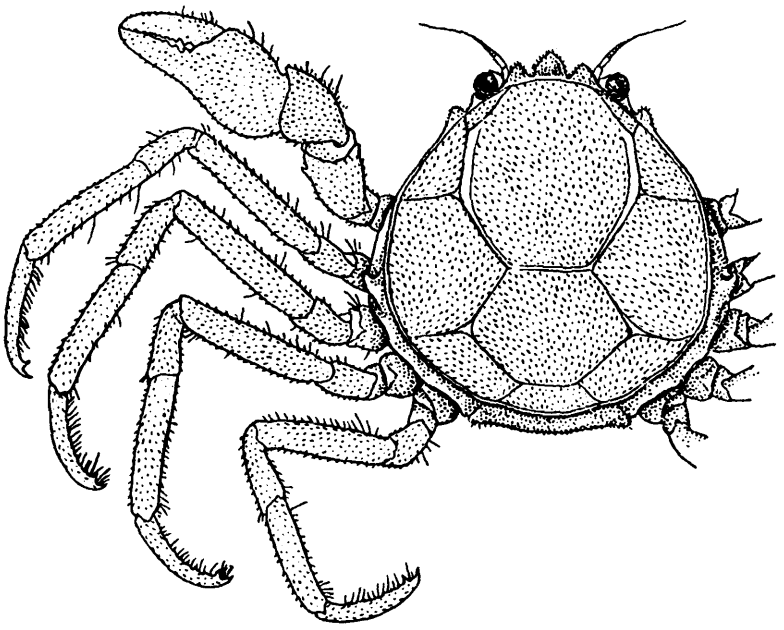
[1] Smith, *Mitt. Stat. Neapel* XVII, pp. 312-318 (1905).

[2] Alcock, *Journ. As. Soc. Bengal* LXIX, p. 388 (1900), and *Illus. Zool. 'Investigator,'* pl. lxiv, fig. 4 (1902).

[3] Kemp, *Rec. Ind. Mus.* XIII, pp. 256-258 (1917).

post-ocular tooth on the margin of the carapace is another larger tooth corresponding to the anterior tooth in *R. wood-masoni* (Alcock); the second tooth present on the margin of Alcock's species is altogether missing in the present form. Near the base of the first walking leg, below the margin of the carapace, is a very conspicuous tooth-like process, which is directed forwards and outwards. This tooth is somewhat acutely pointed at the tip and is hooked.

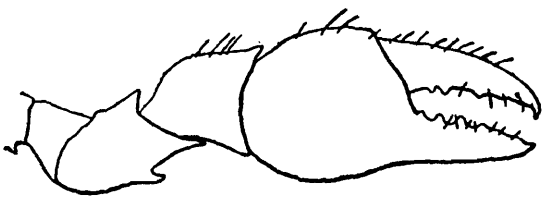


Text-fig. 2.—*Rhynchoplax kempi*, sp. nov.

As is usual, the rostrum is formed of three lobes, the median lobe being the largest of the three. All the three lobes are rounded, the median more broadly than the lateral ones; its apex is deflexed and lies at a lower level than that of the lateral lobes.

The antennules, when folded, are not completely concealed beneath the rostrum, and are separated at their bases by a septum. The external maxillipeds do not completely close the buccal cavern; in shape they resemble those of *R. alcocki* Kemp or *R. demeloi* Kemp.

The chelipeds are stouter than the walking legs in both the sexes, and are somewhat more so in the male than in the female. In the male the merus bears a sharp, forwardly-directed tooth, a little above the middle of its lower margin, but there are no teeth on the upper margin.

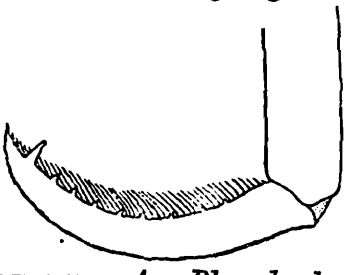


Text-fig. 3.—*Rhynchoplax kempi*, sp. nov.
Cheliped of adult male.

The carpus is without any teeth. The chela is not as much compressed as it is in *R. alcocki*; in a large example it is about twice as long as high. The borders of the palm are not carinate, and the upper border is considerably shorter than the dactylus. The fingers gape near the base,

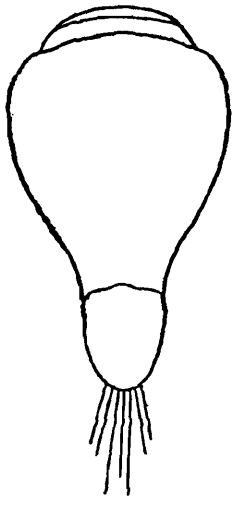
but meet for about the distal half of their length. The dactylus is provided with five or six small teeth, the proximal two of which are separated by a considerable gap from the rest. There are five or six small regular teeth on the fixed finger also. The tips are somewhat hooked and appear to be slightly spooned. In the female the tooth on the merus is obscure and the fingers show a smaller gap.

The walking legs are rather stout, and those of the second pair are the longest; these are a little less than twice as long as the carapace and the rostrum. There is an obscure tooth at the end of the upper border of the merus and another in a similar position on the carpus. The dactylus is curved and there are two large recurved teeth at the tip; the dactyli of the last three pairs have, in addition, a series of small curved teeth, more or less evenly distributed on almost the entire posterior border. The number of teeth, however, appears to be somewhat less than that in *R. alcocki.* The legs, as also the chelipeds, are sparsely clothed with hairs.



TEXT-FIG. 4.—*Rhynchoplax kempi*, sp. nov. Dactylus of walking leg.

The abdomen of the male is like that of *R. alcocki,* but the terminal segment is longer than broad. The portion preceding it is also proportionately broader and its sides, near the base, are regularly curved. The abdomen is markedly constricted near the base of the terminal segment.



TEXT-FIG. 5.—*Rhynchoplax kempi*, sp. nov. Abdomen of male.

The largest female specimens in the collection are about 5 mm. long from the tip of the rostrum to the posterior margin of the carapace, though some ovigerous examples are of a considerably smaller size also. The males are smaller, some of the larger specimens being 3·8 mm. long only.

Locality.—The species is described from a large number of specimens, including several ovigerous females, collected by Lt.-Col. H. J. Walton, at Basra (Shat-al-Arab) about 70 miles from the sea in November, 1918. The specimens were "clinging in large numbers to a weed entangled in anchor," and were obtained in fresh water.

C 1475/1	Basra (Shat-al-Arab), Mesopotamia.	H. J. Walton, Nov., 1918.	Several; TYPES and COTYPES.

Rhynchoplax kempi differs in a number of well-marked characters from the other species of the genus, having a tooth on the side of the carapace at the base of the first walking leg. It can be readily distinguished from *R. octagonalis* Kemp, by the different shape of the carapace; in Kemp's species the carapace, as the name suggests, is octagonal in outline and has no tooth on the margin below the eye, while in the present form it is ovate or subcircular and has one distinct tooth on the margin. The rostrum in the two species is also different. From *R.*

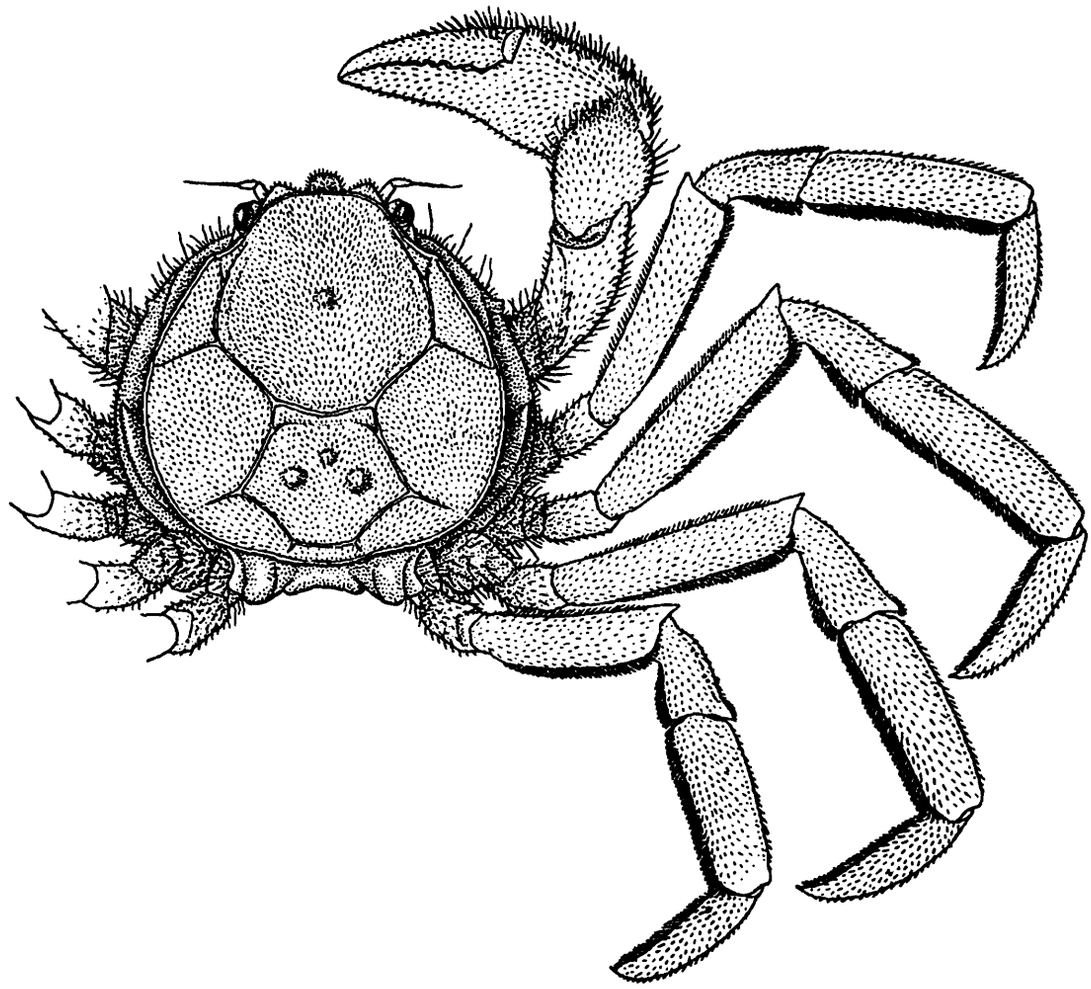
wood-masoni (Alcock) the present species differs, among other characters, in having the carapace proportionately broader, in having the lobes of the rostrum shorter and apically rounded, in having a single tooth on the side of the carapace below the eye, and in the merus of the male cheliped having no teeth on the upper margin. *R. kempi* seems to resemble most closely *R. alcocki* Kemp, but even from this it differs in several important respects. The principal characters in which *R. kempi* differs from Kemp's species may be enumerated as follows :—

1. The lobes of the rostrum are much shorter and the median lobe is more bluntly rounded.
2. The tooth-like process at the base of the first walking leg is somewhat sharp and procurved.
3. The chela of the male is less compressed, being almost twice as long as high. The fingers are less gaping and the dactylus is provided with a larger number of teeth.
4. The merus of the male cheliped is not dentate on the upper border.
5. The walking legs are stouter and shorter, those of the second pair being a little less than twice as long as the carapace.
6. The terminal segment of the male abdomen is longer than broad.

Rhynchoplax tuberculata, sp. nov.

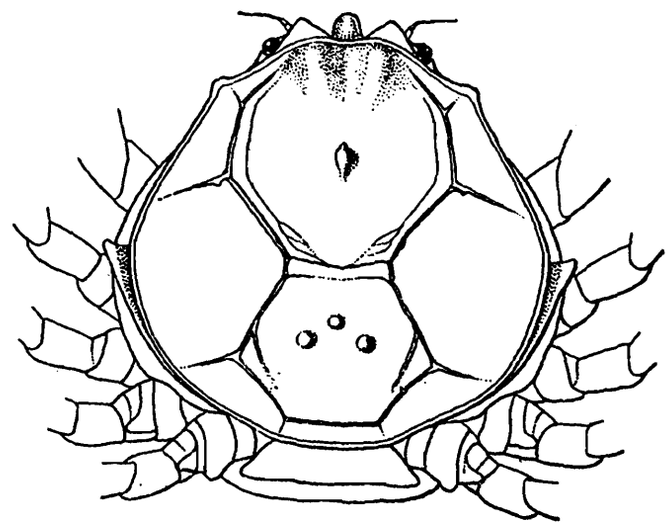
The carpace is somewhat ovate in outline, being considerably narrower in front than behind, and is broadest a little behind the middle. The length of the carapace, including the rostrum, is a little greater than the breadth of its upper surface, while, excluding the rostrum, the breadth almost equals the length. The margins of the carapace are upturned, and are continuous from side to side across the base of the rostrum. The dorsal surface is flat and the different regions are clearly marked. The carapace is finely granular and has also several large tubercles on the surface. In the middle of the gastric area there is a large tubercle, the upper surface of which is raised in a blunt spine, and there are three other tubercles forming a triangle at about the middle of the hepatic region. Of these latter two are large, while the third, the median one, which is anteriorly placed, is smaller. These tubercles, though present on all the specimens, are better seen in large examples, and in some of the large females are very conspicuous. In some specimens the spine on the gastric region is somewhat sharp, and has the appearance of a short narrow crest. In the larger specimens the anterior border of the carapace just behind the front is raised in two short longitudinal ridges, and between these the carapace is somewhat depressed. The antero-lateral borders of the carapace are arched, except close behind the front, where they are more or less deeply concave. The posterior border is straight or slightly arched. In larger specimens the outline of the carapace is distinctly more angular than in smaller forms. This is clearly seen in text-figure 7. There is a large tooth-like process directed forwards and outwards, below the margin of the carapace on each side, at the base of the first walking leg,

and another small blunt tooth is present on the antero-lateral margin of the carapace in the position of the first similar tooth of *R. woodmasoni* (Alcock)[1]. The second tooth present in Alcock's species is not



Text-fig. 6.—*Rhynchoplax tuberculata*, sp. nov.

represented here. A small postocular tooth is visible from above. The eyes are small, and are only partially seen in the dorsal view.



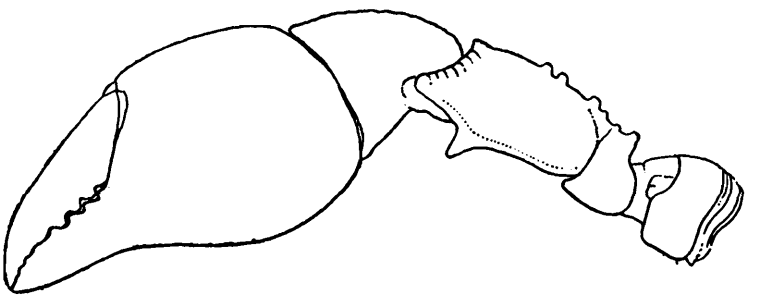
Text-fig. 7.—*Rhynchoplax tuberculata*, sp. nov.
Carapace of a large female.

[1] Alcock, *Journ. As. Soc. Bengal* LXIX, p. 388 (1900), and *Illus. Zool.* '*Investigator*,' pl. lxiv, fig. 4 (1902).

The rostrum is trilobed, the lateral lobes are sharply rounded anteriorly, while the median is truncate. The latter is situated at a considerably lower level than the lateral lobes, and is slightly longer than these. The margins of all the three lobes appear to be slightly fringed.

The antennules, when folded, are completely hidden beneath the rostrum, and are not visible from the dorsal view. At their bases they are separated by a spine-like septum. The epistome is of moderate length, and the external maxillipeds do not completely close the buccal cavern. In structure they closely resemble those of *Rhynchoplax alcocki* Kemp; the ischium is produced at its inner-distal angle and the merus is prominently expanded antero-externally, partially concealing the exognath.

In both sexes the chelipeds are stouter than the walking legs, and those of the male are particularly large. In the large male the merus bears a prominent, conical tooth near the end of its lower margin. The upper margin is also toothed, there being five or six small blunt teeth.

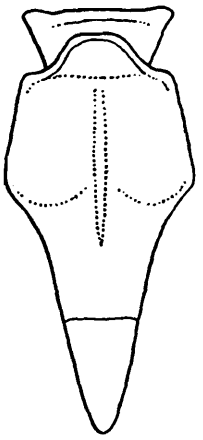


TEXT-FIG. 8.—*Rhynchoplax tuberculata*, sp. nov.
Cheliped of a large male.

Some of these teeth are more or less ridge-like. The basium also bears two such teeth on its superior margin. The carpus is unarmed. The chela is not greatly compressed and is almost twice as long as high. The anterior border is slightly arched, and is somewhat shorter than the height of the palm. The palm in lateral view is somewhat like that of *R. woodmasoni*, and its lower border, which is convex, is not prominently keeled. The fingers meet throughout their length and do not gape. The dactylus is slightly longer than the height of the palm and is considerably longer than the length of its upper border. The fingers bear five or six interlocking teeth, diminishing in size from behind forwards. There are no teeth near the tips, which are not sharply hooked. In the female cheliped the teeth on the superior border of the merus are somewhat obscure, while that on the lower border is fairly well developed. The chela is proportionately narrow, being considerably more than twice as long as high. The dactylus is also proportionately longer. The fingers gape slightly near the base, and are armed with a number of interlocking teeth. The proportions of the different parts of the chela are shown in the following table :—

	♂	♀
Total length of chela	4·5	4·2
Height of palm	2·3	1·7
Length of upper border of palm	2·0	1·6
Length of dactylus	2·6	2·6

The walking legs are not very slender; those of the second pair are the longest, and are about 2½ times the length of the carapace and rostrum. The anterior borders of the merus and carpus end in prominent teeth, and the anterior border of the propodus is finely crenulate. The dactyli are curved, and at their apices have a sharp curved tooth. The posterior margins of the legs are densely hairy.



TEXT-FIG. 9.—*Rhynchoplax tuberculata*, sp. nov. Abdomen of male.

The abdomen of the male is like that of *Rhynchoplax demeloi* Kemp,[1] but is narrower. The ultimate segment is much longer than broad, and is more or less acutely pointed at the tip. The preceding portion, which is believed to be composed of three fused segments, is much broader at the base than distally; about the middle of its length the margin is distinctly angular, and in front of this point is concave. It is grooved in the median line, and its posterior margin is regularly and broadly rounded.

A large male is about 5 mm. in length from the tip of its rostrum to the posterior border of the carapace, though the largest specimen is as much as 6·2 mm. long. Some of the female specimens are larger, the largest in the collection being 7·2 mm. long, though several ovigerous females are even smaller than 5 mm. The carapace and legs are densely hairy, and particles of mud, etc. are found sticking between the hairs.

Locality.—A large number of specimens, collected at different places in the back-waters of Cochin and Travancore, are in the collection. The water at all these places, at the time of collecting, was distinctly brackish, though at other times of the year it is said to be more or less fresh.

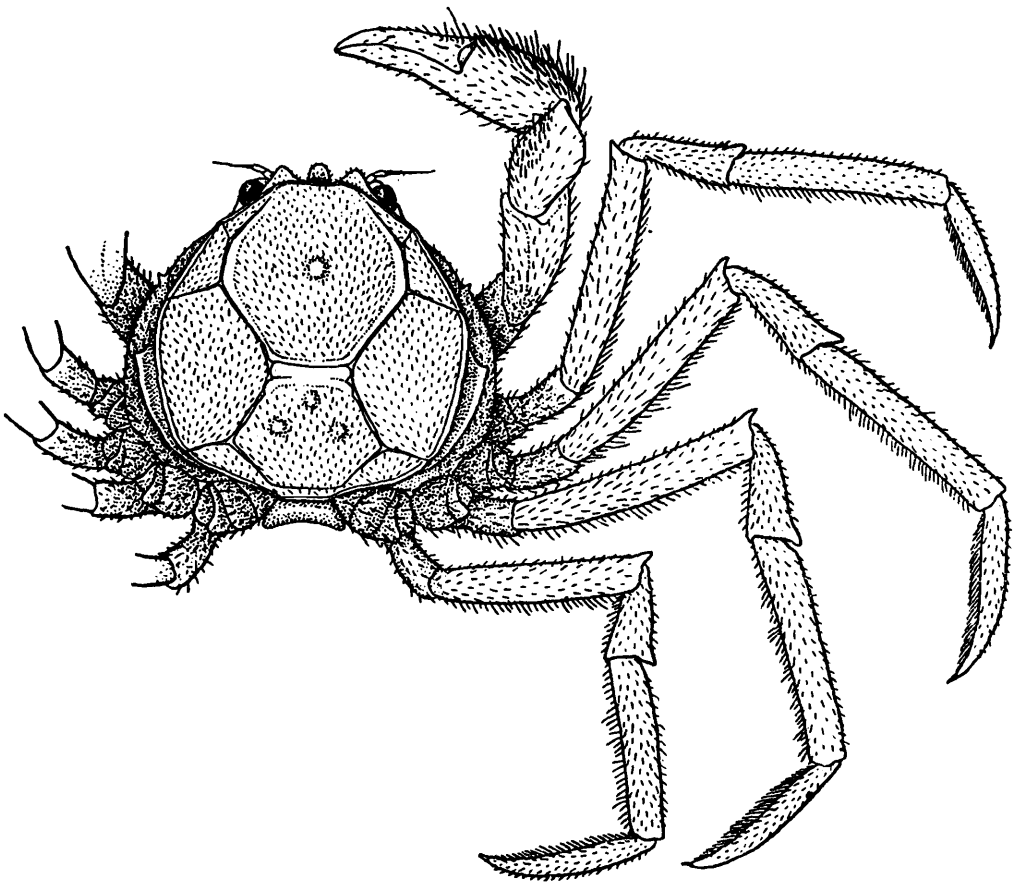
C 1476/1	Back-water between Ernakulam and Edapatti, Cochin State.	H. S. Rao, Jan., 1928.	4 ♂♂ and 3 ♀♀ TYPES.
C 1477/1	West Narakhal, Cochin State.	H. S. Rao, Jan., 1928.	Several ♂♂ and ♀♀
C 1478/1	Quillon, Travancore. ..	H. S. Rao and M. Sharif.	
C 1479/1	Puttankari, Travancore. ..	H. S. Rao and M. Sharif.	
C 1480/1	Back-water between Paraven and Kappil, Travancore.	H. S. Rao, Feb., 1928.	

Rhynchoplax tuberculata var. **attenuipes,** nov.

There are a number of specimens in the collection that differ in one or two respects from the description given above. In all other respects they resemble the other specimens so closely that they can at most be considered to represent a distinct variety. The legs are considerably thinner than in the typical form; in the latter the propodus of the second walking leg is about 4 times as long as broad, while in the variety the

[1] Kemp, *Rec. Ind. Mus.* XIII, p. 259, fig. 9 (1917).

greatest breadth is even less than one-sixth of the length. In the propodus of the third pair of walking legs this difference is still more



Text-fig. 10.—*Rhynchoplax tuberculata* var. *attenuipes*, nov.

apparent; in the *forma typica* the breadth is to length as 1 : $\frac{7}{2}$, while in the variety the breadth is only one-sixth of the length. A similar attenuation is visible in other segments of the legs also. The walking legs in the variety are also proportionately longer; those of the second pair are the longest, and are $2\frac{2}{3}$ times as long as the carapace and the rostrum combined. In the typical form the second legs are a little less than $2\frac{1}{2}$ times the length of the carapace and rostrum.

Locality.—The variety, like the *forma typica*, is known from the back-waters of Cochin and Travancore. It is described from 7 specimens.

C 1481/1	West Narakhel, Cochin.	..	H. S. Rao, Jan., 1928. 2 ♂♂ and 1 ♀ TYPES.
C 1482/1	East Kumblam, Cochin.	..	H. S. Rao, Dec., 1927. 1 ♀
C 1483/1	Back-water between Paraven and Kappil, Travancore.		H. S. Rao, Feb., 1928. 1 ♂ and 2 ♀♀

Rhynchoplax tuberculata belongs to the group of species that are characterised by the presence of a large tooth-like process on the side of the carapace above the first walking leg. This group comprises *R. wood-masoni* (Alcock), *R. alcocki* Kemp, *R. octagonalis* Kemp, and *R. kempi*, described as a new species in this paper. From the last two species it differs, among other characters, in having distinct teeth on the upper border of the merus of the male cheliped. It can also be easily distinguished from *R. wood-masoni* in having only one tooth on the margin

of the carapace below the eye and in the altogether different shape of the rostrum. Within the group, therefore, *R. tuberculata* shows the greatest resemblance to *R. alcocki*, but the two may be distinguished with the help of the following table:—

Rhynchoplax alcocki.	*Rhynchoplax tuberculata.*
1. Upper surface of carapace without any tubercles.	1. Upper surface of carapace with a number of large tubercles.
2. Median lobe of rostrum bluntly pointed, considerably longer than the lateral lobes.	2. Median lobe of rostrum distally truncate, only slightly longer than the lateral lobes.
3. Chela of male greatly compressed, 1½ times as long as high.	3. Chela of male not greatly compressed, almost twice as long as high.
4. Fingers of male chela widely gaping, with a few irregularly placed teeth.	4. Fingers of male chela not gaping, with five or six regular, interlocking teeth.
5. Dactyli of walking legs armed with a large number of teeth.	5. Dactyli of walking legs armed with a single apical tooth.
6. Upper borders of merus and carpus of walking legs not ending in conspicuous teeth.	6. Upper borders of merus and carpus of walking legs ending in distinct teeth.
7. Terminal segment of male abdomen as long as broad, apically rounded; margins of preceding portion not distinctly angular.	7. Terminal segment of male abdomen much longer than broad, apically pointed; margin of preceding portion distinctly angular about the middle.

Elamena truncata (Stimpson).

1917. *Elamena truncata*, Kemp, *Rec. Ind. Mus.* XIII, pp. 272-274.
1918. *Elamena truncata*, Tesch, *Siboga Exped. Rep.* XXXIX c, pp. 22-24, pl. i, fig. 4.

Besides the three specimens referred to by Kemp, one from the Nicobars and two from the Andamans, there are now another two specimens of this species in the collection. They are both from the Andamans and are females. All the five specimens in the collection of the Indian Museum are females; an examination of male specimens is desirable on account of the doubt expressed by Kemp with regards to the number of segments forming the male abdomen.

C 1484/1	Ross Island Reef, Port Blair, Andamans.	S. W. Kemp, March, 1921.	1 ♀
C 1485/1	Port Blair, Andamans. ..	R. F. Lowis ..	1 ♀

Elamena sindensis Alcock.

1917. *Elamena sindensis*, Kemp, *Rec. Ind. Mus.* XIII, p. 274.
1918. *Elamena sindensis*, Tesch, *Siboga Exped. Rep.* XXXIX c, p. 24.

The species was so far known from Karachi only. We are now referring to it a number of specimens from the Persian Gulf, as also several additional examples from Karachi.

Nothing need be added to the fairly detailed description given by Alcock and amplified by Kemp. The Persian Gulf examples are smaller than the specimens from Karachi, and there are no ovigerous females in the collection. The walking legs, which are broken in most cases, appear to be somewhat more compressed than those in the types, and the characteristic teeth at the end of the upper border of merus and carpus are smaller. The dactylus, as usual, is triunguiculate.

The Karachi specimens agree with the types in all respects.

The record of the species from the Persian Gulf extends its range considerably. The species perhaps occurs more extensively in the Arabian Sea than the present records show.

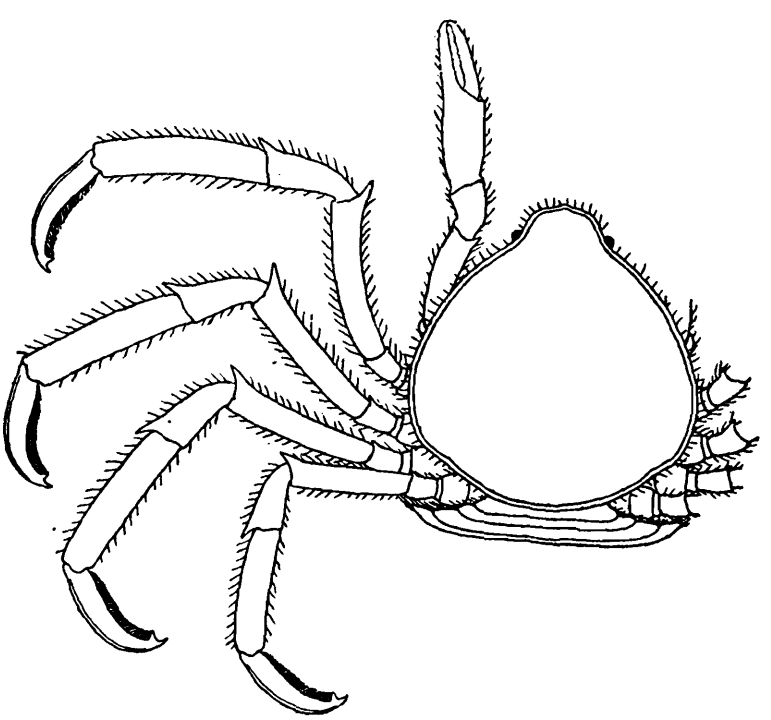
6556/10	Koweit Shores, Persian Gulf.	R. E. Lloyd, 18th Oct., 1908.	4 ♂♂ and 3 ♀♀
C 1486/1	Under stones, near high-water mark, Karachi.	H. J. Walton, 12th Oct., 1918.	4 ♂♂ and 5 ♀♀

Elamena cristatipes Gravely.

1893. *Elamena truncata*, Henderson, *Trans. Linn. Soc. London*, (2) Zoology, V, p. 395.

1927. *Elamene cristatipes*, Gravely, *Bull. Madras Govt. Mus.* (*n. s.*) I, p. 150, pl. xxi, fig. 24.

Elamena cristatipes was described by Gravely from two specimens, one male and one female, collected off Krusadai Island, in the Gulf of Manaar. The description given by Gravely is rather meagre; we have now amplified it by an examination of Gravely's type-specimens, as also from fresh material from Madras.



TEXT-FIG. 11.—*Elamena cristatipes* Gravely.
Outline of dorsal view of female type-specimen.

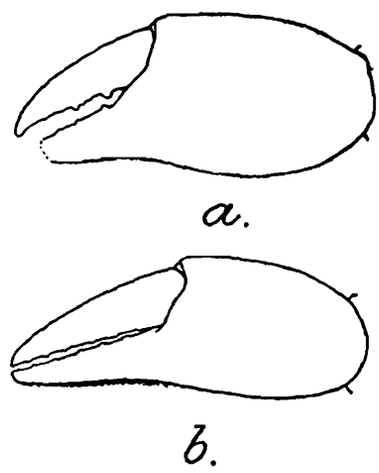
The species closely resembles *Elamena truncata* (Stimpson), but, as remarked by Gravely, can be easily distinguished from it by its rounded

front and the biunguiculate tarsi of the walking legs. The strong crest on the propodus, to which the specific name refers, is also a characteristic feature of the present species. The last two segments of the legs are also more flattened than in Stimpson's species.

The carapace is flat, with the margins strongly upturned, and, as usual in the genus, the various regions are not demarcated. The carapace, including the rostrum, is longer than broad, and is more or less pyriform in outline. The antero-lateral borders are longer than the postero-lateral, and both are regularly arched. The posterior margin is somewhat more rounded than shown in Gravely's figure. The rostrum is broad and its anterior margin is arched and is not truncate as in *E. truncata*. There is a small acute point about the middle of the anterior margin. The eyes are slightly visible from above, and the post-ocular tooth is greatly reduced and can be seen only from below.

The antennules are entirely concealed by the rostrum, and are not visible in the dorsal view. The vertical keel on the lower surface of the rostrum, between the bases of the antennules is well developed, and the rostrum seen from in front presents a T-shaped appearance.

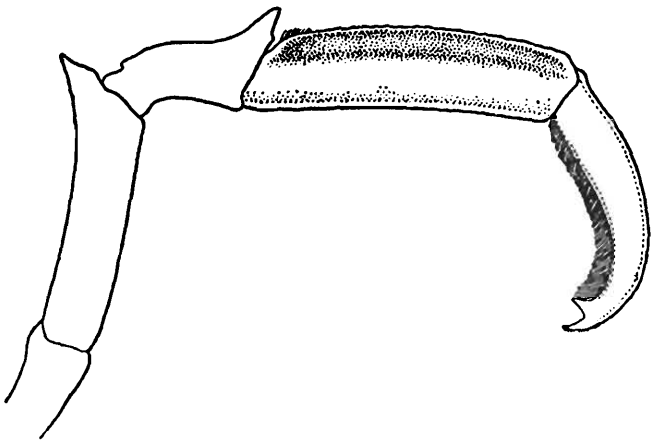
The chelipeds in the male are considerably stouter than the walking legs. The merus has a blunt tooth on the distal end of its margin, and a blunt tubercle is present in a similar position on the carpus. The palm is greatly inflated, being, in the type-specimen, a little less than half the length of the chela. In another specimen, somewhat smaller than the type, the height is proportionately less. A low keel runs longitudinally on the upper surface of the palm. The fingers do not gape, and are provided with a number of very minute teeth, interspersed with a few larger ones. The fingers are somewhat blunt at the tips. The chelipeds in the female are not much stouter than the walking legs, and the chela is proportionately much less high. The fingers gape a little throughout their length and meet only at the tips, which are more or less sharply hooked. The larger teeth on the fingers seem to be evenly distributed.



TEXT-FIG. 12.—*Elamena cristatipes* Gravely.
a. Chela of male type-specimen.
b. Chela of a young male from Madras.

The walking legs are not slender. The last two or three segments being considerably more flattened than in the other species of the genus. The legs of the second pair are slightly the longest, and are a little less than twice the length of the carapace and rostrum. A strong spine is present at the distal extremity of the upper border of the merus, and another in a similar position on the carpus; the propodus is flat, and is very strongly compressed all along its length, below the upper margin. We have, however, failed to see the "strong crest," that according to Gravely's figure is present a little below the upper margin on the dorsal surface of the propodus. A thickened ridge-like structure running longitudinally some distance below the upper margin is present on the ventral side of the propodus, and as

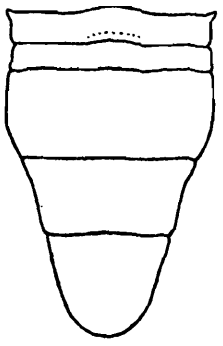
the portion between this and the upper margin is greatly compressed, this may have been taken for a crest by Gravely. We give



Text-fig. 13.—*Elamena cristatipes* Gravely.
Walking leg, ventral surface.

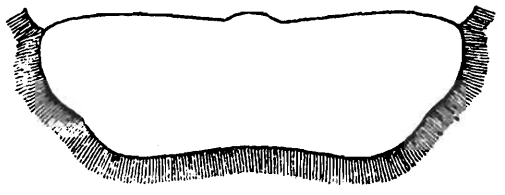
here a figure of the ventral surface of a walking leg and this shows the structure of the propodus very clearly. The upper margin of the propodus is somewhat serrated; the dactylus is flattened and curved, and is provided with two curved teeth at the tip.

The abdomen of the male is formed of five pieces; the third and the fourth segments only appear to have been fused. In this respect the abdomen of *E. cristatipes* resembles the description and figure given by Baker [1] for *E. truncata*, and does not correspond with Kemp's account of the other species. The abdomen is triangular with the sides somewhat sinuous and the terminal segment is broadly rounded. The terminal segment of the female abdomen is strongly sinuous and is concave about the middle.



Text-fig. 14.—*Elamena cristatipes* Gravely.
Abdomen of male type-specimen.

The female type-specimen is about 5·5 mm. long from the tip of the rostrum to the posterior border of the carapace, while the male is about 6 mm. long. Of the four specimens from Madras the largest female is a little over 5 mm. long, while the single male is also 5 mm. in length.



Text-fig. 15.—*Elamena cristatipes* Gravely.
Terminal segment of abdomen of female type-specimen.

The type-specimen is numbered C 1254/1 in the registers of the Zoological Survey of India, and is preserved in the Indian Museum.

[1] Baker, *Trans. Roy. Soc. S. Australia* XXX, p. 113, pl. ii, fig. 2*a* (1906).

Locality.—The types were collected at Krusadai Island in the Gulf of Manaar, while the four additional specimens now referred to the species are from Madras Harbour. All these latter specimens were collected by Dr. Kemp in May, 1918, at a depth of 4-5 fathoms. According to Dr. Kemp's station-book the carapace, in life, is "dark, with red streaks running inwards on either side postero-laterally."

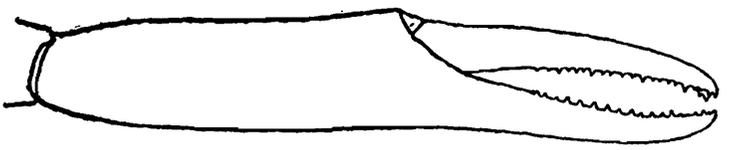
C 1487/1	Madras Harbour: on large blocks at end of harbour extension, submerged in 5 fathoms of water.	S. W. Kemp, May, 1918.	1 ♂
C 1488/1	Madras Harbour: in angle between new extension and old arm of harbour, 4-5 fathoms.	S. W. Kemp, May, 1918.	2 ♀♀
C 1489/1	Madras Harbour: on old blocks hauled from bottom at end of harbour wall, 4-5 fathoms.	S. W. Kemp, May, 1918.	1 ♂

Elamena (Trigonoplax) unguiformis de Haan.

1917. *Elamena* (*Trigonoplax*) *unguiformis*, Kemp, *Rec. Ind. Mus.* XIII, pp. 277, 278.
1918. *Trigonoplax unguiformis*, Tesch., *Siboga Exped. Rep.* XXXIX c, pp. 25, 26.

This species seems to be very common at Port Blair, for, besides the specimens recorded from there by Wood-Mason and Kemp, there are in the present collection five other examples from the same locality.

The species has been very well described by several authors. The chela in both the sexes has the fingers gaping, and besides the minute



TEXT-FIG. 16.—*Elamena* (*Trigonoplax*) *unguiformis* de Haan Chela of male.

teeth there are a few bigger and blunter teeth near the tips of the fingers, which, as mentioned by Alcock, are spooned.

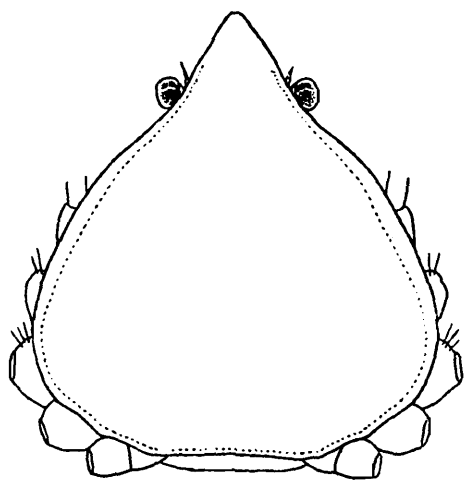
C 1490/1	Ross Channel, Port Blair, Andamans, 2-9 fathoms.	S. W. Kemp	3 ♂♂ and 2 ♀♀

Elamena (Trigonoplax) sp.

There is a single specimen of *Trigonoplax* in the collection, that we find difficult to refer to any of the known species. In most of the important characters it resembles *E.* (*T.*) *xavieri* Kemp [1] from Portuguese India, but differs from it in one or two noteworthy characters. In Kemp's species the carapace is longer than broad, but in our specimen the length is proportionately a little greater than that in Kemp's form. The antero-lateral borders are also less strongly arched than in *E.* (*T.*)

[1] Kemp, *Rec. Ind. Mus.* XIII, pp. 275-277 (1917).

xavieri. Further the rostrum appears to be proportionately a little longer, and its sides are more or less straight, and not arched, as in Kemp's



TEXT-FIG. 17.—*Elamena* (*Trigonoplax*) sp.
Outline of carapace.

species. The sharp forwardly-directed tooth on the ventral surface of the rostrum is better developed in our specimen than shown in Kemp's figure of *E. xavieri.* The chelipeds and the legs agree in all material respects with Kemp's description. The walking legs, however, are not appreciably roughened as described by Kemp.

In the shape of the carapace the present specimen seems to be intermediate between *E. xavieri* and *E.* (*T.*) *cimex* Kemp,[1] but it differs from the latter, among other characters, in the shape of the rostrum, in the presence of a septum between the antennules and of a forwardly-directed tooth on the ventral side of the rostrum. The dactyli of the walking legs are also differently armed.

The single specimen described above was collected by Dr. Kemp in the Andaman Islands. It is a male, 4·2 mm. long, and has most of its legs detached.

C 1491/1	In channel, north of Viper Island, Port Blair, Andamans.	S. W. Kemp	1 ♂

[1] Kemp, *Mem. Ind. Mus.* V, pp. 216-218, pl. xii, fig. 3 (1915).

NOTES ON THE OPHIUROID GENUS *TRICHASTER*, WITH A DESCRIPTION OF *T ACANTHIFER* DODERLEIN.

By S. B. SETNA, *M.Sc.* (*Punjab*), *Ph.D.* (*Cantab*), *Zoological Survey of India, Calcutta.*

(Plate XIII).

The following notes are based on the material of the genus *Trichaster* collected by Lieut.-Col. R. B. S. Sewell in1913, when employed as Surgeon Naturalist on board the R. I. M. S. " Investigator." Col. Sewell worked on this material for a short time, but owing to pressure of other more important work gave it up. He has very kindly entrusted the entire collection to me with a suggestion to identify the animal specifically and to prepare a diagnostic key by which the known species of the interesting genus *Trichaster* can be distinguished from one another. I have great pleasure in offering my thanks to Col. Sewell for giving me the material and for helpful suggestions and criticisms.

Genus **Trichaster** L. Agassiz, 1835.

In the present state of our knowledge only three species of the genus *Trichaster* are known, *viz.*, *T elegans*[1] Ludwig, *T palmiferus* (Lamarck) and the new species recently described by Doderlein as *T acanthifer*. The last species was based on a single specimen, which its author in 1911 had doubtfully identified as *T palmiferus*. In 1927, however, he seems to have examined the specimen more closely for he gives its chief distinguishing characters and establishes it as a type of his new species. Doderlein, at the same time, seems to have come to the conclusion that the three species of *Trichaster* are merely varieties and expressed the view that future researches will show that the three species are synonymous. I have examined twenty-two specimens of *Trichaster acanthifer* collected from three different localities and find that it is not only a well-marked species, but is distinguished from the other two on fundamental diagnostic characters. Before I discuss these differences between the three species I propose to redescribe Doderlein's species from fresh material obtained from the Indian Ocean.

Trichaster acanthifer Doderlein.

1911. *Trichaster palmiferus*, Doderlein (in part), *Japan. u. andere Euryalae*, taf. ix, fig. 5.
1927. *Trichaster acanthifer*, Doderlein, *Indopacifische Euryalae*, taf. ix, fig. 1.

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[1] Since the preceding note went to the press, a valuable addition has been made to our knowledge of the Ophiuroidea, by the publication of Doderlein's (4) paper on " Die Ophiuroiden der Deutschen Tiefsee-Expedition. 2 : Euryalae ". The author is led to believe that the species *T. elegans* Ludwig is synonymous with *T. flagellifer* v. Martens, the latter name having already been employed for the species found at Singapore. An examination and description of the two by the author revealed to him no material difference which could justify their separation. Doderlein has therefore retained v. Martens' name *flagellifer* for the species generally referred to as *elegans*, though it is regretted that *elegans*, a far more suitable name, has to be discarded.

In the collection of the Zoological Survey of India *T acanthifer* is represented from the following localities :—

Station.	Date.	Position.	Nature of bottom.	Net.	Depth of net (fathoms).	Number of specimens.
548	21-X	12° 49′ 23″ N. 98° 23′ 30″ E.	M. S. Sh.[1]	A. T.[1]	23	8
549	21-X	12° 48′ 00″ N. 98° 16′ 10″ E.	M. S. Sh.[1]	A. T.[1]	24	5
554	21-X	12° 47′ 30″ N. 98° 15′ 30″ E.	M. S. Sh.[1]	A. T.[1]	24	9

Registered No. P. $\frac{491}{1}$, Zoological Survey of India, (Indian Museum), Calcutta.

The above constitute new distribution records for a species which is already known in literature.

In the specimens from station 549 the disc is comparatively small. It is 16 millimetres from the end of a radial shield to the opposite inter-brachial margin and the length of the arm up to the first bifurcation is from 49 to 53 mm. ; the disc is pentagonal owing to its being slightly excavated in the inter-radial spaces and, unlike *T elegans* and *T palmiferus*, more sharply marked of from and slightly raised above the surface of the arms. In the example from station 554 the disc is slightly larger. The collection from this station includes forms which range from very small to very large ones, representing all growth-stages. The disc diameters vary between 10 to 20 mm. and so also do the arm lengths vary. The arms are about five times as long as the disc diameters ; they are long, slender and fairly rigid, slightly higher than wide at the base and quadrangular in transverse section. The width of the arm at the first bifurcation being one-fourth of that at the base.

The spines present on the arms are arranged in two alternating and outwardly directed rows ; they are prolonged and curved in the proximal part of the arm, simple in the middle ; they diminish in length as they approach the tip of the arm and on the distal one-third of the arm the spines completely disappear. In transverse section the arm is distinctly circular in outline.

The disc is also beset with spines like those on the arms. The constancy in the number of disc spines is very striking for there are not more than two at the base of each arm. In general the spines vary in size and, approximately, proportionately to the size of the animal.

The drawings given illustrate the character of the spines at different heights of the arm.

The skin on the dorsal and ventral surfaces of the disc is opaque and granular. The radial shields have the same form as in *T elegans* ; they are narrow, bar-like structures, gently raised and forming ridges with distinct outlines. Their tapering ends do not quite reach the centre, while they are armed with spines near their outer ends. The

[1] M=mud. S=sand. Sh. = shell. A. T. = Agassiz trawl.

lateral arm plates are also expanded at their outer ends as in *T palmiferus* and carry the spines.

I give below some measurements for comparison with the other species.

Disc diameter (largest specimen)—20 mm.

Arms.	Length.	Number of segments.
Base to first bifurcation	56 mm.	34
First to second bifurcation	13 „	13
From second to third bifurcation	11½ „	16
From third to fourth bifurcation	11 „	15
	Breadth.	Height.
Base of arm	8 mm.	6 mm.
Near first bifurcation	2½ „	2½ „

Spines height—3 mm. Width at base—2¼ mm.
Space between a pair of disc spines—4½ mm.
Oval inter-brachial space—Length 5 mm. Width—3½ mm.
Bursal aperture, vertical diameter—2¼ mm.
Interval between a pair of bursal apertures—2·5 mm.

The apertures of the genital bursae in the present specimen are situated in an oval space; the openings are elongated oval in outline, a little diverging dorsally and separated by a wide wall along the edges of which are large grains which appear very much like papillae.

Doderlein states that the number of segments up to the first bifurcation on the five arms is as follows:—44, 36, 43, 38 and 44, which is very approximately what obtains in my specimens; this being so it will be seen that very little taxonomic importance can be attached to the number of segments in the arms.

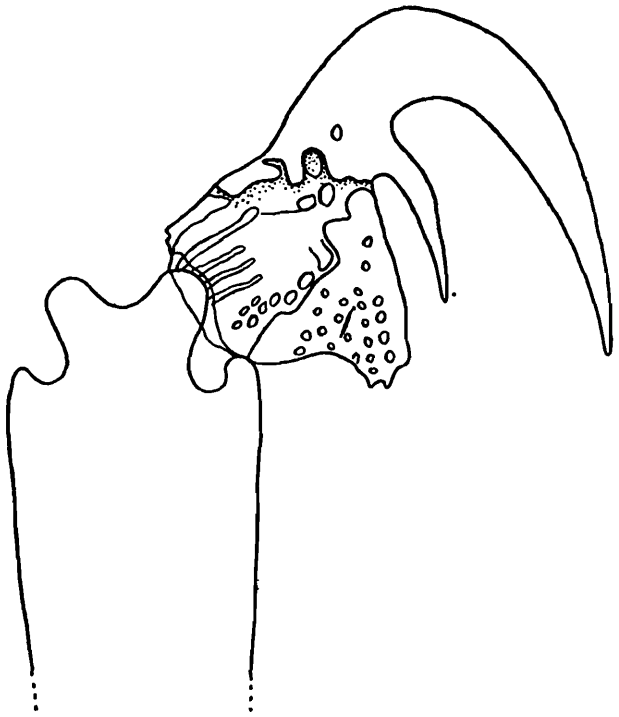
Affinities and distinctive features.—The most important feature in which this species is distinguishable from *T palmiferous*, without referring to minor points of difference, are the very wide space between the inter-brachials, the very widely spaced stigmatal fissures and the presence of very well developed spines. The possession of such well-marked and constant structures, as the spines in the present species, precludes the possibility of its being either *T elegans* or *T palmiferus*.

Doderlein argues that the differentiating characters in the three species of *Trichaster* are so variable and dependent on age and preserving conditions that, if a study of a large number of individuals is undertaken, it will lead to an amalgamation of the three species under one specific name. I have been fortunate in being able to compare this specimen with a specimen of *T elegans* Ludwig (Reg. No. ZEV $\frac{5480}{7}$) from the Bay of Bengal, described by Bomford (1913), and *T palmiferus* (Lamarck) (Reg. No. ZEV $\frac{5481}{7}$) presented to the Indian Museum by Dr. Hungerford who obtained it from Hongkong. My examination of twenty-two (mostly mature) individuals confirm my determination and afford evidence that the three species, though closely allied, are yet in every case sufficiently distinct to be recognisable from their outward form alone by casual observation.

I am not in agreement with Doderlein's views, for *T. acanthifer* has a well-developed combination of characters which have specific significance and accord neither with *T elegans* nor *T palmiferus*. *T acanthifer*, as now recognised and defined, occupies an intermediate position between the already recognised species. It seems evidently to be more closely related to *T elegans*, which has like itself a large inter-brachial space and well separated bursal apertures, but differs from the latter in the general facies, presence of well-developed spines, character and number of arm bifurcations and other minor characters.

I was able to count only four bifurcations in this species as contrasted with six in *T elegans*.

The microscopical character of the talons borne on the tentacle papillae, while agreeing with the type common in the family and figured by Bomford, is distinguished by slightly greater development of the lower branch, which is comparatively more elongated (text-fig. 1).



TEXT-FIG. 1.—Tentacle hooks of *Trichaster acanthifer* Doderlein. × 140.

Key to species of Trichaster.

A. A robust and much more heavily built species ; disc circular in outline with the arms merging insensibly into the disc ; inter-brachial space narrow, so that the two genital slits are very close together and form a single aperture ; arms almost triangular in section with 62 arm joints within the first bifurcation, each proximal arm joint bearing a pair of stumpy tubercles on the dorsal side ; arm width at the first bifurcation about one-third of that at the base.

Colour in alcohol.—Whitish or very pale yellow. *T. palmiferus.*

B. A slender, large and elegant species ; disc circular in outline with the arms merging insensibly into the disc ; inter-brachial space not extremely narrow, so that the two genital slits are well separated from each other ; arms quadrangular in section with thirty-nine to fifty-three, usually forty-five, arm joints within the first bifurcation ; arms entirely free of stumpy tubercles ; arm width at first bifurcation being less than one-fourth of that at the base.

Colour in alcohol.—Space between the radial shields and the grooves in the median dorsal line of the arms yellowish-brown ; the rest light yellow. *T. elegans.*

C. A slender and comparatively small form; disc more or less pentagonal in outline and more sharply marked off from the arms; inter-brachial space as wide as in *T. elegans* and the genital slits rather well separated from each other; arms quadrangular in section with thirty-four to forty-five, usually thirty-seven, arm joints within the first bifurcation; arms and disc provided with well-developed spines; arm width at the first bifurcation being one-fourth of that at the base.

Colour in alcohol.—Uniformly white.[1] *T. acanthifer.*

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[1] Colonel Sewell informs me that the colour of the animal was slaty-grey in the living condition.

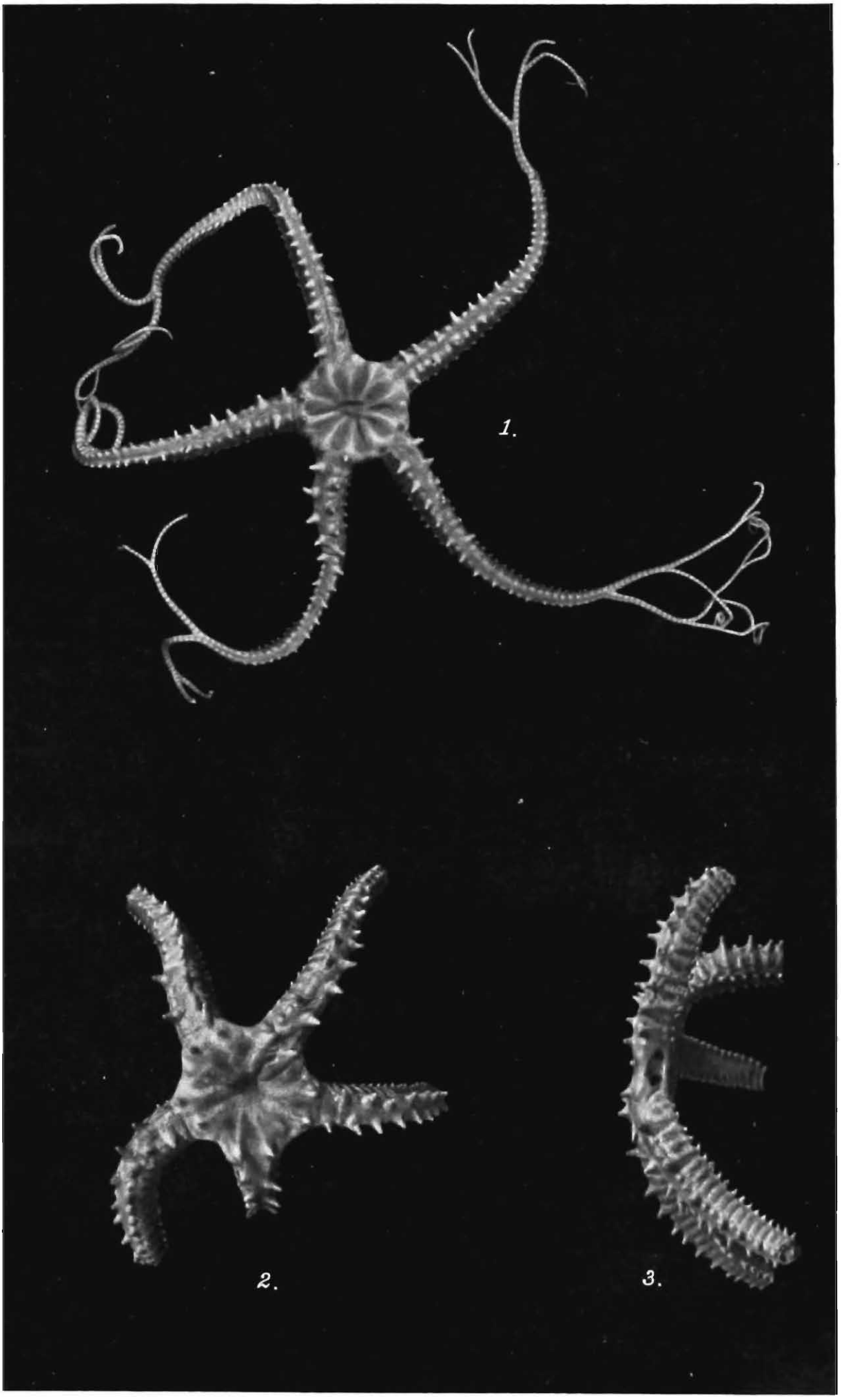
EXPLANATION OF PLATE XIII.

Trichaster acanthifer Doderlein.

FIG. 1.—Entire animal, dorsal view.

„ 2.—Disc region, dorsal view to show arrangement of spines.

„ 3.—Lateral view of interbrachial space.



S. C. Mondul, photo.

TRICHASTER ACANTHIFER.

EIN NEUER *HETEROCERUS* (COLEOPTERA) AUS CALCUTTA.

By RICHARD MAMITZA, *Wien.*

Dank dem liebenswürdigen Entgegenkommen seitens der Leitung des Indian Museum, Calcutta, hatte ich Gelegenheit, das gesamte undeterminierte Heteroceridae-Material zu bearbeiten. Es sei mir hier gestattet, der Leitung des genannten Museums meinen verbindlichsten Dank für die Ueberlassung der Materialien zum Studium abzustatten. Die Untersuchung ergab hiebei folgendes Resultat :—

Heterocerus tonkinensis Grouv. : Kashmir, North-Western Himalayas.

Heterocerus maindroni Grouv. : Balugaon, Orissa. Chilka Lake, Ganjam dist., Madras Presidency. Calcutta, Bengal.

Heterocerus micans Mamitza : Mariambari Tea Estate, Pankhabari.

Heterocerus punctatissimus, n. sp. Calcutta, Bengal.

Heterocerus punctatissimus, n. sp.

Dem *Heterocerus arrowi* Mamitza nahestehend, von demselben durch deutlich gestreifte Flügeldecken, feiner, dichter Punktierung und kurzer dichter Behaarung leicht zu unterscheiden.

Länglich, etwa 2½ mal so lang als breit, gewölbt, glänzend, schwarz, (unausgefärbte Exemplare braun) ohne Spuren von Makel.

Kopf mit den Augen etwas breiter als mit den Mandibeln lang, dicht und fein punktiert, mit nach vorne gerichteten, kurzen gelben Haaren bedeckt. Die Oberlippe ist 1½ mal so breit als lang, an der Basis am breitesten, die Seiten sind bogenförmig nach vorne verengt ; Vorderrand schwach eingedrückt. Mandibeln ziemlich lang, mit scharf ausgezogener Spitze, auf der Aussenseite hinter der Mitte mit einem schwachen Einschnitt versehen. Fühler schwarz, elfgliedrig mit siebengliedriger Keule.

Halsschild an der Basis fast doppelt so breit als lang, beim ♂ etwas breiter beim ♀ etwas schmäler wie die Flügeldecken, dicht und fein punktiert, kurz gelb behaart. Die vollkommen bis zu den Hinterwinkeln gerandete Basis bogenförmig, die Seiten von den Hinterwinkeln bis zur Mitte parallel dann stark nach vorne verengt ; Vorderwinkel abgerundet, Hinterwinkel deutlich markiert. Scutellum dreieckig, etwas länger als an der Basis breit ; vertieft.

Flügeldecken doppelt so lang als zusammen breit, hinter der Schulter eingedrückt, nach der Mitte gemeinschaftlich abgerundet ; sehr fein und dicht punktiert ; die gelbe Behaarung dicht und kurz, schräg abstehend nach rückwärts gerichtet. Die vollkommen schwarzen, stark glänzenden Flügeldecken sind von der Basis bis zum letzten Drittel deutlich gestreift.

Unterseite schwarz, glänzend, die Seiten des Abdomens rotbraun. Die von der Mittelhüfte schräg gegen den Seitenrand ziehende Linie ist vorhanden. Die Punktierung ist fein, am Metasternum und Abdomen

ziemlich dicht. Behaarung kurz, mässig dicht, gelb. *Beine* schwarz, Tarsen braun, die Vorderschienen auf der Aussenseite mit zehn, zur Spitze länger werdenden Dornen bewaffnet.

Die Schenkellinie des ersten Abdominalsternites vollständig, innen vom Hinterrand des Sternites zur Basis desselben bogenförmig zurückkehrend.

Länge $3\frac{1}{2}$ mm.
Latria : Calcutta.

Drei übereinstimmende Exemplare, hievon zwei im Indian Museum, Calcutta und das dritte in meiner Sammlung.

CONTRIBUTIONS TO A KNOWLEDGE OF THE INDO-MALAYAN JAPYGIDAE (THYSANURA).

By F. SILVESTRI, *Portici.*

The first species of the Japygidae to be recorded from the Indo-Malayan region was obtained by Max Weber and was described by Oudemans[1] under the name *Japyx indicus;* the examples that were referred to this species were collected in Sumatra, Java, Saleyer and Flores in the Malay Archipelago. A second species, *J. oudemansi*, was described by Parona[2] from specimens taken by L. Fea in Burma; and a third and fourth were described by me[3] from India (*Parajapyx grassianus* var. *indica*) and from Sumatra (*Japyx sumatranus*). In addition Parona recorded *J. indicus* from Burma and I also reported the occurrence of this species in Ceylon. At the present time, however, I consider that the genuine form of *J. indicus* is limited to Sumatra and that examples from other places should be regarded as varieties. In the Indo-Malayan region there exist a number of species, subspecies and varieties, hitherto grouped together as *Japyx indicus* Oud. This species I have taken as the type of a new genus *Indjapyx.*

For a complete revision it is necessary to have available extensive material including a number of adult specimens; the present paper is only a preliminary account and is based on scanty material, and consequently still leaves one in doubt regarding the structure and the presence and number of the glandular pseudopori on the middle of the first urosternum.

The specimens referred by Parona to *Japyx oudemansi* are here redescribed as belonging to two species of a new genus *Burmjapyx.* This genus presents several interesting features, especially that of the subcoxal organs of the first urosternum. I also include in this note two specie from Mesopotamia.

The number of species and varieties listed below include 26 of which 7 are provisionally referred to the genus *Japyx* Hal., 16 (varieties included) to *Indjapyx*, 2 to *Burmjapyx* and 1 to *Parajapyx.* The last genus is represented by species in the tropical and temperate zones throughout the world. *Indjapyx* includes a few members from the extreme Asiatic oriental subregion and from the Australian region.

Japyx syriacus Silv. var. **inferior,** nov.

Corpus colore consueto; caput setis brevibus et brevioribus numerosis et setis nonnullis parum longis instructum. Antennae

[1] Max Weber, *Zool. Erg. ein Reise Niederl. Ost-Indien* I (1890): Apterygota (Japygidae, pp. 77-80).

[2] Di alcuni Tisanuri e Collembol della Birmania raccolti da Leonardo Fea.—*Atti Soc. It. Sc. nat.* XXXIV, pp. 5-7, tav. i, fig. 4-6.

[3] On some Thysanura in the Indian Museum.—*Rec. Ind. Mus.* IX (1913), Japygidas, pp. 52-53, fig. 2.

Descrizione di alcuni Tisanuri indo-malesi.—*Bol. Lab. Zool. Sc. sup. Agr. Portici,* XI (1916), Japygidae, pp. 87-88, fig. 2.

47-articulatae, articulo tertio subaeque longo atque lato et quam quartus paullum longiore setis majoribus mm. 0·46 longis, setis longis, brevibus et brevioribus instructis.

Thorax: pronotum setis longis et sat longis 14+14 et setis sat numerosis brevibus et brevioribus instructum, meso- et metanotum praescuto et scuto setis numerosis brevibus et brevioribus numerosis et scuto setis aliis longis et sat longis c. 12+12 instructo; presterni parte antica 2+2 longis +4—5 parum longis instructa.

Pedes persetosi, tarsi setis inferis biseriatis parum robustioribus, praetarsi unguicula bene evoluta, ejusdem ungue postica quam tarsus fere 2/3 breviore.

Abdomen: tergitorum superficies setis brevibus et brevioribus sat numerosis et macrochaetis sat longis, tergiti septimi angulo postico elongato, angustato, acuto, retrorsum magis quam tergiti margine medius producto, segmenti ejusdem parte marginali postica seta nonnulla brevissima instructis. Urosternum primum eidem formae typicae subsimile est.

Segmentum decimum subrectangulare, parum longius quam latius, carinis sublateralibus subintegris, acropygio latiusculo breviore.

Forceps brachii laevi sinu basali tuberculis $\frac{8}{10}$ dente postmediano sat magno, margine postdentali brevi tractu vix crenulato; brachio dextero tuberculis basalibus tribus, dente praemediano magno, margine postdentali fere usque ad apicem crenulato.

Long. corp. mm. 15, lat. urotergiti septimi 1·70, long. antennarum 6; long. forcipis 1·50.

Habitat.—Mesopotamia: Amara, exemplum typicum Dr. A. Buxton legit.

Observatio.—Varietas haec a forma typica urotergiti septimi angulo postico parum minus producto et forcipe parum minus crassiore et ejusdem brachii laevi dente postmediano parum magis distante diversa est.

Japyx evansi, sp. nov.

(Fig. I-II.)

Corpus cremeum ab abdominis segmento octavo ochraceo, forcipis parte distali badia marginibus obscurioribus.

Caput supra setis longis nonnullis, setis sat longis sat numerosis et setis nonnullis brevioribus instructum; antennae 42-articulatae, articulo tertio subaeque longo atque lato, setis majoribus mm. 0·23 longis, articulo duodecimo subaeque longo atque lato, articulis penultimo et ultimo brevioribus; maxillae primi paris lobus internus laminis pectinatis quinque instructus; palpus labialis mm. 0·15 longus.

Thorax: pronotum setis longis 5+5, sat longis 7+7 et nonnulla breviore, meso- et metanotum praescuto setis longis et sat longis 5+5 et seta nonnulla breviore, scuto setis longis et sat longis 17+17 et setis nonnullis brevioribus instructo; prosterni pars antica setis duabus lateralibus longis et setis 6—7 sat longis utrimque instructa.

Pedes bene setosis, tibiae seta infera apicali sat longa et parum robusta, tarsi setis inferis seriei anticae (6) parum robustis, praetarsi ungue majore quam tarsi longitudo 5/7 breviore, quam unguis altera

parum longiore, unguiculae parte prominenti nulla, tantum ejusdem parte basali chitinea distincta.

Abdomen tergiti sexti angulo postico rotundato, tergiti septimi angustato, elongato, spiniformi, retrorsum aliquantum producto, tergitum octavum septimum longitudine subaequans et quam idem aliquantum angustius, lateribus angulatim retrorsum paullum productis.

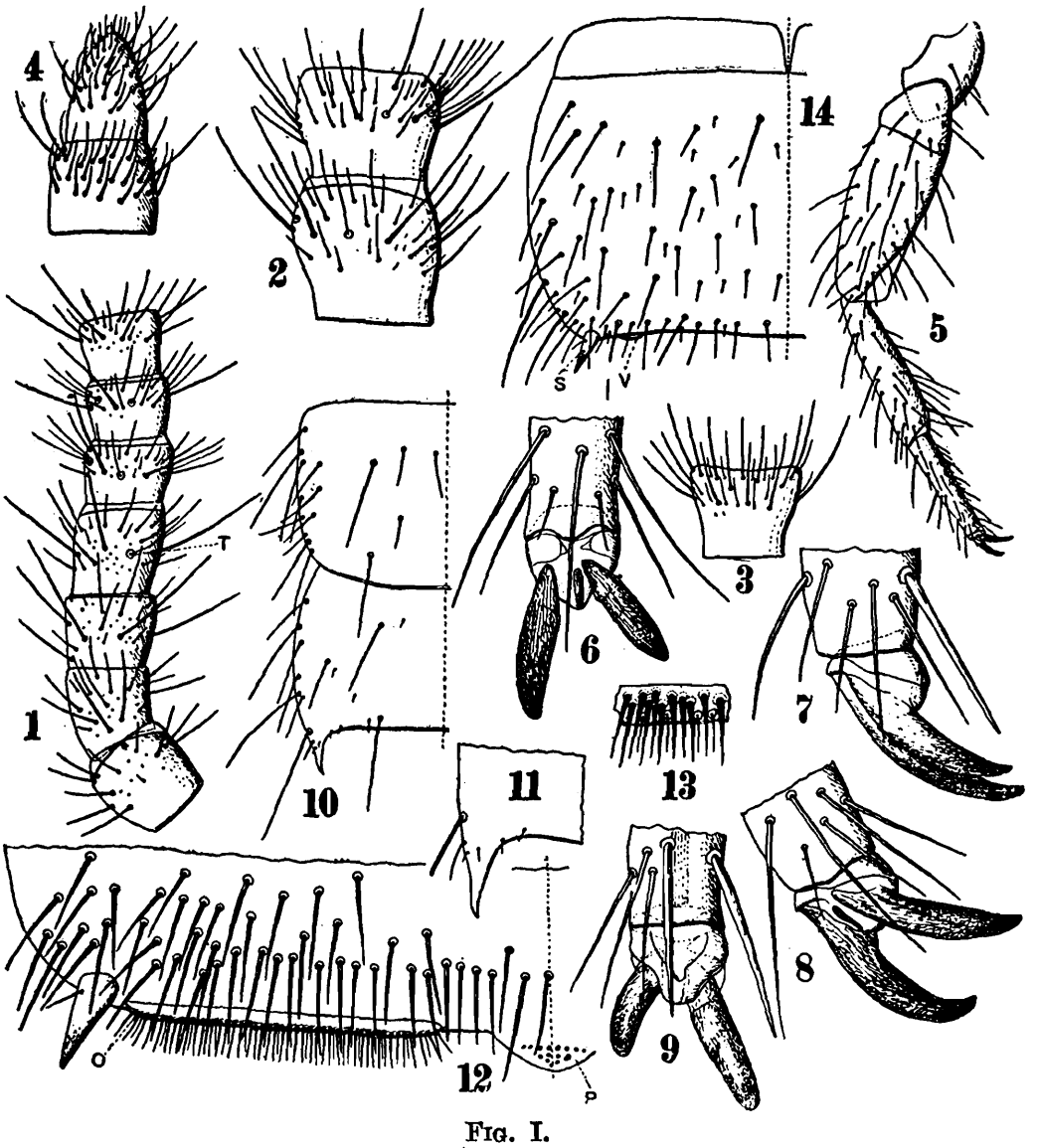


FIG. I.

Japyx evansi : 1. antennae laevae pars proximalis prona ; 2. antennae laevae articuli quartus et quintus proni ; 3. antennae articulus vigesimus ; 4. antennae pars apicalis ; 5. pes paris tertii ; 6-9. tarsi apex et preatarsus supra, lateraliter, oblique et subtus ; 10. uratergitorum sexti et septimi dimidia pars ; 11. urotergiti septimi pars postica lateralis ; 12. urosterniti primi dimidia pars postica magis ampliata ; 13. urosterni primi organi subcoxalis particula magis ampliata ; 14. urosterniti secundi dimidia pars.

Urosternum primum organis subcoxalibus lateribus latis inter sese multo minus quam organi singuli latitudo distantibus, setis glandularibus brevioribus crebris 1-2 seriatis et setis brevissimis subtilioribus minus numerosis posticis auctis, superficie pone organum subcoxale setis numerosis brevibus postice subseriatis, ceteris sparsis, sterni margine postico medio organo glandulari parvo instructo, urosterni cetera superficie setis sat numerosis sat longis transverse 5-6 irregulariter seriatis

et setis brevissimis sparsis aucta; urosterna cetera setis sat longis numerosis transverse 6-7 subseriatis et setis brevibus et brevissimis sparsis instructa; stili parum elongati; vesiculae male distinguendae.

Segmentum decimum supra parum longius quam latius, carinis sublateralibus subintegris, setis longis 8 + 8 et setis brevissimis nonnullis sparsis; acropygio breviore.

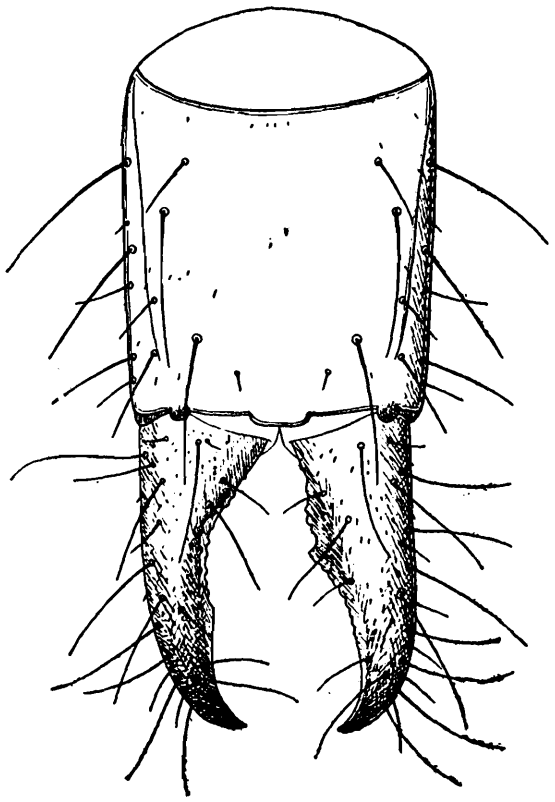


FIG. II.
Japyx evansi; abdominis segmentum decimum cum forcipe pronum.

Forceps brachii asymmetricis: brachio laevo parum longe a basi usque ad dentem postmedianum paullum sinuato et tuberculis $\frac{7}{8}$ inter sese distantibus dente postmediano sat parvo, margine distali integro; brachio dextero dente praemediano, sat magno, tuberculis proximalibus 4, quorum mediana majora sunt, margine postdentali subintegro, tantum vix et late crenulato.

Long. corp. ad mm. 11: lat. urotergiti septimi 1·30; long. antennarum 2·60; long. forcipis 1·04.

Patria.— Mesopotamia: Jebel Hamrin apud Ruz, exempla tria sub saxis Cl. H. E. Evans, cuius memoriae speciem dico, legit.

Observatio.—Species haec antennarum articulorum numero, urosterni primi et forcipis forma facile distinguenda et a speciebus omnibus hucusque mihi notis praetarsi unguicula mediana parte prominenti destituta distinctissima est.

Japyx beccarii, sp. nov.

(Fig. III-IV.)

Mas.—Corpus ochroleucum abdomine a segmento octavo ochraceo forcipe maxima pro parte badio.

Caput supra setis brevibus c. 16 + 16 et nonnullis brevioribus et brevissimis instructum; antennae 32-articulatae, articulis setis longis, brevibus et brevioribus ut fig. III, 1-2 demonstrant instructis, trichobothriis superis internis longis; maxillae primi paris lobus internus laminis pectinatis 5, palpus labialis mm. 0·090 longus.

Thorax: pronotum setis longis et sat longis 6 + 6, brevibus 2 + 2 et nonnullis brevioribus et brevissimis instructum; meso- et metanotum praescuto setis duabus submedianis sat longis et duabus sublateralibus brevibus, scuto setis 5 + 5 sat longis, 2 + 2 brevibus et nonnullis brevioribus et brevissimis.

Pedes tarso quam praetarsus paullum minus quam duplo longiore, infra setis robustioribus 4 instructo, praetarsi unguibus elongatis

attenuatis, ungue postico quam anticus aliquantum longiore unguicula mediana bene evoluta.

Abdomen : tergitum primum praescuto eidem metanoti simile, scuto setis duabus submedianis subanticis et duabus subposticis sat longis et nonnullis brevissimis ; tergita 3-7 setis sat longis 6+6 et setis nonnullis brevioribus et brevissimis instructa, tergiti sexti angulo postico rotundato,

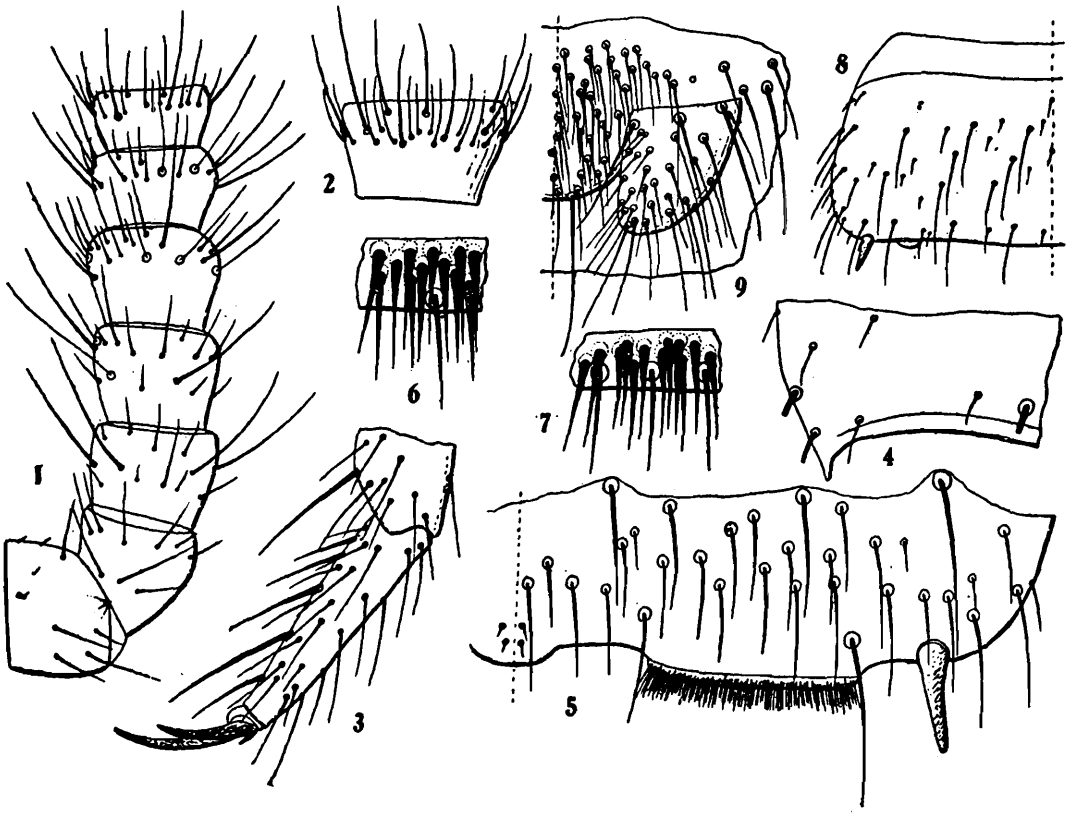


FIG. III.

Japyx beccarii : 1. antennae laevae pars proximalis prona ; 2. antennae articulus decimus octavus ; 3. pes paris tertii a tibiae apice ; 4. urotergiti septimi pars postica lateralis magis ampliata ; 5. urosterniti dimidia pars postica magis ampliata ; 6-7. urosterniti septimi organi subcoxalis particula lateralis externa et interna ; 8. urosterniti secundi dimidia pars ; 9. maris dimidia area externa genitalis cum appendice.

septimi angulatim retrorsum aliquantum producto et apice ipso in processum breviorem angustiorem acutum conformato ; tergitum octavum septimum longitudine subaequans et quam idem parum angustius, lateribus postice haud productis ; tergitum nonum brevius.

Urosternum primum organis subcoxalibus parum latis inter sese magis quam unius latitudo remotis, setis glandularibus brevissimis (mm. 0·026 longis) numerosis inter sese subtangentibus transverse biseriatis et setis paucis brevissimis posticis robustis ex area circulari orientibus instructis, superficie pone organum subcoxale setis parum numerosis brevibus 2-3 inordinatim seriatis, urosterni parte mediana postica setis minimis 4+4 pseudoporis indistinctis (an semper ?) urosterni superficie cetera ut eadem urosternorum sequentium setis paucis sat longis 3-seriatis (praesterni serie exclusa) et setis aliis brevioribus.

Stili et vesiculae consueta.

Appendices genitales subconicae persetosae.

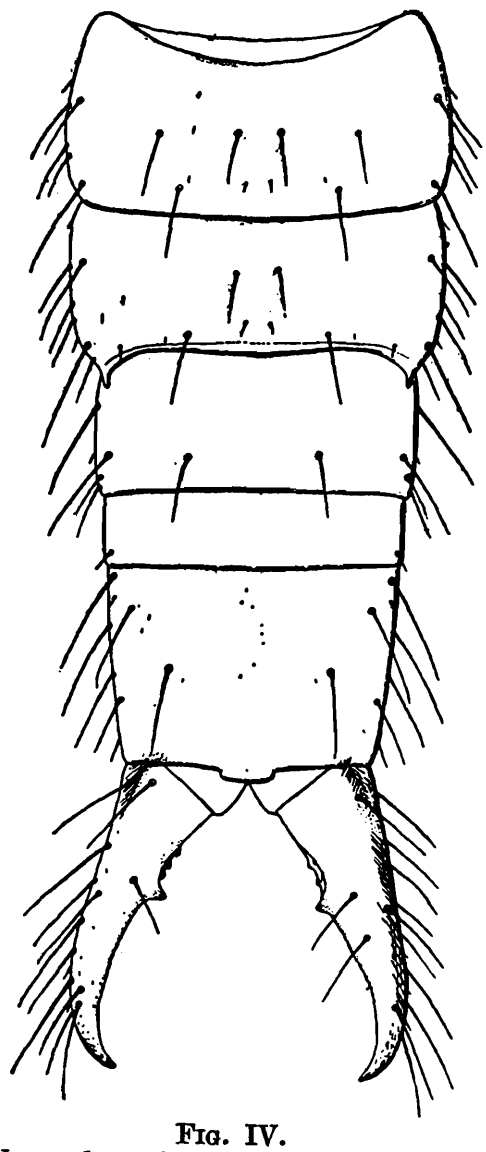


FIG. IV.
Japyx beccarii; corporis pars postica prona a segmento sexto.

Segmentum decimum supra inspectum aliquantum latius quam longius carinis indistinctis setis longis 6+6 et setis brevissimis nonnullis, acropygio lato, brevissimo.

Forceps quam segmenti decimi latitudo parum longior, brachiis elongatis attenuatis, laevo dente praemediano sat magno, margine praedentali parum sinuato tuberculis parvis $\frac{2}{3}$, margine postdentali subintegro, brachio dextero dente quam idem laevi parum magis a basi remoto, margine praedentali tuberculis parvis $\frac{1}{3}$, margine postdentali subintegro.

Long. corporis mm. 7, lat. urotergiti septimi 1·00, long. antennarum 1·82, forcipis 0·85.

Habitat.—Borneo: Mt. Dulit (Mjöberg legit, Mus. Sarawak).

Observatio.—Species haec in memoriam clar. Odoardo Beccari dicata, antennarum articulorum numero, urosterni primi organis subcoxalibus, forcipis forma bene distincta est.

Japyx sumatranus Silv.

Sumatra: Tandjon Slamat.

Japyx greeni, sp. nov.

(Fig. V-VIII.)

Corpus cremeum abdominis segmento decimo pallide ferrugineo, forcipis marginibus et apice badiis.

Caput supra setis c. 20+20 brevibus et nonnullis brevioribus et brevissimis instructum; antennae 26-articulatae setis longis, brevibus et brevioribus ut fig. V, 1-2 demonstrant instructis, trichobothriis superis internis longis; maxillae primi paris lobus internus laminis pectinatis quatuor et lamina falciformi simplici abbreviata instructus, palpus labialis brevissimus.

Thorax: pronotum setis longis et sat longis 5+5, brevioribus 1+1 et nonnullis brevissimis, meso- et metanotum praescuto setis duabus brevibus submedianis, scuto setis 5+5 longis et sat longis, 4+4 brevibus et nonnullis brevissimis.

Pedes tarso quam praetarsus duplo longiore infra etis robustioribus 3+3 instructo, praetarsi ungue postico quam anticus aliquantum longiore, unguicula mediana bene evoluta.

Abdomen: tergitum primum praescuto eidem metanoti simili, scuto setis duabus submedianis subanticis et du abus subposticis sublateralibus

brevibus ; tergita 3-7 setis sat longis 8+8, brevibus 1+1 et nonnullis brevissimis, tergiti sexti angulo postico rotundato, septimi in processum

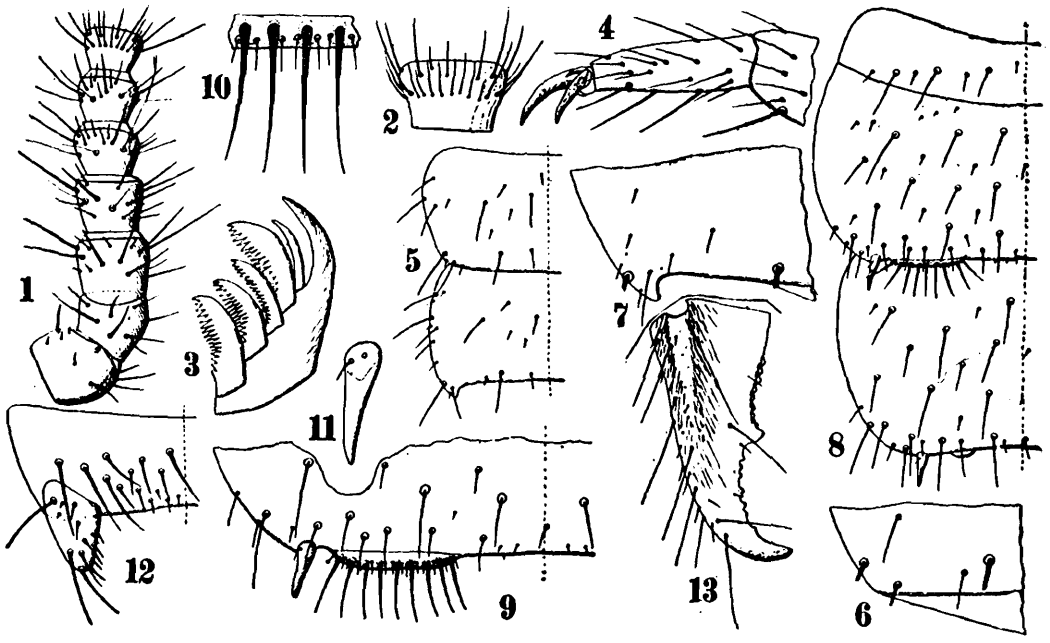


FIG. V.

Japyx greeni : 1. antennae laevae pars proximalis prona ; 2. antennae articulus decimus quartus ; 3. maxillae primi paris lobus internus ; 4. pes paris tertii a tibiae apice ; 5. urotergitorum sexti et septimi dimidia pars ; 6-7. eorumdem pars postica lateralis magis ampliata ; 8. urosternorum primi et secundi dimidia pars ; 9. ejusdem dimidia pars postica magis ampliata ; 10. urosterni primi organi subcoxalis particula magis ampliata ; 11. ejusdem stilus ; 12. maris dimidia area genitalis cum appendice.

breviorem crassiusculum producto, seta laterali subpostica quam postica sequens paullum longiore ; tergitum octavum quam septimum parum brevius et angustius lateribus postice haud productis ; tergitum nonum brevius.

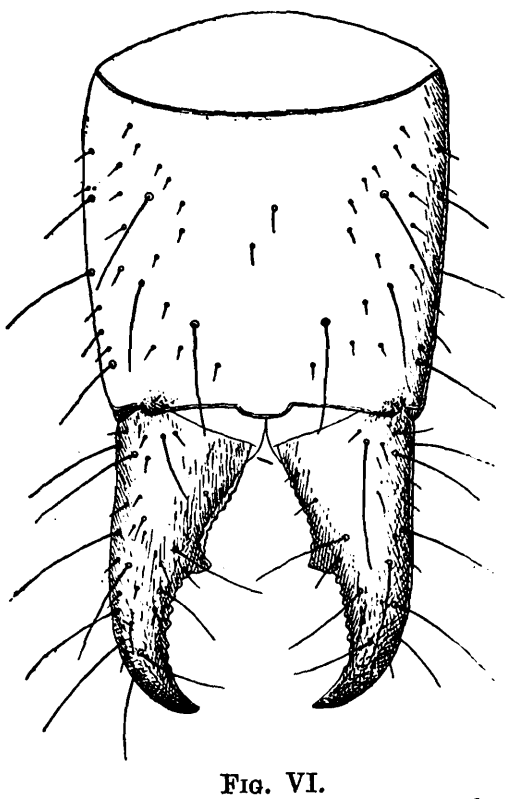


FIG. VI.

Japyx greeni : abdominis segmentum decimum cum forcipe pronum.

Urosternum primum organis subcoxalibus inter sese quam unius latitudo fere duplo remotis, setis glandularibus 9 uniseriatis, brevioribus inter sese aequalibus et setis subtilioribus brevissimis ad basim setarum glandularium instructis, superficie pone organum subcoxale setis 4 brevioribus, urosterni parte mediana pseudoporis glandularibus indistinctis utrimque setis minimis 2+2 submedianis instructa, urosterni superficie cetera ut eadem urosternorum sequentium setis paucis brevibus, praesterni serie exclusa, 3-seriatis et setis nonnullis brevissimis.

Stili elongati, seta proximali externa brevissima, vesiculae parvae.

Segmentum decimum supra inspectum paullum ad basim latius quam longius, carinis indistinctis, setis longis 6+6 et aliis parum numerosis brevissimis, acropygio parvo postice rotundato.

Forceps segmenti decimi longitudinem subaequans brachiis crassiusculis: brachio laevo dente paullum praemediano sat magno, margine praedentali tuberculis $\frac{6}{8}$ parvis, margine postdentali fere usque ad partem apicalem profunde crenulato, brachio dextero dente paullum praedentali denticulis 7 uniseriatis instructo, margine postdentali eidem opposito subsimili.

Long. corporis mm. 6·5, lat. urotergiti septimi 0·75, long. antennarum 1·56, forcipis 0·46.

Larva secunda (Fig. VII), long. corporis mm. 2·50, lat. urotergiti septimi 0·32, long. antennarum 0·90, forcipis 0·19.

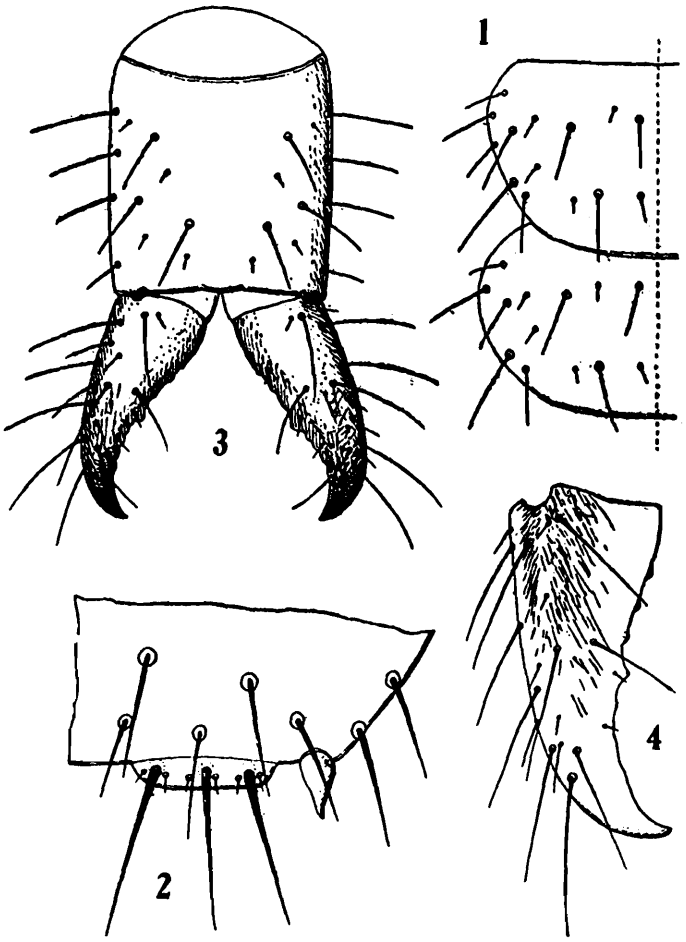


FIG. VII.

Japyx greenii: larva secunda: 1 urotergitorum quinti et sexti dimidia pars; 2. urosterni primi pars postica lateralis; 3. segmentum decimum pronum cum forcipe; 4. forcipis brachium laevum pronum.

Corpus album abdominis segmento decimo cum forcipe stramineo.

Antennae 26-articulatae.

Urotergiti septimi angulus posticus rotundatus, urosterni primi organis subcoxalibus parvis setis glandularibus brevibus tribus et setis subtilioribus brevissimis instructis.

Forceps brachii laevi et dexteri margine praedentali tuberculis minimis tribus aucto.

Larva tertia (Fig. VIII), long. corporis mm. 3·30, lat. urotergiti septimi 0·50, long. antennarum 1·30, forcipis 0·30

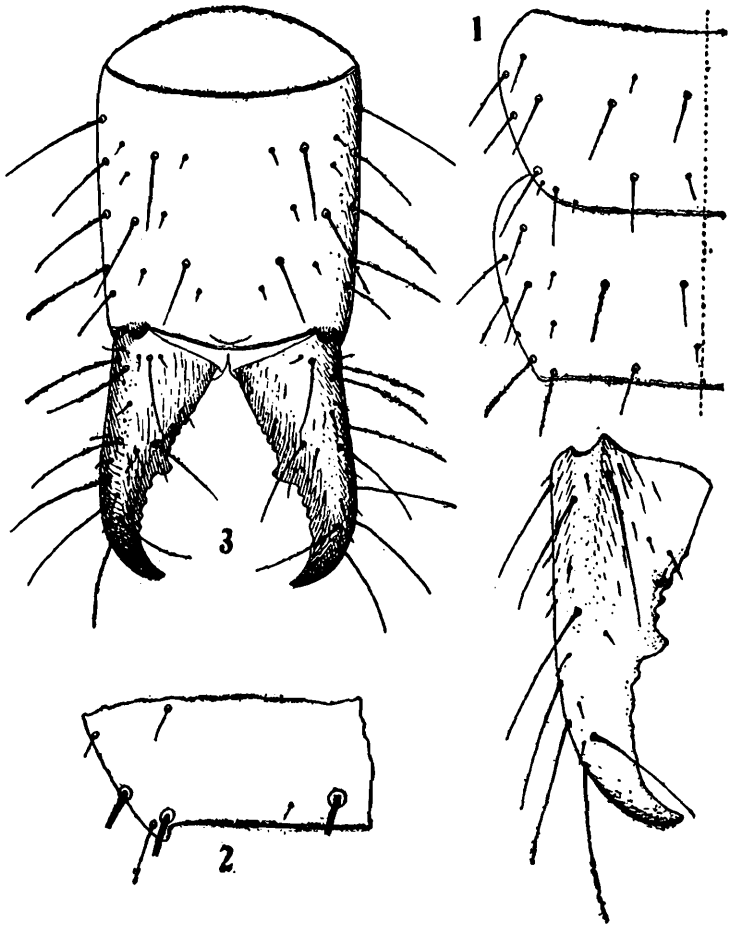


FIG. VIII.

Jaypx greenii : larva tertia : 1. urotergitorum quinti et sexti dimidia pars ; 2. urotergiti septimi pars postica lateralis magis ampliata ; 3. segmentum decimum pronum cum forcipe ; 4. forcipis brachium laevum pronum.

Corpus albicans abdomen a segmento octavo pallide ochroleuco.

Antennae 26-articulatae.

Urotergiti septimi angulus posticus brevissime productus ; urosterni primi organis subcoxalibus setis glandularibus 8.

Forcipis brachium laevum tuberculis praedentalibus $\frac{1}{3}$, brachium dexterum denticulis praedentalibus 5.

Habitat.—Ceylon : Namunakuli, exempla descripta a clar. E. Green, cui species animo grato dico, legit.

Observatio.—Species haec antennae articulorum numero et forcipis forma distinctissima est.

Japyx immsi, sp. nov.

(Fig IX-X.)

Mas.—Corpus cremeum abdomine a segmento octavo ochroleuco, forcipis marginibus badiis.

Caput supra setis brevibus c. 15+15 et nonnullis brevioribus instructum ; antennae 26-articulatae, articulis setis longis et sat longis

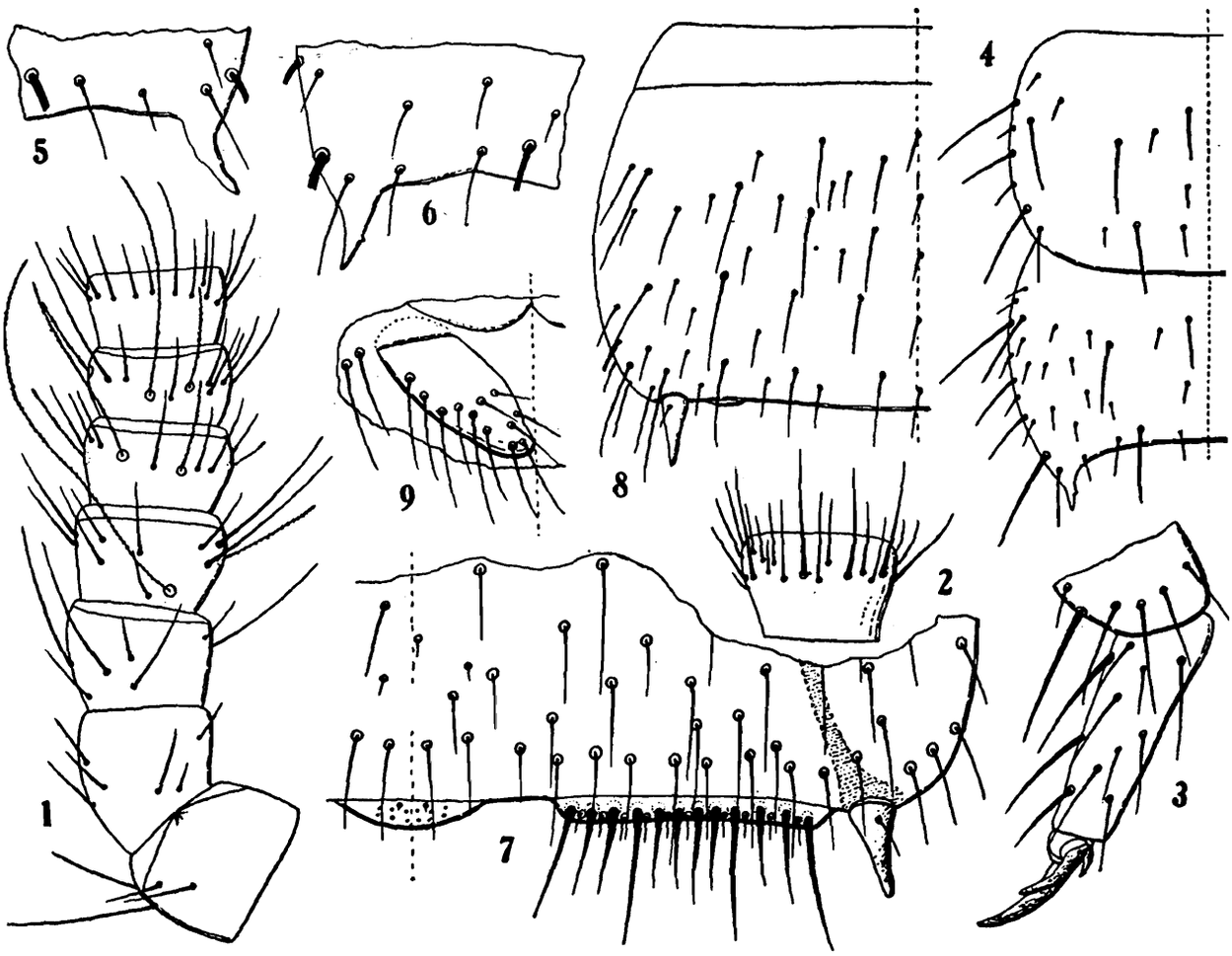


FIG. IX.

Japyx immsi : 1. antennae dexterae pars proximalis prona ; 2. antennae articulus decimus quintus ; 3. pes paris tertii a tibiae apice ; 4. urotergitorum sexti et septimi dimidia pars ; 5. urotergiti quinti pars portica laterali ; 6. eadem exempli alii ; 7. urosterniti primi, dimidia pars postica magis ampliata ; 8. urosterni secundi dimidia pars ; 9. maris dimidia area genitalis cum appendice.

et brevibus ut fig. IX, 1-2 demonstrant instructis, trichobothrio supero interno articuli quarti proximali, trichobothriis omnibus superis internis longis ; maxillae primi paris lobus internus laminis pectinatis 5, palpus labialis 0·04 longus.

Thorax : pronotum setis longis et sat longis 5+5 et nonnullis brevioribus ; meso- et metanotum praescuto setis duabus submedianis sat longis, scuto setis 5+5 sat longis et 5+5 brevioribus.

Pedes tarso quam praetarsus minus quam duplo longiore, infra setis robustioribus tribus, praetarsi ungue postico quam anticus c. $\frac{1}{3}$ longiore.

Abdomen : tergitum primum praescuto eidem metanoti simile, scuto setis sat longis 1+1 sublateralibus subposticis et paucis brevioribus, tergita 3-7 scuto setis sat longis 5+5, brevibus 1+1 et nonnullis brevioribus, tergiti sexti angulo postico rotundato, septimi in processum sat longum angustiorem acutum margine interno medio angulato (vel aculeato) apice extrorsum parum producto ; tergitum octavum septimum longitudine subaequans et quam idem parum angustius, lateribus postica haud productis, tergitum nonum brevius.

Urosternum primum organis subcoxalibus inter sese parum magis quam unius latitudo remotis, setis glandularibus 12 uniseriatis, quarum 4 breves et 8 breviores, instructis, nec non setis brevioribus et subtilioribus posticis c. 11, superficie pone organum subcoxale serie setarum brevium et setis aliis brevibus parum numerosis sparsis, urosterni parte mediana postica setis minimis submedianis et poris minimis c. 12, urosterni superficie cetera setis brevibus paucis subtriseriatis et setis brevioribus instructa.

Stili seta proximali brevissima ; vesiculae perparvae.

Appendices genitales subconicae, elongatae, setis sat numerosis brevibus instructae.

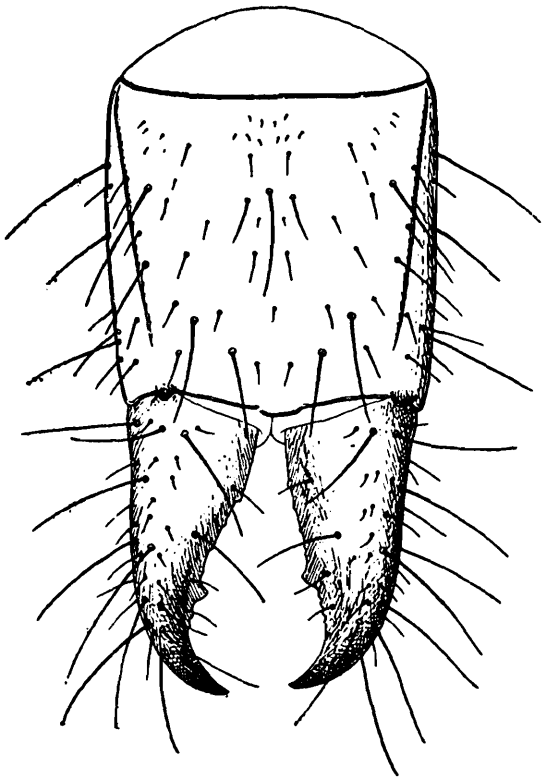


FIG. X.
Japyx immsi : abdominis segmentum decimum cum forcipe pronum.

Segmentum decimum supra inspectum vix ad basim latius quam longius, carinis distinctis, setis longis 7+1+7 et setis sat numerosis brevioribus et brevissimis, acropygio brevissimo latiusculo.

Forceps brachiis sat robustis : laevo dente subdistali sat magno, margine praedentali tuberculis minimis 4, margine postdentali brevi tractu parum profunde crenulato, brachio dextero dente quam idem laevi parum minus distali, sat magno, margine predentali tuberculis minimis 5, margine postdentali tractu parum longo parum profunde crenulato.

Long. corporis mm. 3, lat. urotergiti septimi 0·45, long. antennarum 0·80, forcipis 0·26.

Habitat.—Exemplum typicum clar. Dr. A. D. Imms, cui speciem amicissime dico, ad Kumaun (India) legit.

Observatio.—Species haec ab *J. greeni* maxillarum lobi interni laminis pectinatis quinque, urosterni primi charactetibus et forcipis forma distinctissima est.

Japyx murudensis, sp. nov.

(Fig. XI-XII.)

Femina.—Corpus ochroleucum abdomine a segmento octavo pallide ochraceo.

Caput supra setis brevibus c. 15+15 et aliis brevioribus et brevissimis parum numerosis instructum ; antennae 43-articulatae, articulis setis longis, brevibus et brevioribus ut fig. XI, 1-2 demonstrant instructis, trichobothriis superis internis sat longis ; maxillae primi paris lobus internus laminis pectinatis 5, palpus labialis mm. 0·20.

Thorax: pronotum setis 5+5 longis, 6+6 sat brevibus et 3+3 brevioribus instructum; mesonotum praescuto setis duabus sat longis, scuto setis 5+5 longis, 3×3 sat longis et 5+5 brevibus et brevioribus, metanoti scuto setis longis 3+3.

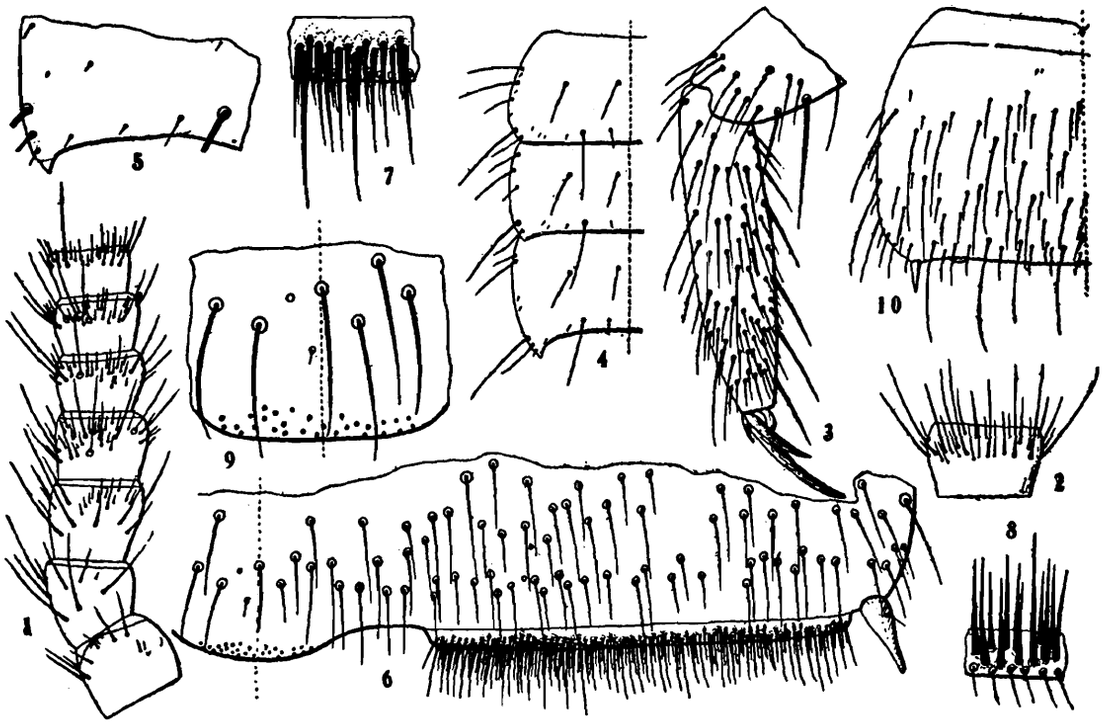


Fig. XI.

Japyx murudensis: 1. antennae dexterae pars proximalis prona; 2. antennae articulus vigesimus quintus; 3. pes paris tertii a tibiae apice; 4. urotergitorum quinti sexti et septimi; 5. urotergiti septimi pars postica lateralis magis ampliata; 6. urosterni primi dimidia pars postica magis ampliata; 7-8. urosterni primi organi subcoxalis particula magis ampliata; 9. urosterni primi pars mediana postica; 10. urosterni secundi dimidia pars.

Pedes persetosi, tarso quam praetarsus parum magis quam duplo longiore infra setis robustioribus 5+5, praetarsi unguibus attenuatis parum arcuatis, ungue postico quam anticus aliquantum magis quam duplo longiore, unguicula mediana bene evoluta.

Abdomen: tergitum primum praescuto setis duabus submedianis sat longis, scuto setis duabus submedianis subanticis sat longis, setis duabus submedianis subposticis brevibus et nonnullis brevioribus, tergita 3-7 setis 7+7 longis et sat longis et setis nonnullis brevioribus et brevissimis instructa, tergiti sexti angulo postico subrecto, septimi in processum breviorem, angustum, sat acutum producto, tergitum octavum quam septimum parum brevius et parum angustius lateribus postice angulatim parum productis, tergitum nonum brevius.

Urosternum primum organis subcoxalibus latis, inter sese minus quam unius latitudo remotis, setis glandularibus brevibus (mm. 0·065 longis) et brevioribus (mm. 0·040 longis) inter sese subtangentibus transverse sub-biseriatis et serie postica setarum subtiliorum breviorum instructis, superficie pone organum subcoxale setis brevibus sat numerosis 2-4 inordinatim seriatis, urosterni parte postica mediana arcuatim parum producta pseudoporis glandularibus minimis c. 28 instructa, urosterni superficie cetera ut eadem urosternorum sequentium setis paucis longis 3-seriatis et setis brevibus parum numerosis instructa.

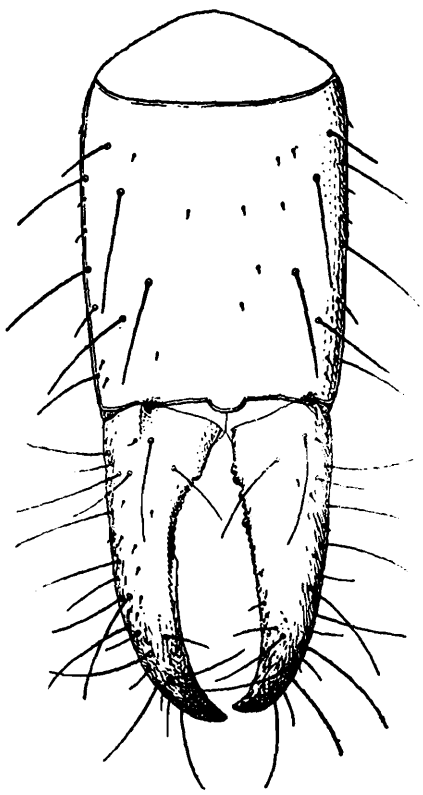


FIG. XII.
Japyx murudensis : abdominis segmentum decimum cum forcipe pronum.

Stili breviores seta proximali externa brevissima ; vesiculae perparvae.

Segmentum decimum supra inspectum parum longius quam latius carinis indistinctis, setis longis 7+7 et nonnullis brevissimis instructum, acropygio breviore angulis rotundatis.

Forceps elongata segmenti decimi longitudinem dorsualem subaequans, brachiis apice parum arcuatis, dente majore destitutis tuberculis tantum instructis ; laevo parte proximali tuberculis parvis gradatim minoribus $\frac{1}{4}^{0}$ et cetero margine integro, brachio dextero margine proximali tuberculis parvis 6, cetero margine vix crenulato, subintegro.

Long. corporis mm. 9, lat. urotergiti septimi 1·25, long. antennarum 2·90, forcipis 1·10.

Habitat.—Borneo : Mt. Murud, alt. 7,000-7,200, Dr. E. Mjöberg legit.

Observatio.—Species haec forcipis brachiis elongatis dente distincto destitutis, tantum margine proximali tuberculato (vel denticulato) distinctissima est.

Gen. **Indjapyx,** nov.

Corpus abdominis segmentum octavum quam septimum aliquantum brevius.

Antennae (in speciebus notis) 36—40 articulatae, articulis 4-6 trichobothriis consuetis, sed *trichobothrio supero proximali articul quarti ad articuli basim perproximo.*

Urosternum primum organis subcoxalibus lateralibus plus minusve latis, setis glandularibus plerumque uniseriatis plus minusve numerosis et parte postica mediana glandulis pseudoporis minimis plus minusve numerosis (in specie nonnulla pseudoporis indistinctis, sed earumdem exemplis aliis observandis).

Vesiculae et stili in segmentis 1—7.

Forceps brachiis subsimilibus, margine praedentali seriebus duabus tuberculorum instructo.

Species typica : *Indjapyx indicus* Oud.

Observatio.—Genus hoc a genere *Japyx* trichobothrii proximali articuli quarti positione facillime distinguendum est.

Indjapyx indicus Oud.

(Fig. XIII-XV.)

Japyx indicus Oud. ex parte (exemplum ex Sumatra).—Weber, *Zool. Ergeb. Reise Niederl. Ost.-Indien,* I, p. 76, taf. vi, fig. 3-5.

Corpus ochroleucum abdomine a segmento octavo ferrugineo forcipe maxima pro parte badia.

Caput supra area mediana postica setis brevissimis crebris instructa inter marginem posticum, apodematis apicem et partem sublateralem

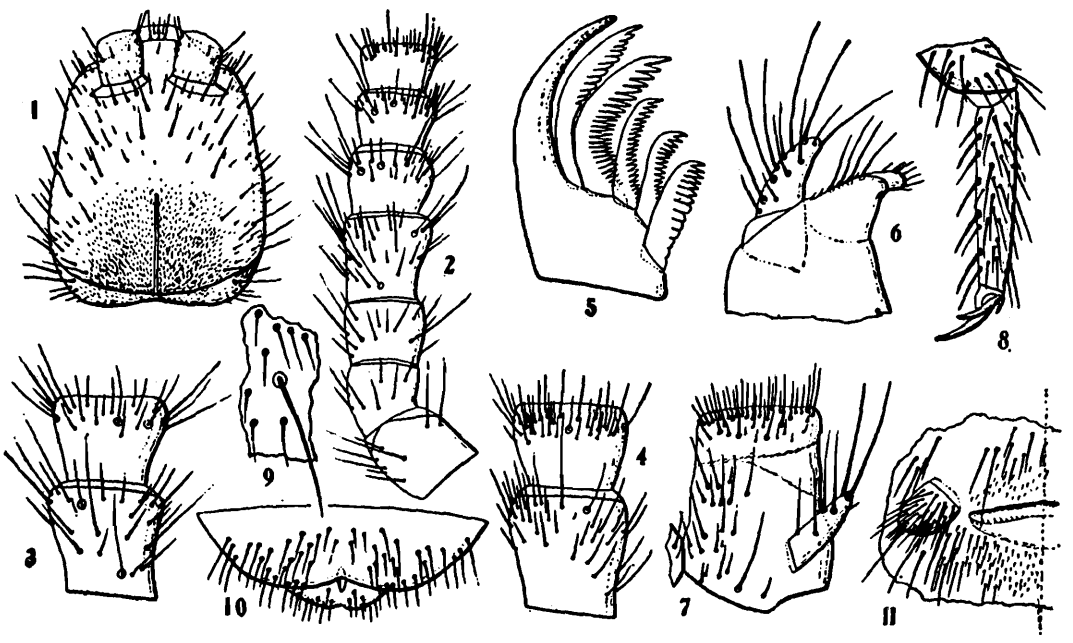


FIG. XIII.

Indjapyx indicus : 1. Caput pronum ; 2. antennae dexterae pars proximalis prona ; 3. antennae articulus quartus et quintus proni ; 4. iidem supini ; 5. maxillae primi paris lobus internus ; 6. maxillae primi paris lobus externus ; 7. labii dimidia pars antica ; 8. pes paris tertii a tibia ; 9. capitis particula postica sublateralis magis ampliata ; 10. feminae area genitalis ; 11. maris dimidia area genitalis.

extensa, superficie cetera setis c. 20+20 brevibus et nonnullis brevioribus et brevissimis ; antennae 36-articulatae, trichobothriis superis internis longis.

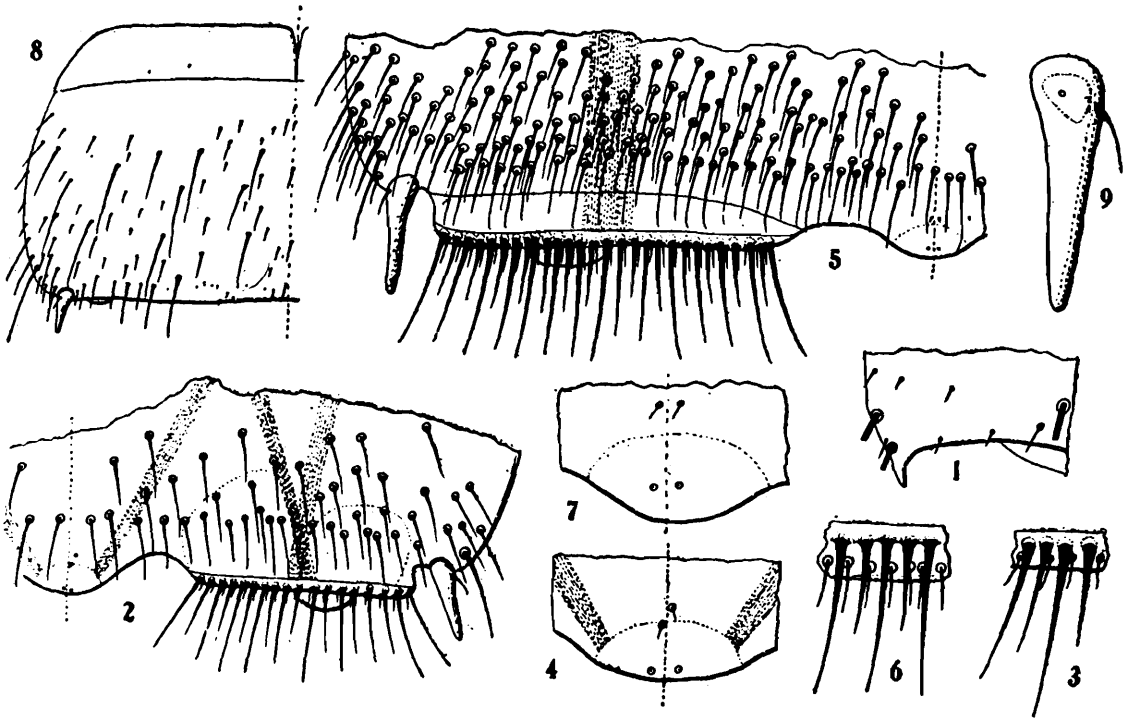


FIG. XIV.

Indjapyx indicus : 1. urotergiti septimi pars postica lateralis magis ampliata ; 2. urosterniti primi dimidia pars postica magis ampliata ; 3. feminae urosterni primi organi subcoxalis particula magis ampliata ; 4. urosterni primi pars postica mediana magis ampliata ; 5. maris urosterni primi dimidia pars postica. 6. maris urosterni primi organi subcoxalis particula magis ampliata ; 7. maris urosterni primi pars postica mediana ; 8. urosterni secundi dimidia pars ; 9. ejusdem stilus.

Thorax : pronotum setis 5+5 sat longis, 5+5 brevibus et paucis brevioribus et brevissimis ; meso- et metanotum praescuto setis duabus submedianis sat longis et 4+4 brevioribus, scuto setis longis 3+3, brevibus 5+5 et nonnullis brevioribus et brevissimis.

Pedes tarso quam praetarsus parum magis quam duplo longiore, infra setis robustioribus 6+6, praetarsi unque postico quam anticus aliquantum longiore, unguicula mediana bene evoluta.

Abdomen : tergitum primum praescuto eidem metathoracis simile, scuto setis duabus submedianis subposticis sat longis, tergita 3—6 setis sat longis 6+6, brevibus 3+3 et nonnullis brevioribus instructa ; urotergiti sexti angulo postico rotundato, septimi in angulum brevem angustiorem acutum producto, seta subpostica laterali quam sequens paullum longiore ; tergitum octavum lateribus postice haud productis.

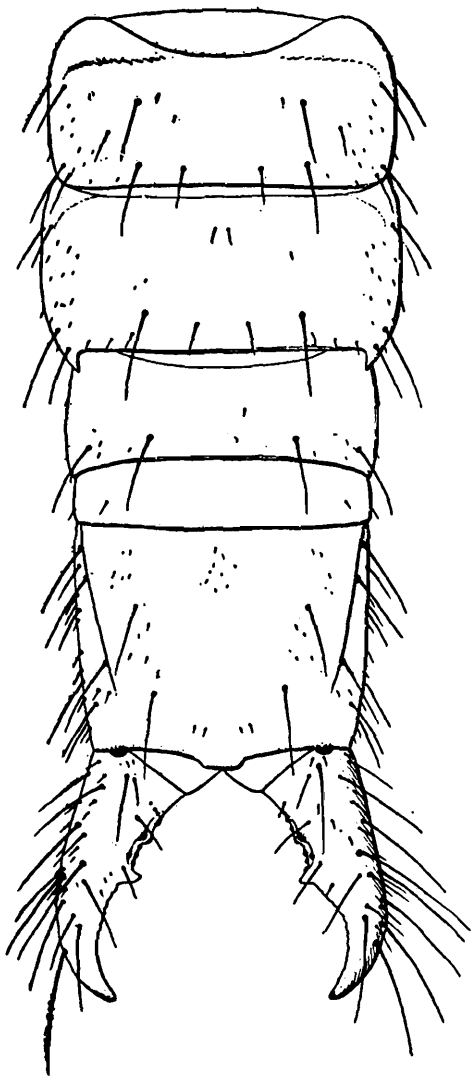


FIG. XV.
Indjapyx indicus : corporis pars postica prona a segmento sexto.

Urosternum primum organis subcoxalibus inter sese parum minus quam unius latitudo remotis, setis glandularibus c. 18 brevibus (mm. 0·052 longis) et brevioribus intercalatis uniseriatis et setis brevissimis subtilioribus posticis instructo, superficie pone organum subcoxale setis brevibus pernumerosis 2—6 inordinatim seriatis, urosterni parte mediana postica setis duabus minimis medianis subposticis et poris duobus minimis subposticis submedianis, urosterni superficie cetera setis paucis sat longis 3-seriatis (praesterni serie exclusa) et setis brevioribus et brevissimis sat numerosis sparsis.

Stili elongati, tuberculo basali supero minimo, seta proximali externa brevissima ; vesiculae parvae.

Mas.—Urosterni primi organum subcoxale setis glandularibus c. 28.

Appendices genitales subconicae, bene setosae.

Segmentum decimum supra inspectum aliquantum longius quam ad basim latius, lateribus paullum convergentibus, carinis magis convergentibus, setis longis 7+7, nonnullis brevioribus et aliis brevissimis sparsis, acropygio brevissimo latiusculo.

Forceps segmenti decimi longitudinem dorsualem subaequans, brachiis subsimilibus dente paullum praemediano sat magno, tuberculis praedentalibus $\frac{2}{5-6}$, quorum primum superum et secundum vel tertium inferum quam cetera multo majora sunt, margine postdentali gradatim minus profunde crenulato.

Long. corporis ad mm. 8, lat. urotergiti septimi 1·05, long. antennarum 2·80, forcipis 0·78.

Habitat.—Sumatra (Dr. E. Mjöberg legit).

Indjapyx indicus Oud. var. **separata,** nov.

(Fig. XVI-XVII).

Corpus ochroleucum ab abdominis segmento septimo gradatim magis ferrugineo-badio, forcipis marginibus et apice infuscatis.

Caput supra setis brevibus c. 15+15 et aliis brevioribus et brevissimis nec non area postica mediana a margine occipitali ad cristae metopicae apicem extensa et lateraliter fere capitis 2/3 latitudinem occupante setis brevissimis vestita; antennae 36-articulatae (anomaliter altera 34-

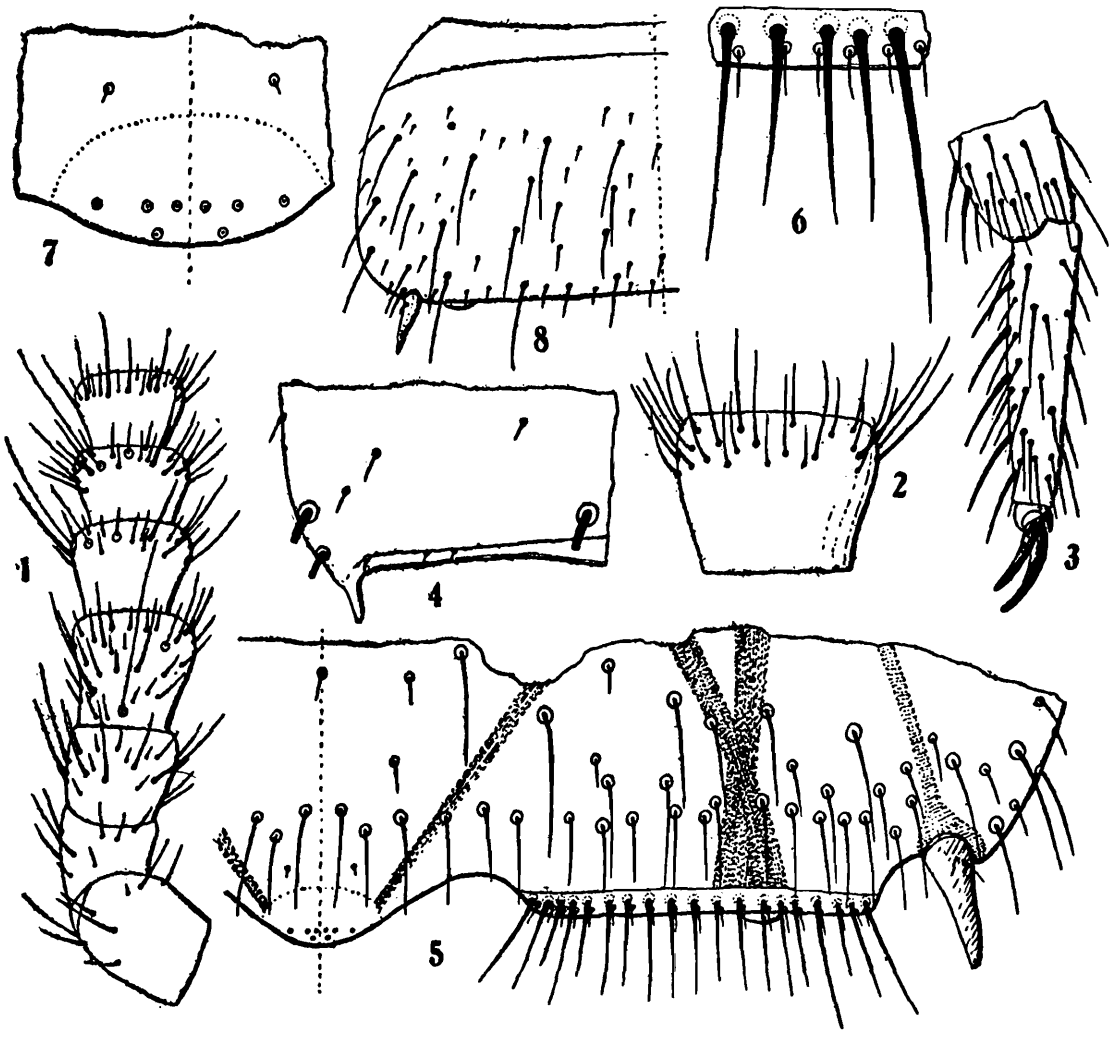


Fig. XVI.

Indjapyx indicus var. *separata*: 1. antennae dexterae pars proximalis prona; 2. antennae articulus decimus octavus 3. pes paris tertii a tibiae; 4. urotergiti septimi pars postica lateralis magis ampliata; 5. urosterni primi dimidia pars postica magis ampliata; 6. urosterni primi organi subcoxalis particula magis ampliata; 7. urosterniti primi pars mediana postica; 8. urosterniti secundi dimidia pars.

articulata) setis longis, brevibus et brevioribus ut fig. XVI, 1-2 demonstrant instructis, trichobothriis superis internis longis; maxillae primi paris lobus internus laminis pectinatis quinque.

Thorax: pronotum setis 5+5 sat brevibus, 5+5 brevioribus et paucis brevissimis; meso- et metanotum praescuto setis duabus

submedianis parum longis et setis nonnullis brevissimis scuto setis parum longis 5+5 brevibus et brevioribus 5+5 et nonnullis brevissimis.

Pedes tarso quam praetarsus magis quam duplo longiore, infra setis robustioribus 5+5, praetarsi ungue postico quam anticus parum longiore, unguicula mediana bene evoluta.

Abdomen: tergitum primum praescuto eidem metanoti simile, scuto setis duabus submedianis subanticis, duabus submedianis posticis, 3+3 brevioribus et nonnullis brevissimis; tergita 3—7 scuto setis 5+5 sat longis, 4+4 brevibus, quarum subapicalis externa quam seta precedens paullum vel parum brevior est, et nonnullis brevissimis; tergiti sexti angulo postico rotundato, septimi in processum brevem dimidia parte distali angustiore acuta producto; tergitum octavum septimum longitudine subaequans et quam idem parum angustius; tergitum nonum brevius.

Urosternum primum organis subcoxalibus inter sese parum magis quam unius latitudo remotis setis glandularibus uniseriatis c. 20 brevibus vel parum brevioribus (mm. 0·050—0·065 longis) et serie postica setarum subtiliorum brevissimarum, superficie pone organum subcoxale serie setarum brevium et setis nonnullis brevibus et brevioribus, urosterni parte postica mediana pseudoporis glandularibus minimis c. 8 et setis duabus minimis subposticis submedianis, superficie cetera ut eadem urosternorum sequentium setis paucis 3-seriatis longis et setis nonnullis brevioribus et brevissimis.

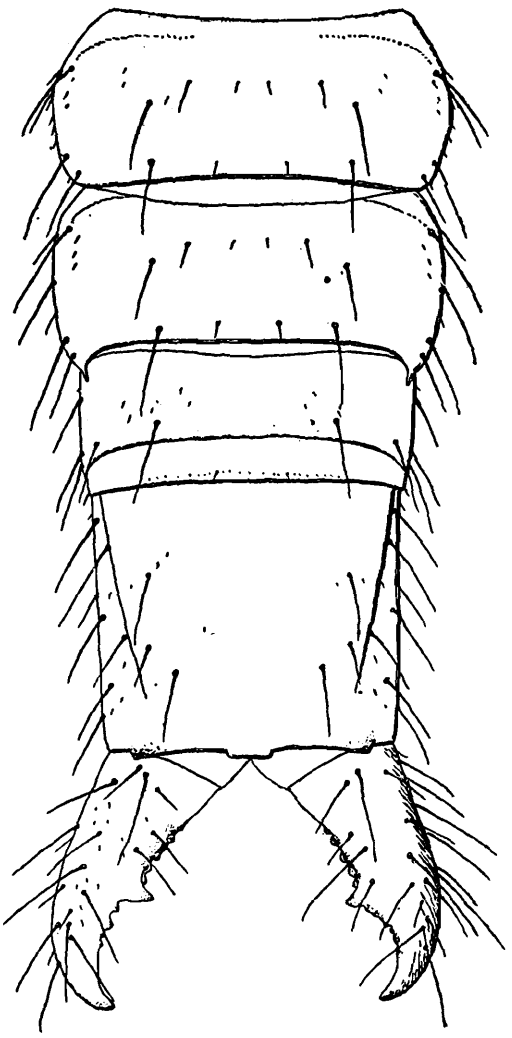


FIG. XVII.
Indjapyx indicus var. *separata*: corporis pars postica prona a segmento sexto.

Stili et vesiculae consueta.

Segmentum decimum super inspectum parum latius quam longius carinis distinctis, setis longis 10+10 et setis brevissimis sparsis, acropygio brevissimo latiusculo.

Forceps robusta segmenti decimi longitudinem dorsualem subaequans, brachio laevo dente parum postmediano magno, margine praedentali tuberculis $\frac{5}{8}$, quorum secundum superum et tertium inferum majora sunt, margine postdentali tractu breve profunde crenulato cetero gradatim minus profunde, brachio dextero dente parum postmediano magno, margine praedentali tuberculis $\frac{5}{5}$, quorum tertium superum et inferum quam cetera majora sunt, margine postdentali tractu sat longo profunde crenulato.

Long. corporis ad mm. 9, lat. urotergiti septimi 1·17, long. antennarum 2·60, forcipis 0·78.

Habitat.—Exempla vidi tria ad Dammerman, Doerian (Rioww Archip.) lecta.

Observatio.—Varietas haec a forma typica urosterni primi organo glandulari mediani pseudoporis magis numerosis, forcipis tuberculis praedentalibus distincta.

Indjapyx indicus Oud. var. **javana,** nov.

(Fig. XVIII-XIX).

Femina.—Caput supra area mediana postica setis brevissimis crebris instructa, apodematis apicem parum superante, et superficie cetera

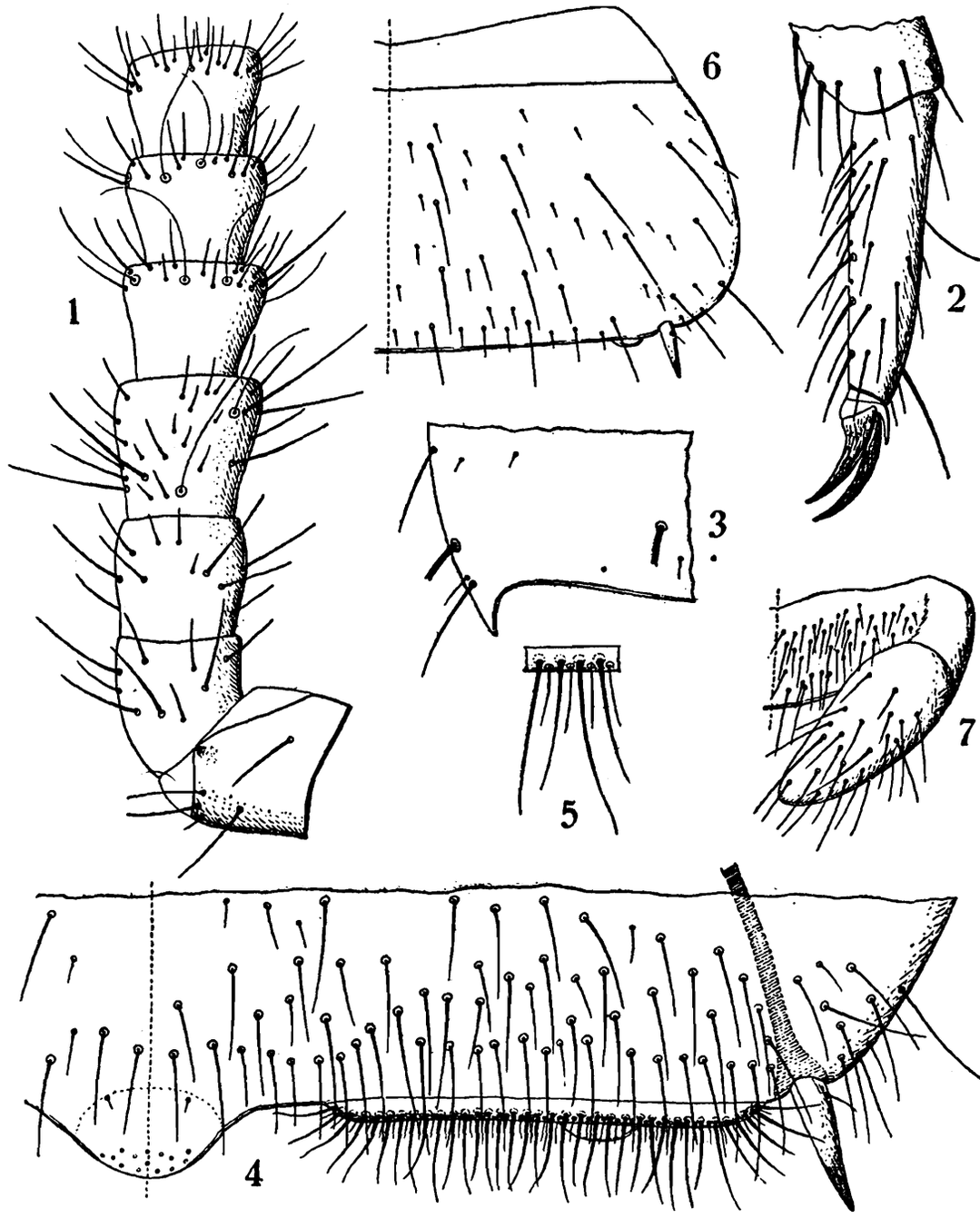


FIG. XVIII.

Indjapyx indicus var. *javana :* 1 antennae dexterae pars proximalis prona ; 2. pes paris tertii a tibiae apice ; 3. urotergiti septimi pars postica lateralis magis ampliata ; 4. urosterni primi dimidia pars postica ; 5. urosterni primi organi subcoxalis particulia magis ampliata ; 6. urosterni secundi dimidia pars ; 7. maris regionis genitalis dimidia pars.

setis brevibus c. 16+16 et setis nonnullis brevioribus et brevissimis; antennae 36-articulatae, articulis setis sat longis, brevibus et brevioribus ut fig. XVIII, 1 demonstrat, trichobothriis superis internis longis; maxillae primi paris laminis pectinatis quinque.

Thorax : pronotum setis 5+5 sat longis, 5+5 brevibus et nonnulla breviore, meso- et metanotum praescuto setis duabus submedianis parum brevibus et utrimque 2-3 brevioribus, scuto setis longis 5+5, parum *longis et brevibus* 4+4 *et nonnullis brevioribus et brevissimis.*

Pedes tarso quam praetarsus duplo longiore infra setis robustioribus 6+6, praetarsi ungue postico quam anticus paullum longiore, unguicula mediana bene evoluta.

Abdomen : tergitum primum praescuto eidem metanoti simile, scuto setis duabus subanticis submedianis et duabus subposticis parum magis externis sat longis instructo ; tergita 3—7 setis 7+7 sat longis et nonnullis brevibus et brevioribus instructa, urotergiti sexti angulo postico rotundato, septimo angulo postico in processum breviorem angustiorem producto ; tergitum octavum lateribus postice haud productis.

Urosternum primum organis subcoxalibus latis inter sese minus quam unius latitudo remotis, setis glandularibus brevibus c. 35 instructis inter sese inaequalibus et serie setarum brevissimarum postica, superficie pone organum subcoxale setis brevibus sat numerosis 3-4 inordinatim transverse seriatis, urosterni parte mediana postica pseudoporis glandularibus c. 13 instructa et setis duabus subposticis minimis submedianis, superficie cetera stili et vesiculae ut in forma praecedenti.

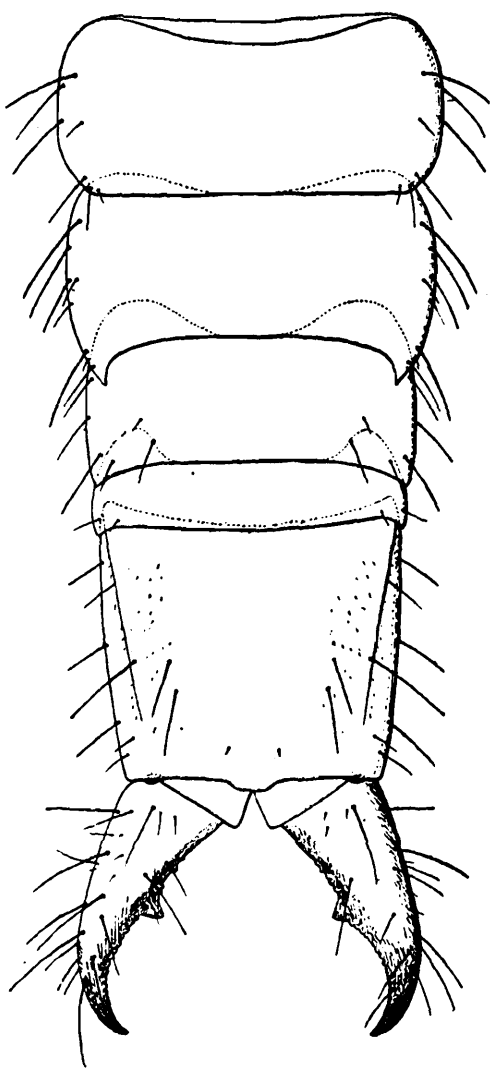


FIG. XIX.
Indjapyx indicus var. *javana :* corporis pars postica prona a segmento sexto.

Segmentum decimum supra inspectum parum ad basim latius quam longius, carinis distinctis, setis longis 7+7 et nonnullis brevissimis, acropygio lato, brevissimo.

Forceps segmenti decimi longitudinem subaequans brachiis subaequalibus dente mediano sat magno, margine praedentali tuberculis $\frac{2}{4}$-$\frac{2}{5}$ quorum unum superum et inferum quam cetera majora.

Long. corporis ad mm. 8·5, lat. urotergiti septimi 1·10, long. antennarum 2·30, forcipis 0·65.

Habitat.—Java : Tjibodas, exempla nonnulla vidi a clar. Max Weber et K. Kraepelin lecta.

Observatio.—Varietas haec urosterni organo subcoxali latitudine majore sat distincta est.

Indjapyx indicus Oud. var. **divisa,** nov.

(Fig. XX-XXI.)

Corpus colore consueto.

Caput parte postica mediana (ab apodematis apice) et sublaterali setis numerosis brevissimis vestita, cetera superficie setis c. 20+20

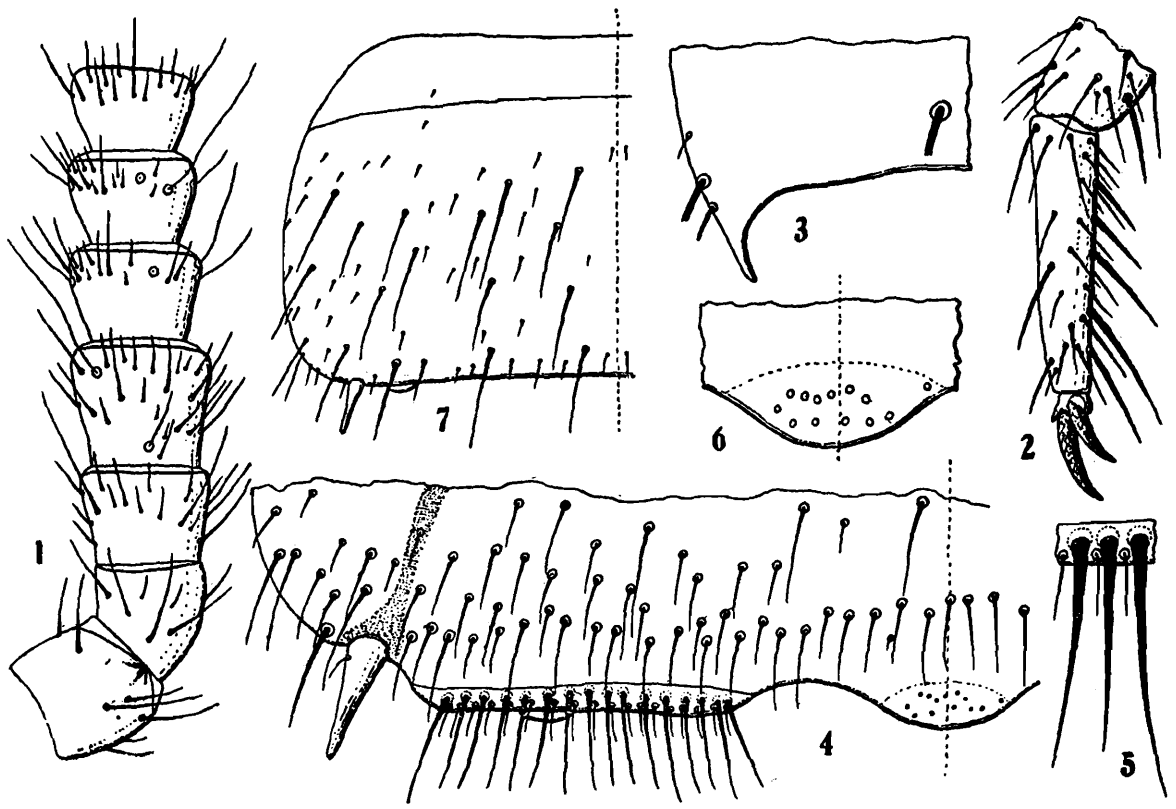


FIG. XX.

Indjapyx indicus var. *divisa :* 1. antennae laevae pars proximalis prona ; 2. pes paris tertii a tibiae apice ; 3. urotergiti septimi pars postica lateralis magis ampliata ; 4. urosterni primi dimidia pars postica ; 5. urosterni primi organi subcoxalis particula magis ampliata ; 6. urosterni primi pars postica mediana magis ampliata ; 7. urosterni secundi dimidia pars.

brevibus et nonnullis brevioribus et brevissimis ; antennae 36-articulatae articulis setis ut fig. XX, 1 demonstrat, trichobothriis superis internis longis.

Thorax : pronotum setis longis 5+5, brevibus 6+6 et nonnullis brevioribus et brevissimis ; meso- et metanotum praescuto setis duabus submedianis sat longis et setis nonnullis brevissimis, scuto setis 7+7 longis et sat longis et setis parum numerosis brevioribus et brevissimis instructo.

Pedes tarso quam praetarsus magis quam duplo longiore infra setis robustioribus 5, praetarsi ungue postico quam anticus aliquantum longiore, unguicula mediana bene evoluta.

Abdomen : tergitum primum praescuto eidem metanoti simile, scuto setis duabus submedianis subposticis parum longis, tergita 3—7 setis sat longis 6+6, brevibus 1+1 et nonnullis brevioribus et brevissimis ; tergiti sexti angulo postico rotundato, septimi in processum breviorem angustiorem acutum producto, seta laterali subpostica quam sequens aliquantum longiore, tergiti octavi lateribus postice haud productis.

Urosternum primum organis subcoxalibus parvis inter sese magis quam unius latitudo remotis, setis glandularibus c. 16 instructis et serie postica setarum subtiliorum brevissimarum, superficie pone organum subcoxale setis brevibus sat numerosis 3-4 inordinatim tranverse seriatis instructa, urosterni parte postica mediana pseudoporis glandularibus c. 14 et setis minimis duabus subposticis instructa ; urosterni superficie cetera setis paucis brevibus (praesterni serie inclusa) 4-seriatis et setis brevioribus et brevissimis sat numerosis instructa.

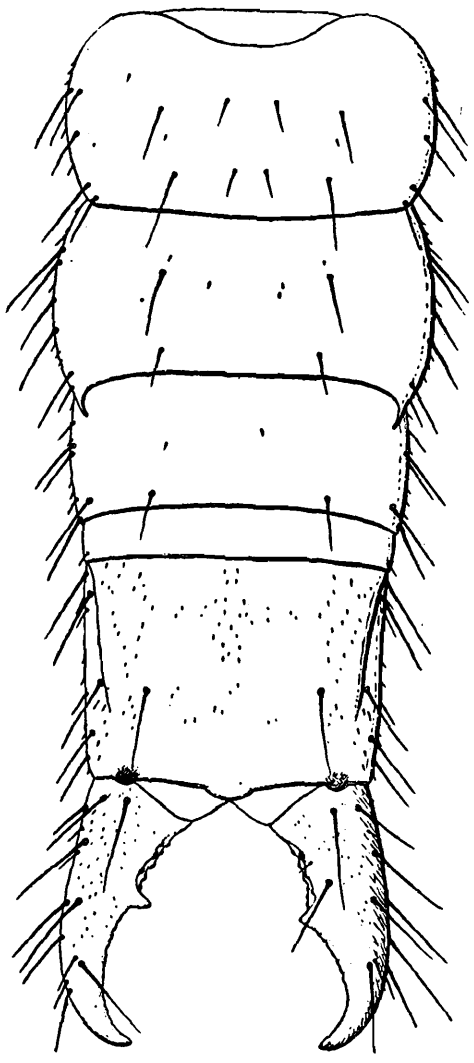


FIG. XXI.
Indjapyx indicus var. *divisa* : corporis pars postica prona a segmento sexto.

Stili et vesiculae consueta.

Segmentum decimum supra inspectum aliquantum latius quam longius, carinis sublateralibus sat distinctis, setis 6+6 sat longis et setis sat numerosis brevissimis et nonnullis brevioribus instructum, acropygio late rotundato.

Forceps segmenti decimi latitudinem subaequans brachiis subsimilibus, dente submediano sat magno, margine praedentali tuberculis $\frac{3}{5}$-$\frac{3}{6}$, margine postdentali vix crenulato.

Long. corp. mm. 7, lat. urotergiti septimi 0·90 ; long. forcipis 0·65.

Habitat.—Flores : Maumerie.

Observatio.—Varietas haec a forma typica urotergiti septimi angulo postico aliquantum magis producto, urosterni primi subcoxis minoribus distincta est.

Indjapyx indicus Oud. var. **birmana,** nov.

(Fig. XXII-XXIV.)

Caput supra a margine postico ad apodematis partem anticam et ad superficiem sublateralem setis minimis pernumerosis vestitum, cetera superficie setis brevibus et brevioribus aliquantum numerosis instructa ; antennae 36-articulatae, articulo tertio vix ad apicem latiore quam longiore, setis majoribus mm. 0·20 longis, articulo quarto quam tertius fere 1/3 longiore, trichobothrio supero subbasali longo instructo, articulis tertio et quarto parum latioribus quam longioribus sensillis consuetis, articulo duodecimo subaeque longo atque lato, articulis ultimo et penultimo brevibus inter sese longitudine subaequalibus ; maxillae primi paris lobus internus laminis pectinatis quinque instructus; palpus abialis mm. 0·13 longus.

Thorax: pronotum setis longis et sat longis 6+6 et setis nonnullis brevibus et brevioribus instructum et superficie areae medianae anticae et ab hac circum laminam medianam minutissime granulosa; meso- et metanotum praescuto setis duabus submedianis et setis sat longis, scuto setis longis 5+5, setis sat longis 6+6 et setis nonnullis brevibus et brevioribus instructo, prosterni pars antica setis longis 2, 1+1, 2.

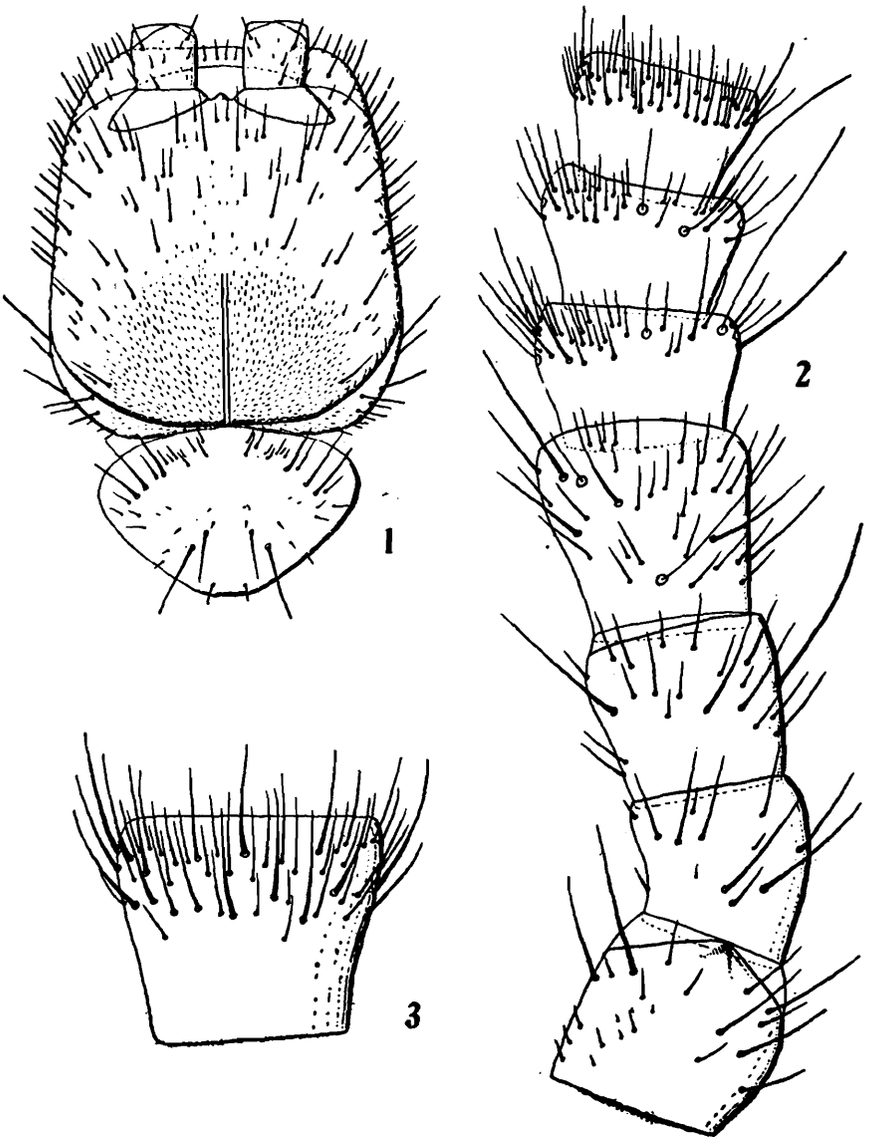


FIG. XXII.
Indjapyx indicus var. *birmana*: 1. caput et pronotum prona; 2. antennae laevae pars proximalis prona; 3. antennae articulus decimus octavus.

Pedes praetarsi longiore quam tarsus c. dimidio breviore, unguicola mediana bene evoluta, setis *vide* fig. XXIII, 1.

Abdomen tergiti sexti angulo postico subrecto, tergiti septimi valde angustato, acuto, subspiniformi retrorsum aliquantum producto, octavi lateribus retrorsum rotundatim vix productis; sternum primum organis subcoxalibus latiusculis, inter sese spatio organi singuli latitudinem subaequante distantibus, serie setarum brevium et aliis brevissimis auctis, superficie pone organa subcoxalia setis irregulariter transverse biseriatis instructa, margine mediano postico arcuatim aliquantum producto et setis tribus brevioribus instructo superficie mediana inter organa subcoxalia serie transversa setarum brevium, superficie cetera setis paucis sat longis transverse 4-seriatis et setis brevibus et brevioribus nonnullis instructa ut sterna sequentia.

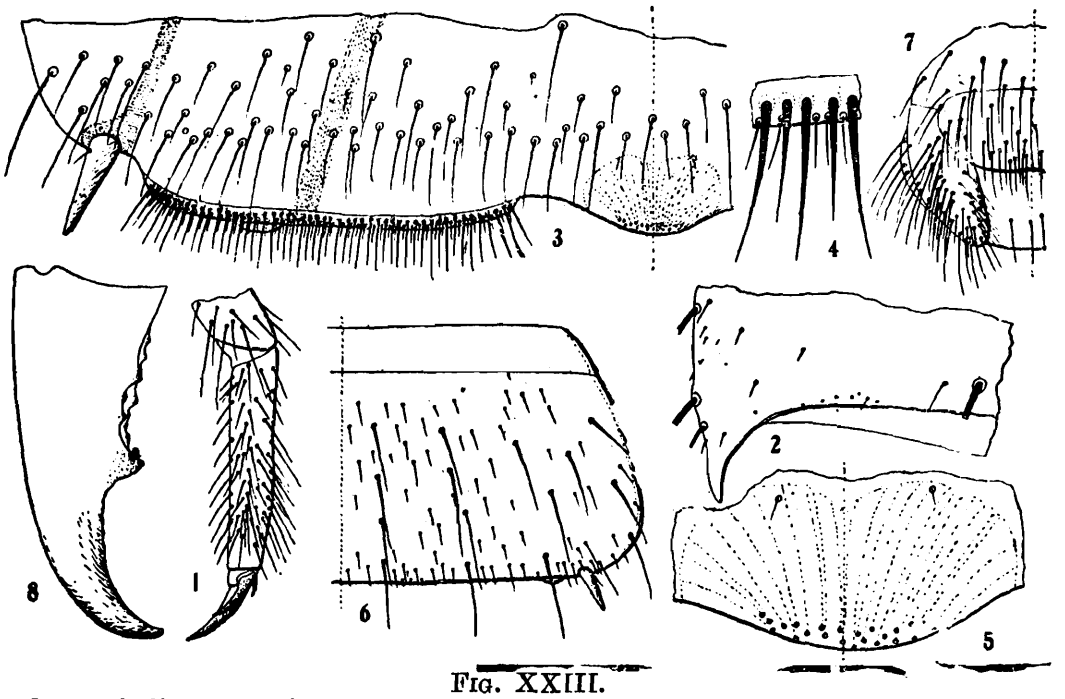


Fig. XXIII.

Indjapyx indicus var. *birmana* : 1. pes paris tertii a tibiae apice; 2. urotergiti septimi pars postica lateralis magis ampliata ; 3. urosterni primi dimidia pars postica; 4. ejusdem organi subcoxalis particula magis ampliata ; 5. urosterni primi pars postica mediana magis ampliata ; 6. urosterni secundi dimidia pars ; 7. maris regionis genitalis dimidia pars cum appendice ; 8. forcipis brachium laevum pronum.

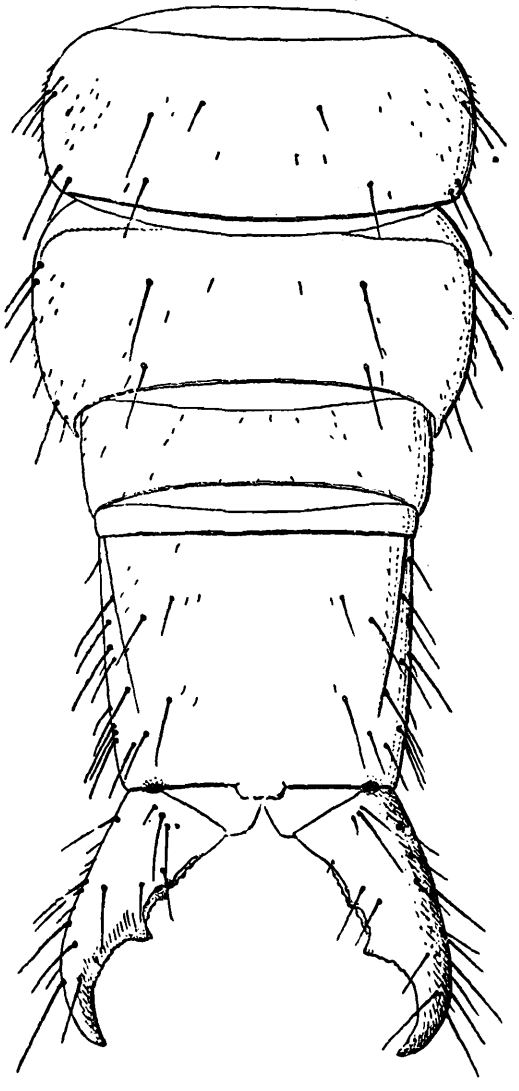


Fig. XXIV.

Indjapyx indicus var. *birmana* : corporis pars postica prona a segmento sexto.

Stili elongati, segmenti septimi mm. 0·10 longi ; vesiculae ventrales parvae sed distinctae.

Segmentum decimum parum ad basim latius quam longius, lateribus parum convergentibus, carinis sublateralibus subintegris, superficie setis 7+7 longis et setis numerosis brevissimis instructa ; acropygio brevissimo, latiusculo, late rotundato.

Forceps brachiis subsimilibus, brachio laevo parte proximali vix sinuata tuberculis $\frac{4-5}{7}$ aucta, quorum secundum superum quam cetera majus est, dente submediano acuto, magno margine postdentali crenulato, denticulis c. 10 gradatim minoribus ; brachio dextero, ut dixi, subsimili, paullum crassiore.

Long. corp. ad mm. 10, lat. urotergiti septimi 1·30, long. antennarum 2·30, forcipis 0·92.

Patria.—Birmania : Bahmo (L. Fea legit).

Observatio.—Varietas haec urosterni primi subcoxis latioribus, forcipis dentibus parum magis a basi remotis saltem distincta est.

Indjapyx indicus Oud. var. **borneensis,** nov.

(Fig. XXV-XXVI.)

Femina.—Caput supra setis c. 18+18 brevibus et nonnullis brevioribus, nec non per verticis aream medianam setis minimis crebris vestita antennae 36-articulatae articulis setis longis, brevibus et brevioribus

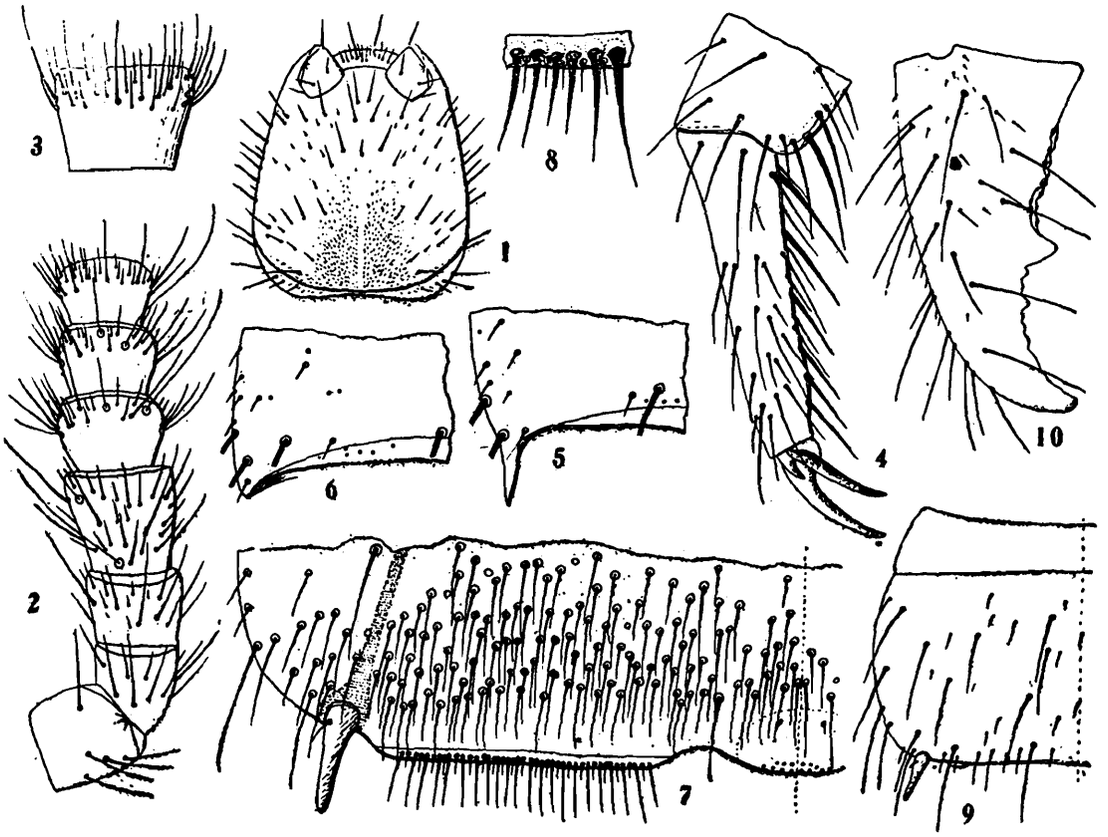


FIG. XXV.

Indjapyx indicus var. *barneensis :* 1. caput pronum ; 2. antennae laevae pars proximalis prona ; 3. antennae articulus decimus octavus ; 4. pes paris tertii a tibiae apice ; 5-6. urotergiti septimi et octavi pars postica lateralis magis ampliata ; 7. urosterni primi dimidia pars postica ; 8. urosterni primi organi subcoxalis particula magis ampliata ; 9. urosterni secundi dimidia pars ; 10 forcipis brachium laevum pronum.

ut fig. XXV, 2-3 demonstrant instructis, trichobothriis superis internis longis ; maxillae primi paris lobus internus laminis pectinatis 5 ; palpus labialis mm. 0·13 longus.

Thorax : pronotum setis 7+7 brevibus et sat longis et nonnullis brevioribus brevissimis ; meso- et metanotum praescuto setis duabus submedianis brevibus et nonnullis brevioribus, scuto setis 6+6 (vel metanoti 5+5) sat longis, et nonnullis brevioribus et brevissimis instructo.

Pedes tarso quam praetarsus magis quam duplo longiore, infra setis robustioribus 6+6, praetarsi ungue postico quam anticus paullum longiore, unguicula mediana bene evoluta.

Abdomen : tergitum primum praescuto eidem metanoti simili, scuto setis duabus submedianis subanticis brevibus, duabus subposticis sublateralibus, duabus submedianis sublateralibus et nonnullis brevissimis ; tergita 3-7 setis 6+6 parum longis et setis paucis brevioribus et brevissimis, tergiti sexti angulo postico rotundato, septimi in processum brevem angustiorem acutum producto ; tergitum octavum quam septimum paullum brevius et parum angustius lateribus postice angulatim brevissime productis ; tergitum nonum brevius.

Urosternum primum organis subcoxalibus inter sese unius latitudine remotis, serie setarum glandularium brevium (mm. 0·050-0·065) longum et serie postica setarum brevissimarum subtiliorum instructis; superficie pone organum subcoxale setis brevibus pernumerosis crebris 4-6 inordinatim seriatis, urosterni parte postica mediana pseudoporis minimis c. 15 instructa et setis minimis duabus subposticis submedianis; superficie cetera ut eadem urosternorum sequentium setis nonnullis brevibus transverse 3-seriatis (praesterni serie exclusa).

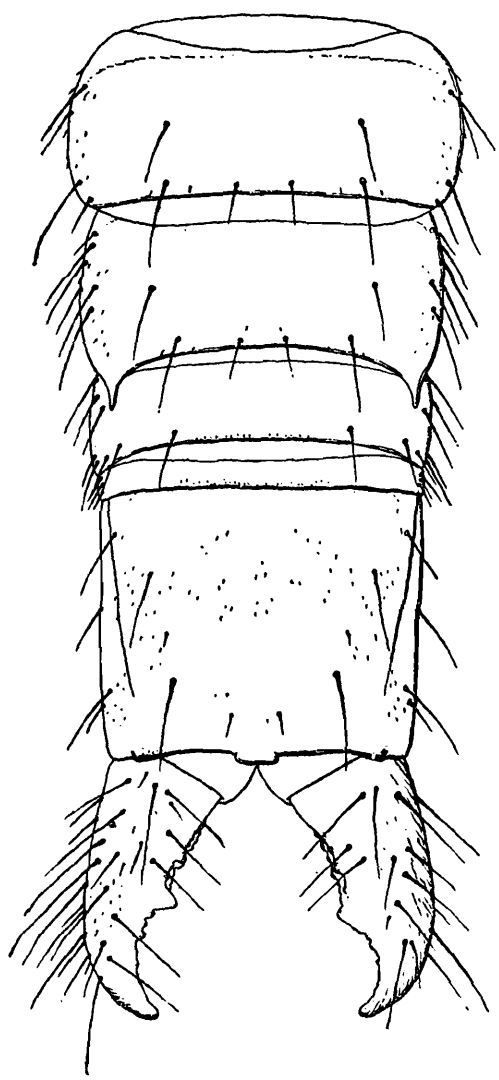


FIG. XXVI.
Indjapyx indicus var. *barneensis*: corporis pars postica prona a segmento sexto.

Stili seta proximali brevissima; vesiculae parvae bene evolutae.

Segmentum decimum supra inspectum aliquantum latius quam longius carinis distinctis setis 5+5 sat longis et setis brevissimis sat numerosis, acropygio brevissimo latiusculo.

Forceps brevis robusta quam segmenti decimi longitudo dorsualis paullum brevior, brachiis crassis: laevo dente mediano magno, margine praedentali tuberculis $\frac{6}{7}$, quorum quartum superum et quintum inferum quam cetera multo majora sunt, margine postdentali dimidio tractu brevi *sat profunde crenulato, brachio dextero* dente paullum postmediano magno, margine praedentali tuberculis $\frac{4}{7}$, quorum tertium superum et quartum inferum quam cetera multo majora sunt, margine postdentali sat profunde crenulato.

Long. corporis mm. 10, lat. urotergiti septimi 1·30, long. antennarum 2·90, forcipis 0·90.

Habitat.—Borneo.

Observatio.—Varietas haec a praecedenti forcipe parum breviore et urosterno primi setis glandularibus minus numerosis distincta.

Indjapyx indicus Oud. var. **bidicola,** nov.

(Fig. XXVII-XXVIII.)

Mas.—Corpus ochroleucum abdomine a segmento septimo gradatim ferrugineo-badio forcipis marginibus et apice fuscecentibus.

Caput supra per aream magis quam capitis dimidia pars postica (lateribus exceptis) latam setis minimis crebris vestitum et superficie cetera setis sat numerosis brevibus et brevioribus instructa;

antennae 36-articulatae (abnormaliter 35, vel antenna altera 32 et 33 sed altera 36-articulata) articulis setis longis, brevibus et brevioribus ut fig. XXVII, 2-3 demonstrant instructis, trichobothriis superis inter-

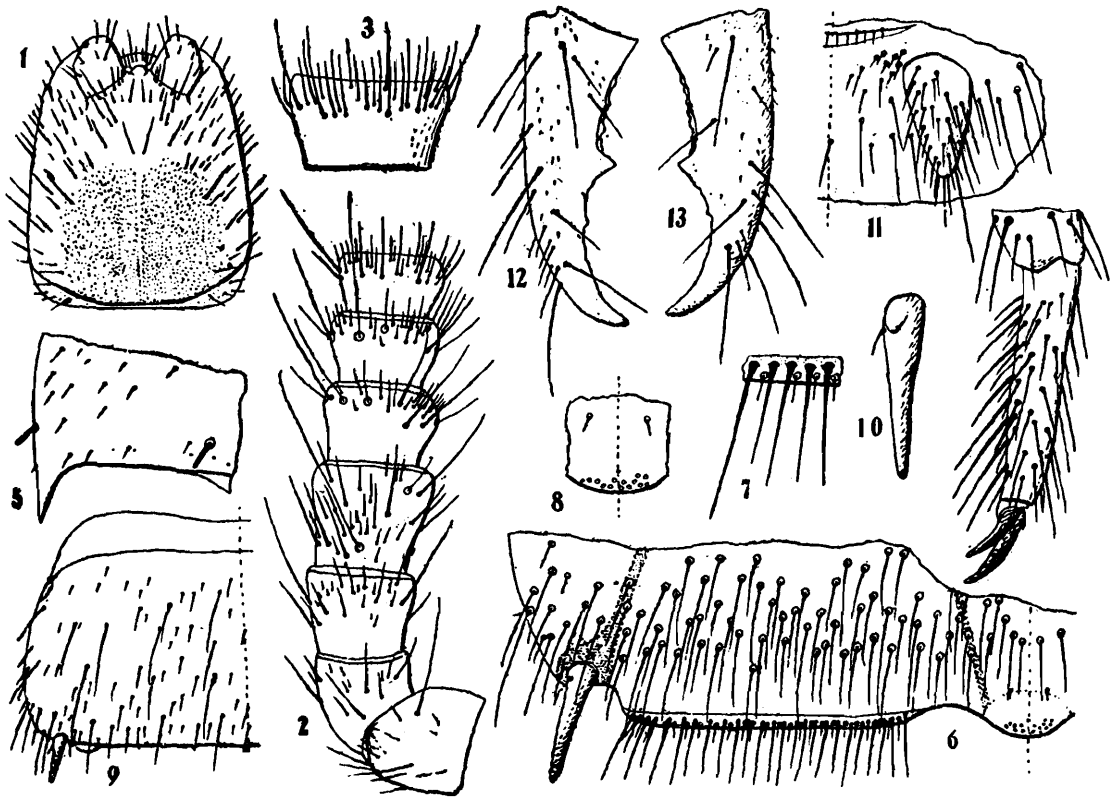


Fig. XXVII.

Indjapyx indicus var. *bidicola* : 1. caput pronum ; 2. antennae dexterae pars proximalis prona ; 3. antennae articulus decimus octavus ; 4. pes paris tertii a tibiae apice ; 5. urotergiti septimi pars postica lateralis magis ampliata ; 6. urosterni primi dimidia pars postica ; 7. urosterni primi organi subcoxalis particula magis ampliata ; 8. urosterni primi pars mediana postica ; 9. urosterniti secundi dimidia pars ; 10. stilus urosterni secundi ; 11. maris regionis genitalis dimidia pars ; 12-13. forcipis brachia prona.

nis longis ; maxillae primi paris lobus internus laminis pectinatis 5, palpus labialis mm. 0·10 longus.

Thorax : pronotum setis 5+5 longis, 4+4 sat brevibus et nonnullis brevioribus, mesonotum praescuto setis duabus submedianis sat brevibus, scuto setis longis 5+5, setis brevibus vel brevioribus 6+6 et nonnullis brevissimis, metanotum setis longis 4+4.

Pedes tarso quam praetarsus aliquantum magis quam duplo, infra setis robustioribus 9 + 9, praetarsi unguibus robustis brevibus, ungue postico quam anticus aliquantum longiore, unguicula mediana bene evoluta.

Abdomen : tergitum primum praescuto setis duabus suhmedianis sat brevibus, scuto setis duabus submedianis subanticis et duabus subposticis sat brevibus ; tergita 3-7 setis parum longis 6+6, setis brevioribus 3+3 et nonnullis brevissimis ; tergiti sexti angulo postico rotundato, septimi in processum sat brevem angustiorem acutum producto ; tergitum octavum septimum longitudine subaequans et quam idem parum angustius, lateribus postice haud productis ; tergitum nonum brevius.

Urosternum primum organis subcoxalibus inter sese aliquantum minus quam unius latiduto remotis, setis glandularibus c. 25 brevibus et

paullum brevioribus (mm. 0·052-0·064 longis) et serie postica setarum subtiliorum brevissimarum instructis, superficie pon . organum subcoxale setis pernumerosis brevibus 3-5 inordinatim seriatis ; urosterni parte mediana postica pseudoporis glandularibus minimis c. 16 instructa et setis duabus minimis submedianis subposticis, urosterni superficie cetera ut eadem urosternorum sequentium setis sat longis paucis 3-seriatis (praesterni serie exclusa) et setis brevioribus et brevissimis magis numerosis.

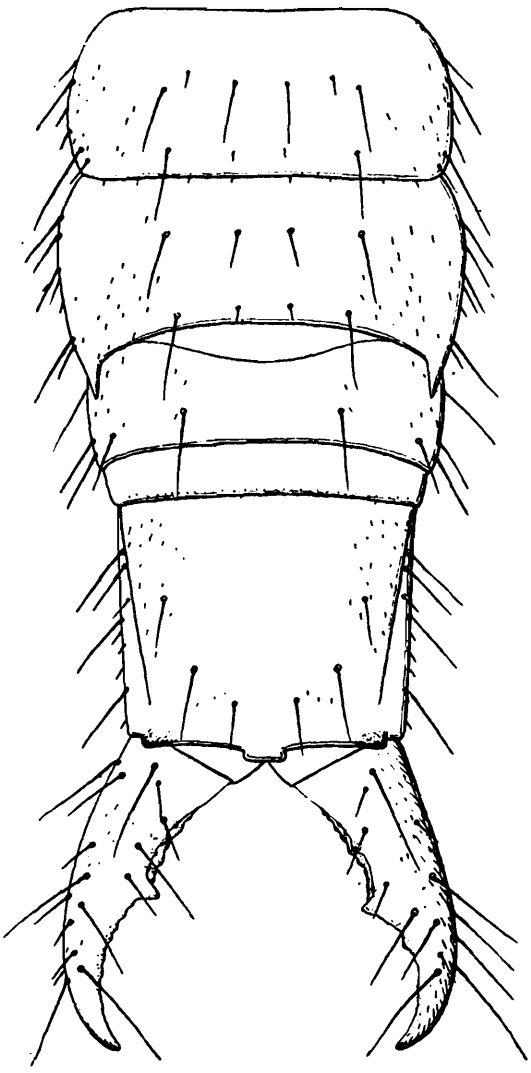


FIG. XXVIII.
Indjapyx indicus : var. *bidicola* : corporis pars postic ı prona a segmento sexto.

Stili elongati, attenuati, seta proximali externa brevissima ; vesiculae parvae.

Appendices genitales conicae persetosae.

Segmentum decimum supra inspectum aliquantum latius quam longius carinis longis, setis sat longis 6 +6 et setis brevissimis sat numerosis instructum, acropygio brevissimo latiusculo.

Forceps brachiis sat attenuatis subsimilibus segmenti decimi latitudinem aequantibus, brachio laevo dente submediano magno acuto, margine praedentali parum sinuato, tuberculis $\frac{4}{7}$, quorum secundum superum et quintum inferum quam cetera majora, margine postdentali parum profunde crenulato, brachio dextero margine praedentali tuberculis $\frac{4}{1\,1}$ cetero laevo simili.

Long. corporis ad mm. 6·5, lat. urotergiti septimi 1·00, long. antennarum 2·60, forcipis 0·78.

Habitat.—Borneo.

Observatio.—Varietas haec a *I. borneensis* capite area setis minimis vestita catiore urosterni primi organis subcoxalibus latioribus, forcipis brachiis magis attenuatis tuberculis praedentalibus minoribus sat distincta.

Indjapyx ceylonicus, sp. nov.

(Fig. XXIX-XXX.)

Corpus ochroleucum abdomine a segmento septimo gradatim magis ferrugineo-badio forcipis marginibus et apice fuscis.

Caput supra setis brevibus c. 20+20 et nonnullis brevioribus et brevissimis area postica brevi et modice lata setis brevissimis vestita ;

antennae 38-articulatae, articulis setis longis brevibus et brevioribus ut fig. XXIX, 2-3 demonstrant, trichobothriis superis internis longis maxillae primi paris lobus internus laminis pectinatis 5 ; palpus labialis mm. 0·090 longus.

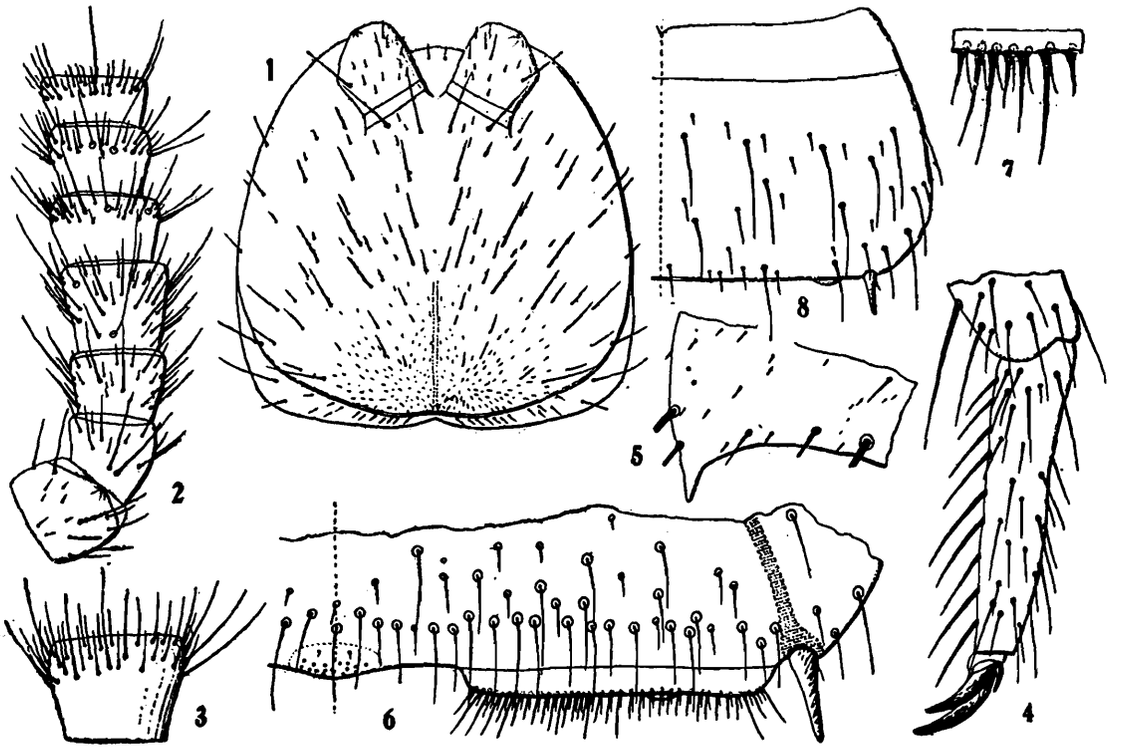


FIG. XXIX.

Indjapyx ceylonicus : 1. caput pronum ; 2. antennae laevae pars proximalis prona ; 3. antennae articulus decimus octavus ; 4. pes paris tertii a tibiae apice ; 5. urotergiti septimi pars postica lateralis magis ampliata ; 6. urosterni primi dimidia pars postica ; 7. urosterni primi organi subcoxalis particula magis ampliata ; 8. urosterni secundi dimidia pars.

Thorax : pronotum setis sat longis 5+5, brevioribus 5+5 et nonnullis brevissimis, meso- et metanotum praescuto setis duabus submedianis et setis nonnullis brevioribus et brevissimis, scuto setis sat longis 5+5, brevibus 4+4 et nonnullis brevioribus.

Pedes tarso quam praetarsus parum minus quam 2/3 longiore, infra setis robustioribus 8+8, praetarsi unguibus crassiusculis brevibus, ungue postico quam anticus parum longiore, unguicula mediana bene evoluta.

Abdomen : tergitum primum praescuto eidem metanoti simili, scuto setis duabus submedianis brevibus subanticis et duabus subposticis instructo ; tergita 3-7 setis parum longis 5+5, brevibus 4+4 et nonnullis brevioribus vel brevissimis ; tergiti sexti angulo postico rotundato, septimi in processum triangularem, apice angustiore acuto, sat longum producto ; tergitum octavum longitudine septimum subaequans lateribus postice haud productis, tergitum nonum brevius.

Urosternum primum parum minus quam latitudo inter sese remotis setis glandularibus numerosis (c. 35) brevibus et brevioribus (mm. 0·050-0·065) uniseriatis et setis brevioribus subtilioribus posticis etiam uniseriatis instructis, superficie pone organum subcoxale serie setarum brevium et setis nonnullis aliis brevibus et brevioribus ; urosterni superficie

cetera setis paucis sat longis 3-seriatis (praesterni serie exclusa) et setis numerosis brevioribus.

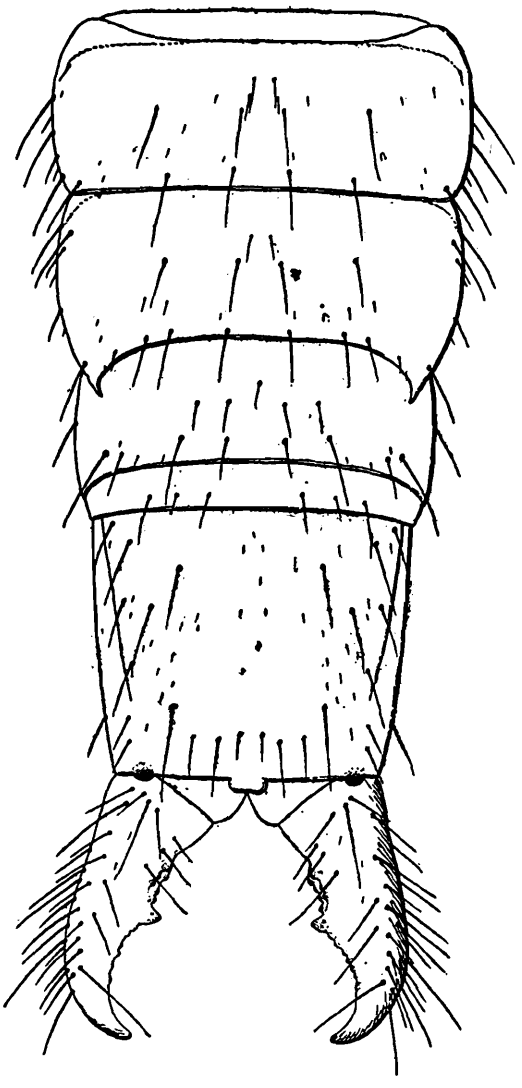


FIG. XXX.
Indjapyx ceylonicus : corporis pars postica prona a segmento sexto.

Stili et vesiculae consueta.

Segmentum decimum supra inspectum parum antice latius quam longius, carinis parum distinctis, setis longis c. 10+10 et setis nonnullis brevioribus et aliis magis numerosis brevissimis, acropygio breviore angulis rotundatis.

Forceps quam segmenti decimi longitudo dorsualis paullum brevior, brachiis robustis, laevo dente mediano sat magno acuto, margine praedentali tuberculis $\frac{3}{3}$, quorum primum superum et inferum quam cetera majora sunt, margine postdentali parum profunde crenulato ; brachio dextero dente mediano magno acuto, margine praedentali tuberculis $\frac{3}{4}$, quorum primum superum et inferum quam cetera majora sunt, margine postdentali tractu sat longo crenulato.

Long. corporis mm. 10, lat. urotergiti septimi 1·40, long. antennarum 3·00, forcipis 1·05.

Habitat.—Ceylon : Peradeniya (exemplum typicum a clar. E. Green lectum).

Observatio.—Species haec ab *I. indicus* Oud. antennarum articulorum numero et forcipis forma sat distincta.

Indjapyx kraepelini, sp. nov.

(Fig. XXXI-XXXII.)

Mas.—Corpus cremeum ab abdominis segmento octavo ochroleucoferrugineo forcipis marginibus parum obscurioribus.

Caput supra fere usque ad antennarum basim setis brevissimis crebris, parte laterali et sublaterali exceptis, nec non setis brevibus c. 15+15 et nonnullis brevioribus instructum ; antennae 40-articulatae (exemplo alio antenna dextera anomaliter 34-articulata), trichobothriis superis internis longis setis ceteris vide fig. XXXI, 2 ; maxillae primi paris laminis pectinatis quinque.

Thorax : pronotum setis 5+5 longis et sat longis et setis 5+5 brevibus, meso- et metanotum praescuto setis 1+1 submedianis sat

brevibus, scuto setis 8+8 longis et sat longis et setis 4+4 brevibus et nonnullis brevioribus instructo.

Pedes tarso quam praetarsus paullum magis quam duplo longiore inira setis robustioribus 7+6, praetarsi ungue postico quam anticus parum longiore, unguicula mediana bene evoluta.

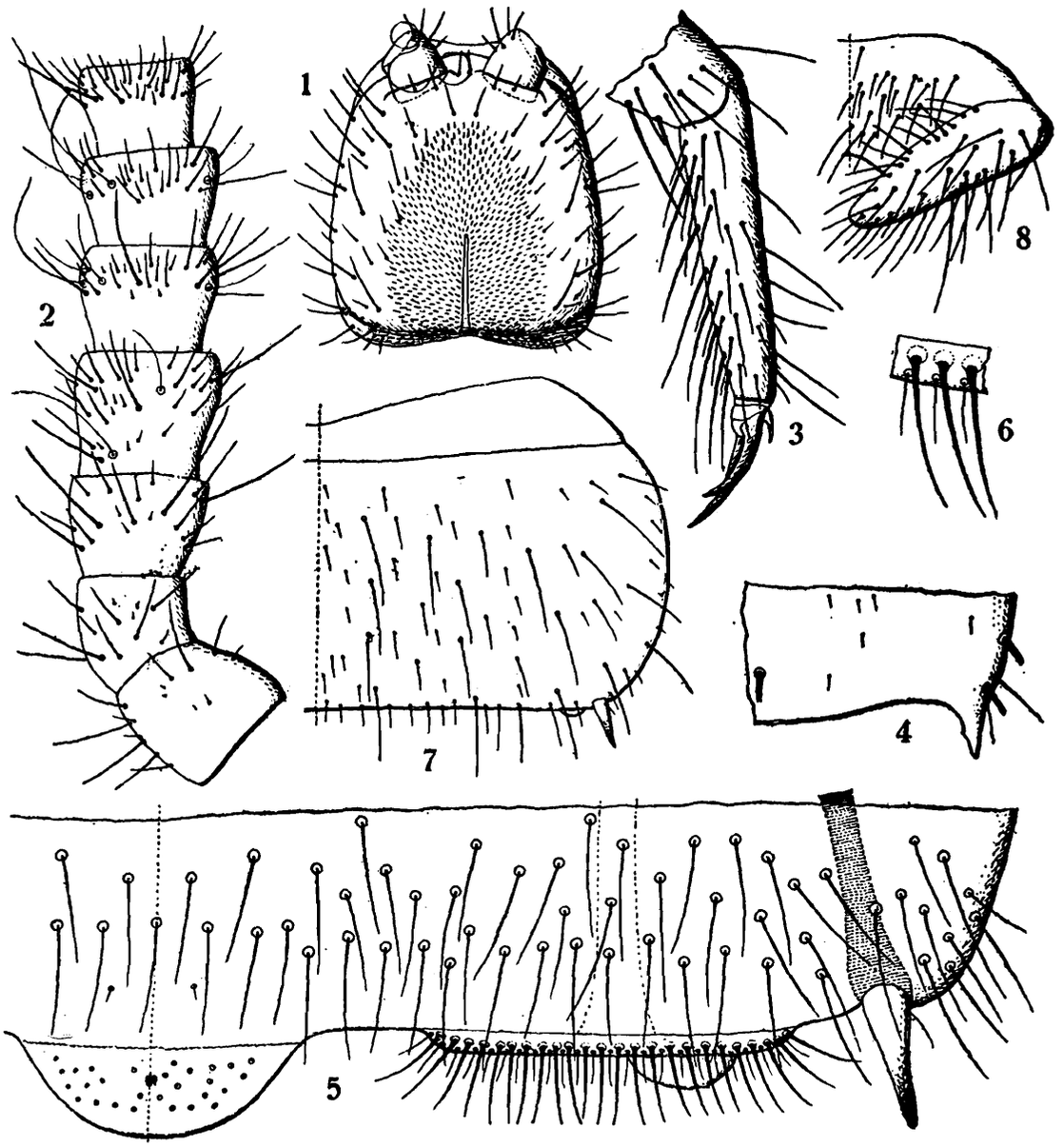


Fig. XXXI.

Indjapyx kraepelini : 1. caput pronum ; 2. antennae dexterae pars proximalis prona ; 3. pes paris tertii a tibiae apice ; 4. urotergiti septimi pars postica lateralis magis ampliata ; 5. urosterni primi dimidia pars postica ; 6. urosterni primi organi subcoxalis particula magis ampliata ; 7. urosterni secundi dimidia pars ; 8. maris regionis genitalis dimidia pars.

Abdomen : tergitum primo praescuto setis duabus metanoti similibus, scuto setis duabus subanticis submedianis brevibus et duabus submedianis sublateralibus subposticis parum longis instructo, tergita 3-7 setis sat longis 7+7 et setis nonnullis brevibus et brevioribus instructa, urotergiti sexti angulo postico rotundato, septimo in processum brevem angustum producto, seta subpostica laterali quam sequens parum longiore ; tergitum octavum lateribus postice haud preductis.

Urosternum primum organis subcoxalibus latis inter sese minus quam unius latitudo distantibus, setis brevibus (mm. 0·050 longis) glandularibus uniseriatis c. 24 et setis posticis subtilioribus, brevioribus etiam uniseriatis auctis superficie pone organum subcoxale setis sat numerosis et sat longis 2-4 transverse inordinatim seriatis, urosterni parte mediana postica setis duabus minimis submedianis subposticis et pseudoporis minimis c. 30 instructa, superficie cetera setis paucis sat longis transverse (praesterni serie inclusa) 4-seriatis et setis magis numerosis brevibus et brevioribus, ut urosterna cetera instructa.

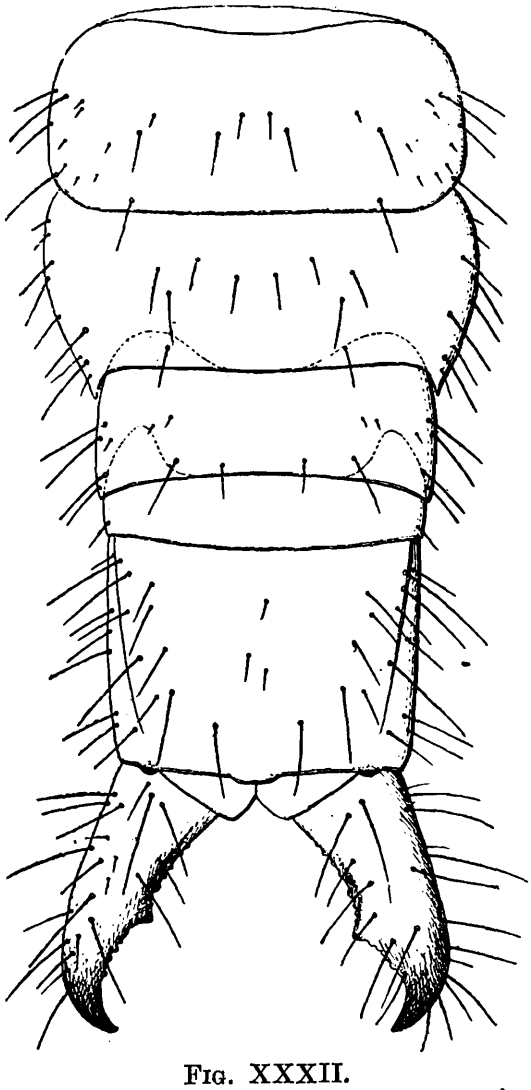


FIG. XXXII.
Indjapyx kraepelini : corporis pars postica prona a segmento sexto.

Stili elongati, seta proximali externa breviore ; vesiculae parvae, sed bene distinctae.

Appendices genitales elongatae, persetosae.

Segmentum decimum supra inspectum aliquantum ad basim latius quam longius, carinis perparvis abbreviatis, setis longis 8+8, brevibus 6+6, acropygio brevissimo late rotundato.

Forceps brachiis subaequalibus dente paullum postmediano sat magno, margine praedentali tuberculis $\frac{3}{6}$-$\frac{3}{8}$, quorum superorum tertium sat magnum, primum et secundum perparva, inferum quintum vel sextum sat magnum cetera parva vel perparva sunt, margine postdentali fere usque ad partem apicalem bene crenulata vel denticulata.

Long. corporis ad mm. 12, lat. urotergiti septimi 1·75, long. antennarum 3, forcipis 1·05.

Femina juvenis (corporis long. mm. 9·5) organis subcoxalibus setis glandularibus c. 20, capitis area mediana setis paucis instructa.

Habitat.—Java : Tjibodas ; exempla typica clar. Prof. K. Kraepelin, cuius memoriae soecies dicta est, legit (Mus. Hamburg).

Observatio.—Species haec ab *I. indicus* exSumatra magnitudine majore, antennarum articulorum numero.

Indjapyx heteronotus, sp. nov.

(Fig. XXXIII-XXXIV.)

Mas.—Corpus ochroleucum, abdominis segmento septimo pallide ferrugineo, segmentis sequentibus badio-ferrugineis, forcipis marginibus et apice nigrescentibus.

Caput supra setis brevibus c. 16+16, setis nonnullis brevioribus et setis brevissimis parum magis numerosis instructum; antennae 38-articulatae (in exemplo uno majore altera 36- et altera 33-articulata) articulis setis longis, brevibus et brevioribus ut fig. XXXIII, 1-2 demonstrant, trichobothriis superis internis longis; maxillae primi paris lobus internus laminis pectinatis 5, palpus labialis mm. 0·13 longus.

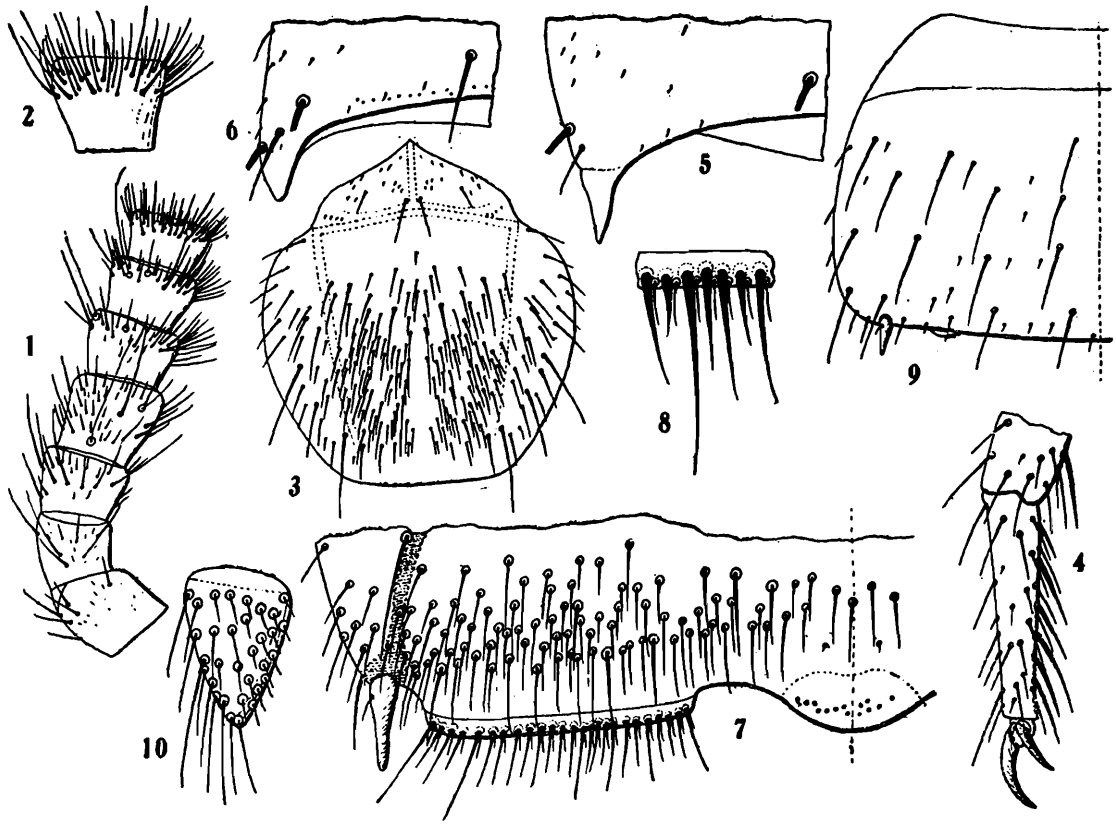


FIG. XXXIII.

Indjapyx heteronotus: 1. antennae dexterae pars proximalis prona; 2. antennae articulus decimus octavus; 3. mesonotum; 4. pes paris tertii a tibiae apice; 5. urotergiti septimi pars postica lateralis; 6. urotergiti octavi pars postica lateralis; 7. urosterni primi dimidia pars postica; 8. urosterni primi organi subcoxalis particula magis ampliata; 9. urosterni secundi pars; 10 maris appendix genitalis.

Thorax: pronotum setis 5+5 sat longis, 4+4 brevioribus et nonnullis brevissimis; meso- et metanotum praescuto setis duabus brevibus submedianis et setis nonnullis brevioribus et minimis, scuto setis 4+4 brevibus et setis pernumerosis brevioribus vestito.

Pedes tarso quam praetarsus fere triplo longiore infra setis robustioribus 6+6, praetarsi ungue postico quam anticus aliquantum longiore, unguicula mediana breviore.

Abdomen: tergitum primum praescuto setis duabus submedianis brevibus et scuto setis duabus submedianis subposticis brevibus, tergita 3-7 scuto setis 5+5 plus minusve brevibus, 3+3 brevioribus et nonnullis brevissimis sparsis instructa; tergiti sexti angulo postico rotundato, septimi in processum sat longum triangularem apice angustiore acuto producto, seta subapicali externa brevissima; tergitum octavum septimum longitudine subaequans et quam idem parum angustius lateribus postice angulatim aliquantum productis; tergitum nonum brevius.

Urosternum primum organis subcoxalibus parum magis quam unius latitudo remotis, setis glandularibus c. 25 brevibus et brevioribus

uniseriatis et setis subtilioribus brevissimis etiam uniseriatis ad basim setarum glandularium orientibus ; superficie pone organum subcoxale setis, brevibus numerosis 2-5 inordinatim seriatis, urosterni parte postica mediana pseudoporis glandularibus minimis c. 14 et setis minimis duabus subposticis instructa, urosterni superficie cetera setis paucis sat longis 3-seriatis et setis nonnullis brevissimis sparsis.

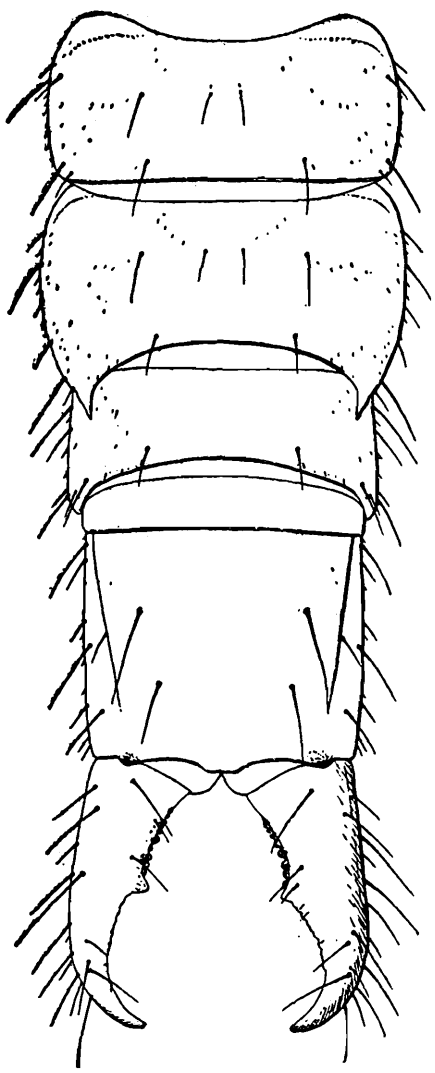


FIG. XXXIV.
Indjapyx heteronotus : corporis pars postica prona a segmento sexto.

Stili et vesiculae consueta.

Appendices genitales conicae persetosae.

Segmentum decimum supra inspectum paullum longius quam latius carinis distinctis, setis longis 6+6 et setis nonnullis brevissimis, acropygio brevissimo latiusculi.

Forceps segmenti decimi latitudinem subaequans, brachiis subsymmetricis : brachio laevo dente parum praemediano magno, margine praedentali tuberculis $\frac{4}{8}$, quorum duo antica supera et tria infera minora sunt, margine postdentali crebre et parum profunde crenulato, brachio dextero dente parum praemediano sat magno, margine praedentali tuberculis $\frac{5}{8}$, quorum tria antica supera et tria infera minora sunt, margine postdentali parum profunde crenulato.

Long. corporis ad mm. 10, lat. urotergiti septimi 1·36, long. antennarum 2·60, forcipis 0·98.

Habitat.—Barkuda, Chilka Lake, exemplum typicum et duo juvenilia (in memoriam clar. Dr. N. Annandale dicata legit).

Observatio.—Species haec meso- et metanoto tantum setis brevissimis pernumerosis vestitis bene distincta est.

Juvenes, longitudo corporis mm. 6-7, lat. urotergiti septimi 0.96.

Antennae 38-articulatae.

Mesonotum tantum (nec metanotum) setis sat numerosis brevissimis vestitum.

Urotergiti septimi angulo postico ejdem adulti simili.

Urosterni pirmi organa subcoxalia setis glandularibus 13-14.

Forcipis brachiorum tuberculis praedentalibus $\frac{3}{5}$.

Indjapyx annandalei, sp. nov.

(Fig. XXXV-XXXVI.)

Corpus ochroleucum ab abdominis segmento septimo ferrugineo, forcipis marginibus infuscatis.

Caput supra setis brevibus c. 15+15 et nonnullis brevioribus et brevissimis praesertim per median frontem nec non area postica mediana parum lata et quam crista metopica parum breviore instructum; antennae 32-articulatae, articulis setis longis, brevibus et brevioribus ut fig. XXXV, 1-2 demonstrant, trichobothriis superis internis perlongis;

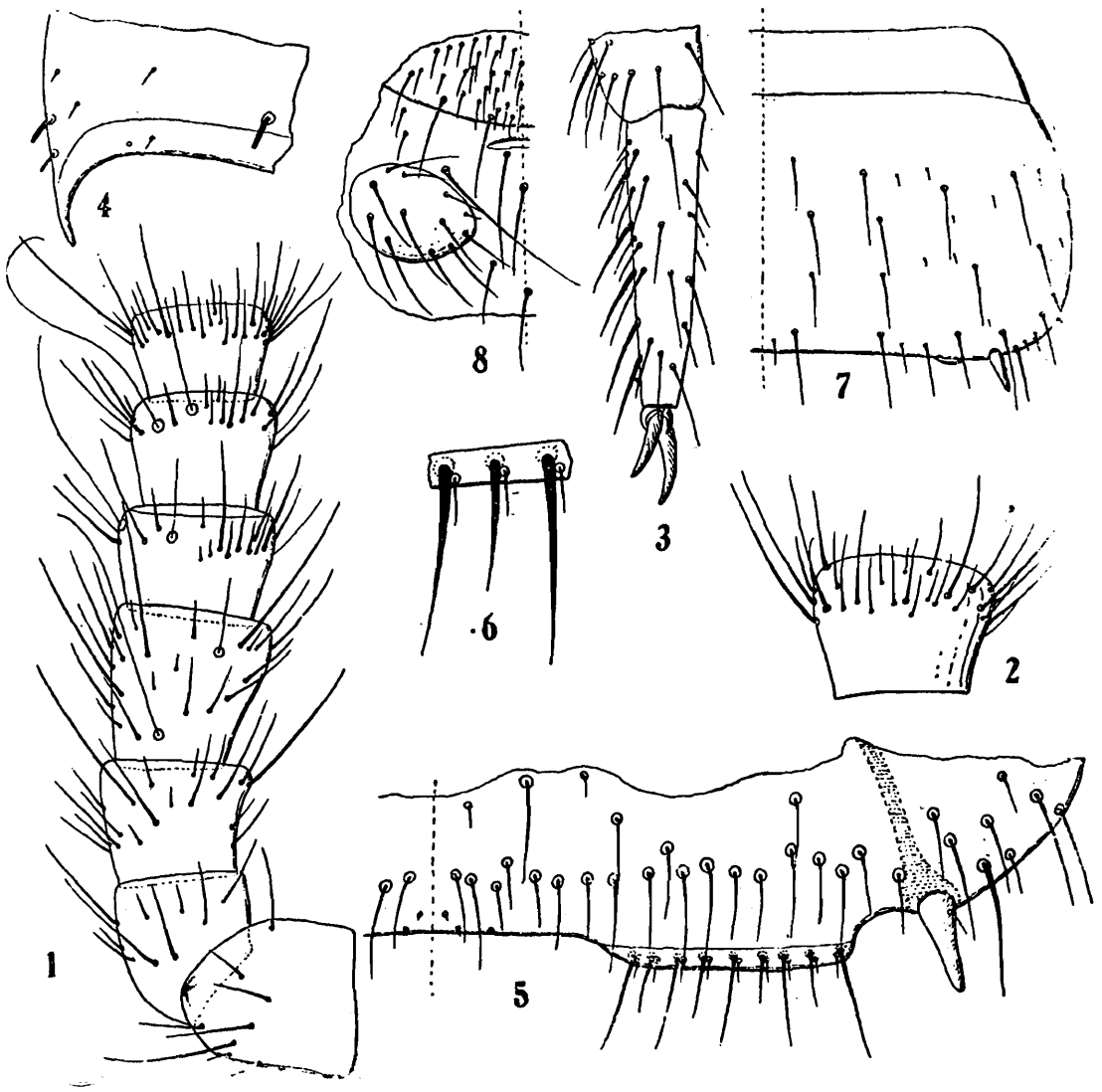


FIG. XXXV.

Indjapyx annandalei: antennae dexterae pars proximalis prona; 2. antennae articulus decimus octavus; 3. pes paris tertii a tibiae apice; 4. urotergiti septimi pars postica lateralis; 5. urosterni primi dimidia pars postica; 6. urosterni primi organi subcoxalis particula magis ampliata; 7. urosterni secundi dimidia pars; 8. maris regionis genitalis dimidia pars.

maxillae primi paris lobus internus laminis pectinatis 5, palpus labialis mm. 0·10 longus, setis 6 instructus.

Thorax: pronotum setis 5+5 sat longis, 3+3 brevioribus et nonnullis brevissimis, meso- et metanotum praescuto setis duabus submedianis brevibus, scuto setis 5+5 sat longis, 3+3 brevibus et nonnullis brevissimis.

Pedes tarso quam praetarsus fere triplo longiore, infra setis robustioribus 5+5, praetarsi unque postico quam anticus parum longiore, unguicula mediana bene evoluta.

Abdomen: tergitum primum praescuto setis duabus submedianis sat brevibus et scuto setis duabus submedianis subposticis, tergita 3-7

scuto setis sat brevibus 5+5 et nonnullis brevissimis, seta laterali subpostica quam macrochaeta praecedens fere duplo breviore, tergiti sexti angulo postico rotundato, septimi in processum sat longum a basi sat angustum cetero angustiore apice subacuto producto ; tergitum octavum septimum longitudine subaequans et quam idem parum angustius, lateribus postice haud productis ; tergitum nonum brevius.

Urosternum primum organis subcoxalibus parvis, inter sese magis quam unius latitudo remotis, setis glandularibus brevibus et parum brevioribus 7—9 (*mm.* 0·054-0·065 *longis*) nec non seta subtiliori brevissima ad basim setarum glandularium instructis, superficie pone organum subcoxale setis brevibus sat numerosis uniseriatis, urosterni parte postica mediana setis minimis 2+2 instructa, urosterni superficie cetera ut eadem urosternorum sequentium setis paucis sat longis 3-seriatis (praesterni serie exclusa) et setis nonnullis brevioribus et brevissimis.

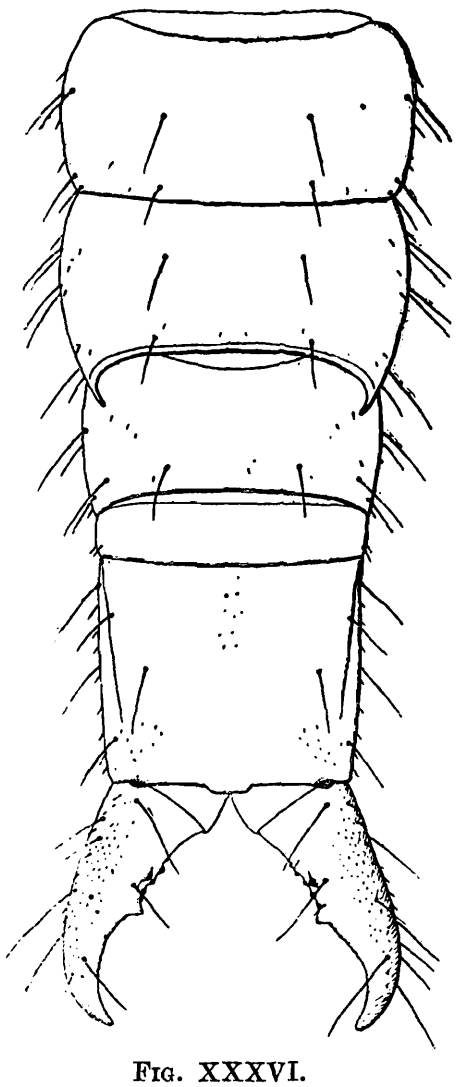


FIG. XXXVI.
Indjapyx annandalei : corporis pars postica prona a segmento sexto.

Stili et vesiculae consueta.

Segmentum decimum supra inspectum parum latius quam longius carinis distinctis, setis longis 5+5 et setis brevissimis sparsis instructum, acropygio breviore postice vix sinuato.

Forceps segmenti decimi longitudinem dorsualem parum superans, brachio laevo dente parum praemediano sat magno, margine praedentali tuberculis $\frac{1}{5}$, margine postdentali paullum profunde et crebre crenulato, brachio dextero laevo simili.

Long. corporis mm. 6, lat. urotergiti septimi 0·82, long. antennarum 2·30, forcipis 0·54.

Habitat.—Tambi, Koyna Valley, Satara District (2,100 ft.).

Observatio.—Species haec antennarum articulo numero, capitis area postica parva, urosterni primi organis subcoxalibus et parte mediana postica, forcipis margine praecedentali tuberculo uno supero bene distincta est.

Indjapyx annandalei Silv. var. **bituberculata,** nov.

(Fig. XXXVII-XXXVIII.)

Corpus colore consueto.

Caput supra setis brevibus c. 18+18 et nonnullis brevioribus instructum ; antennae 32-articulatae, articulis setis longis, brevibus

et brevioribus ut fig. XXXVII, 1 demonstrat instructis, trichobothriis superis internis longis ; maxillae primi paris lobus internus laminis pectinatis quinque.

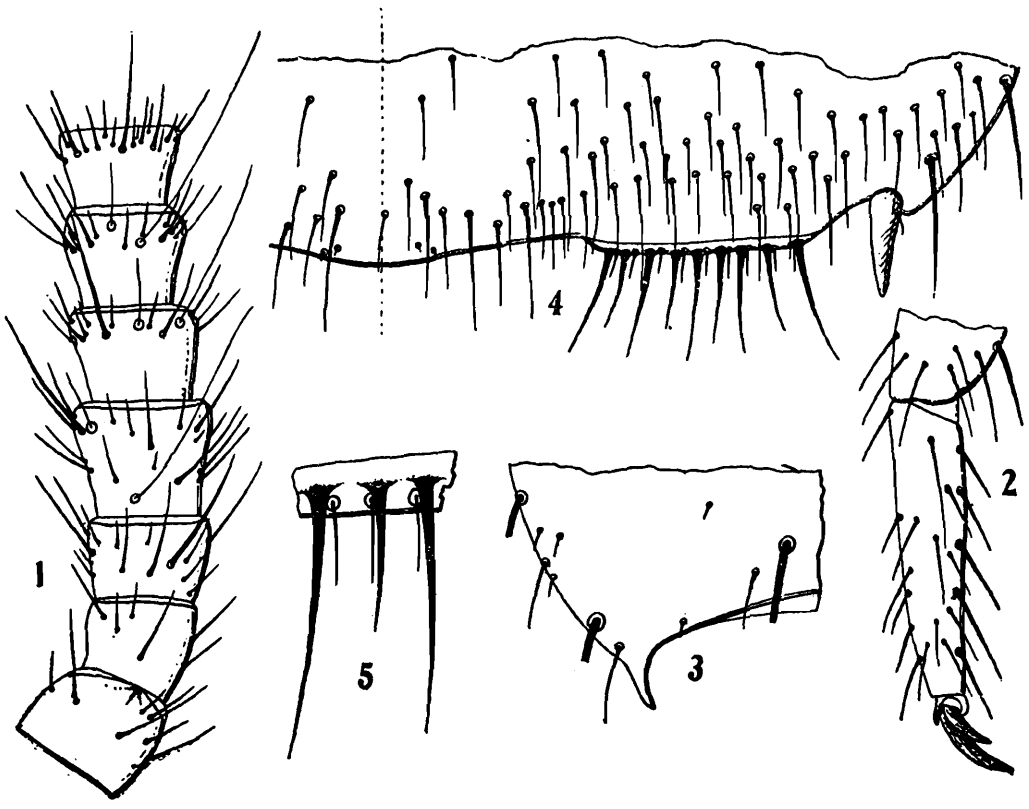


FIG. XXXVII.

Indjapyx unnandalei var. *bituberculata* : 1. antennae laevae pars proximalis prona ; 2. pes paris tertii a tibiae apice ; 3. urotergiti septimi pars postica lateralis ; 4. urosterni primi dimidia pars postica ; 5. urosterni primi organi subcoxalis particula magis ampliata.

Thorax : pronotum setis longis et sat longis 5+5, brevibus 3+3 ; meso- et metanotum praescuto setis duabus submedianis sat brevibus, scuto setis longis et sat longis 5+5, brevibus 4+4. Pedes tarso quam praetarsus fere triplo longiore, praetarsi ungue postico quam anticus aliquantum longiore, unguicula mediana sat bene evoluta.

Abdomen : tergitum primum praescuto setis duabus submedianis brevibus, scuto setis duabus submedianis subposticis, tergita 3-7 scuto setis sat longis 6+6, brevibus 24 et paucis brevioribus et brevissimis instructo, tergiti sexti angulo postico rotundato, septimi in processum parum longum angustiorem acutum producto, seta laterali subpostica quam seta sequens fere duplo longiore ; tergitum octavum septimum longitudine subaequans, lateribus postice haud productis, tergitum nonum brevius.

Urosternum primum organis subcoxalibus inter sese quam unius latitudo fere duplo magis remotis, setis glandularibus 8 brevibus et parum brevioribus (mm. 0·050—0·065 longis) et setis brevissimis ad basim setarum glandularium instructis, superficie pone organi subcoxalis setis

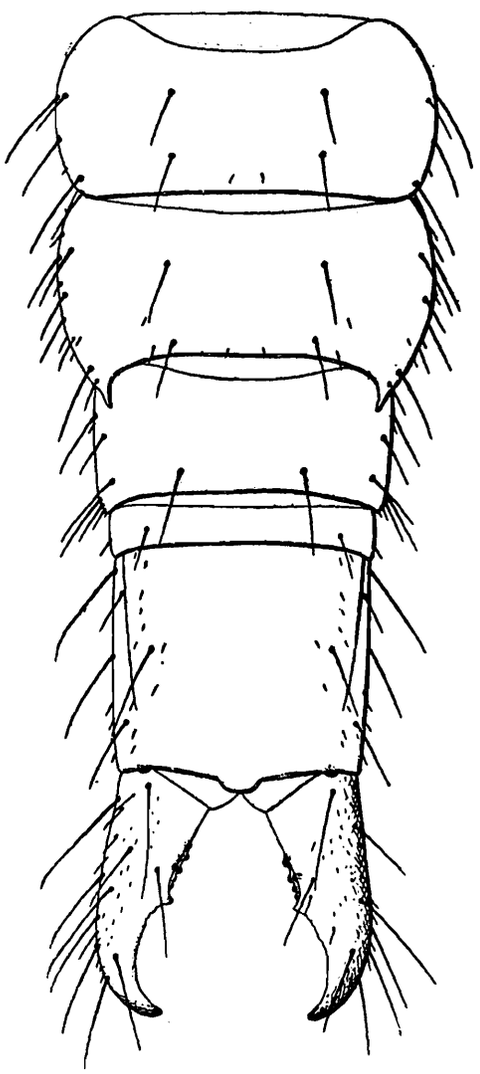


FIG. XXXVIII.
Indjapyx annandalei var. *bituberculata*: corporis pars postica prona a segmento sexto.

nume osis brevibus 2—4 seriatis, urosterni superficie mediana postice psu doporis glandularibus indistinctis, s tis minimis submedianis 2+2, superficie cetera setis brevibus et brevioribus ut in forma typica.

Segmentum decimum supra inspectum paullum latius quam longius setis longis 5+5, carinis sat distinctis, acroygio brevissimo.

Forceps segmenti dceimi longirtudinem dorsua!em aequans, brachiis sub-aequalibus dente paullum praemediano sat parvo, margine praedentali tuberculis $\frac{2}{4}$, margine postdentali paullum profunde crenulato.

Long. corporis mm. 6, lat. urotergiti septimi 0·78, long. antennarum 1·90, forcipis 0·54.

Habitat.—Exempla duo vidi ad East side of Koyna Valley, Satara distr., 3,500 ft. a F. H. Gravely collecta.

Observatio.—Varietas haec a forma typica capite area postica brevissime setosa destituto et forcipis brachiorum margine praedentali tuberculis $\frac{2}{4}$ instructo bene distincta.

Indjapyx seymourii, sp. nov.

(Fig. XXXIX-XL).

Corpus cremeum abdomine a segmento octavo ferrugineo.

Caput supra superficie mediana tractu magis quam dimidia pars postica longiore setis brevissimis crebris vestita, setis brevibus c. 15+15 et setis nonnullis brevioribus et brevissimis sparsis instructum; antennae 32-articulatae, articulis setis longis, brevibus et brevioribus ut fig. XXXIX, 2-3 demonstrant instructis, trichobothriis superis internis perlongis, maxillae primi paris lobus internus laminis pectinatis 5, palpus labialis.

Thorax: pronotum setis longis et sat longis 5+5, brevioribus 4+4, meso- et metanotum praescuto setis daubus submedianis et setis nonnul-

lis brevissimis, scuto setis sat longis 5+5 et nonnullis brevioribus et brevissimis instructo.

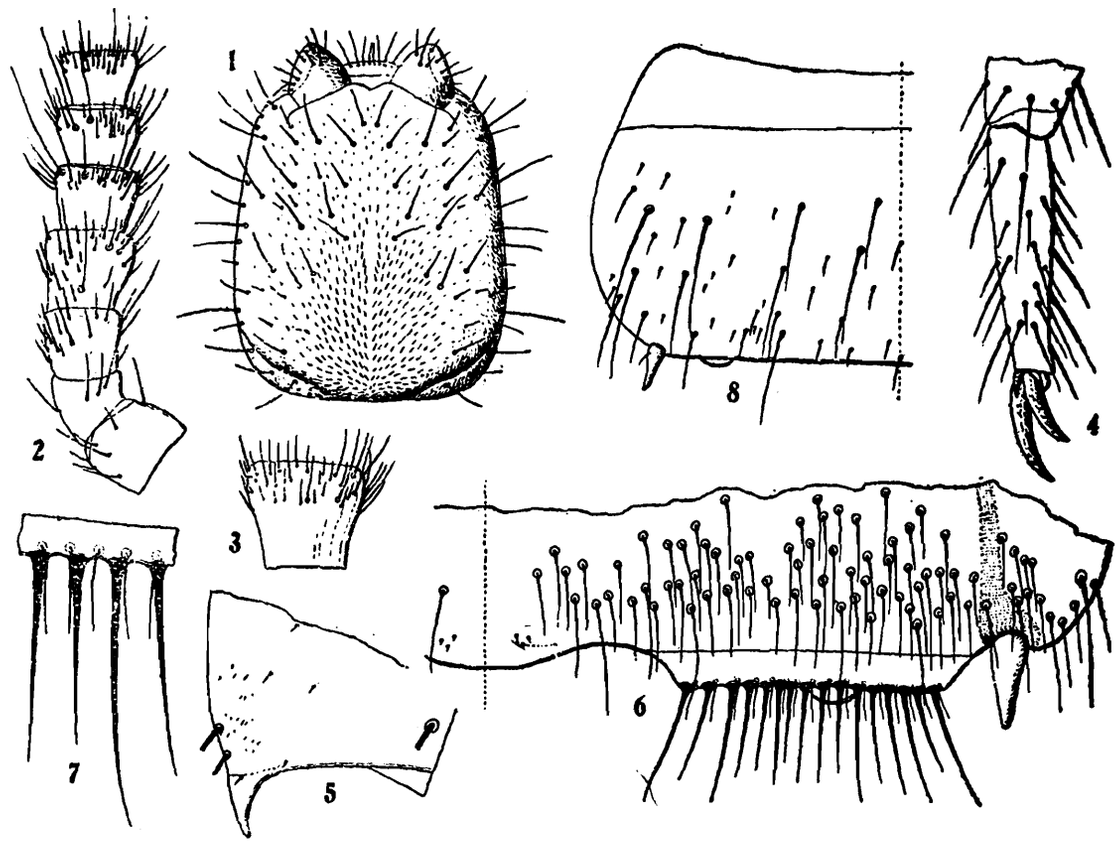


FIG. XXXIX.

Indjapyx seymourii: 1. caput pronum; 2. antennae dexterae pars proximalis prona; 3. antennae articulus decimus sextus; 4. pes paris tertii a tibiae apice, 5. urotergiti septimi pars postica pars lateralis; 6. urosterni primi dimidia pars postica; 7. urosterni primi organi subcoxalis particula magis ampliata; 8. urosterni secundi dimidia pars.

Pedes tarso quam praetarsus duplo longiore infra setis robustioribus 5+5, praetarsi ungue postico quam anticus parum longiore, unguicula mediana brevissima.

Abdomen: tergitum primum praescuto eidem metanoti simili, scuto setis duabus brevibus submedianis subpositicis, tergita 3-7 scuto setis 5+5 sat longis et setis nonnullis brevioribus et brevissimis, tergiti sexti angulo postico rotundato, septimi in processum sat longum gradatim angustiorem producto, macrochaeta laterali postica quam seta sequens duplo longiore; tergitum octavum septimum longitudine subaequans et quam idem parum angustius, lateribus posticis haud productis, tergitum nonum brevius.

Urosternum primum organis subcoxalibus inter sese magis quam unius latitudo remotis, setis glandularibus uniseriatis (c. 16) brevibus et parum brevioribus (mm. 0·056-0·078) et serie postica setarum brevissimarum subtiliorum instructis, superficie pone organum subcoxale setis brevibus pernumerosis 2-5 inordinatim seriatis, urosterni parte postica

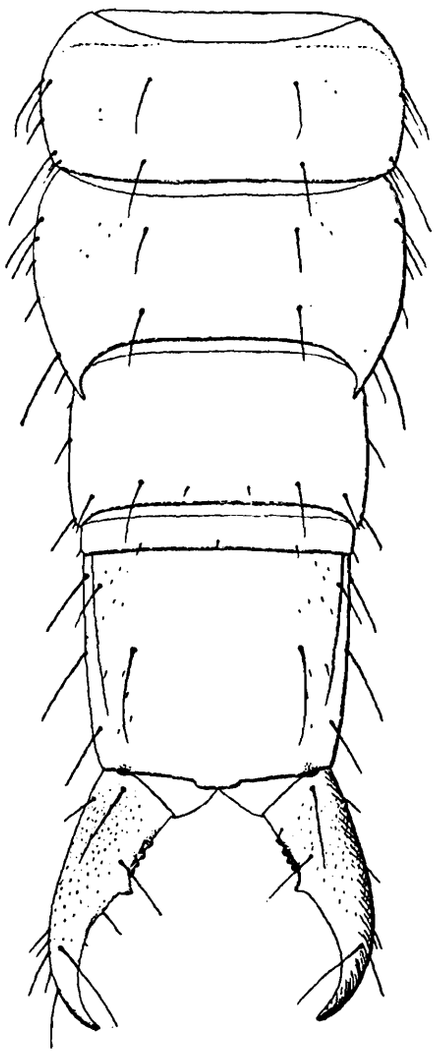


FIG. XL.
Indjapyx seymeurii : corporis pars postica prona a segmento sexto.

madiana setis minimis submedianis 3+3, urosterni superficie cetera setis paucis longis 2-seriatis (praesterni serie exclusa et setis brevissimis sparsis nonnullis.

Stili et vesicluae consueta.

Segmentum decimum supra inspectum paullum latius quam longius, carinis distinctis, setis sat longis 5+5 et aliis sat numerosis brevissimis sparsis, acropygio brevissimo latiusculo.

Forceps brachiis attenuatis, segmenti decimi latiudinem subaequantibus, symmetricis; laevo dente aliquantum praemediano sat magno, margine praedentali tuberculis $\frac{2}{4}$ parvis, margine postdentali vix crenulato, brachio dextero laevo simili

Long. corporis ad mm. 8, lat. urotergiti septimi 1·25, long. antennarum 0·20, forcipis 0·90.

Habitat.—Nagpur (exempla duo).

Observatio.—Species haec, quae Indiarum Zoologi Musei Directori, clar. R. B. Seymour Sewell dicata est forcipis brachiis attenuatis symmetricis, dente aliquantum praemediano armatis distinguenda est.

Indjapyx pruthii, sp. nov.

(Fig. XLI-XLII).

Femina.—Corpus ochroleucum abdomine a segmento septimo pallide ferrugineo, segmento decimo et forcipe badiis.

Caput supra setis brevibus c. 15+15 et nonnullis brevioribus et brevissimis instructum; antennae 32-articulatae, articulis setis longis, brevibus et brevioribus ut fig. XLI, 1-2 demonstrant, trichobotriis superis internis, articuli quarti praesertim, perlongis; maxillae primi paris lobus internus laminis pectinatis 5; palpus labialis mm. 0·10 longus.

Thorax : pronotum setis brevibus et sat brevibus 5+5, brevioribus 4+4, meso- et metanotum praescuto setis duabuss ubmedianis brevibus et 2+2 brevioribus, scuto setis brevibus et sat brevibus 5+5 et nonnullis brevioribus instructo.

Pedes tarso quam praetarsus magis quam duplo longiore, praetarsi ungue postico quam anticus parum longiore, unguicula brevissima.

Abdomen : tergitum primum praescuto eidem metanoti simili, scuto setis duabus submedianis subposticis brevibus ; tergita 3-7 scuto setis

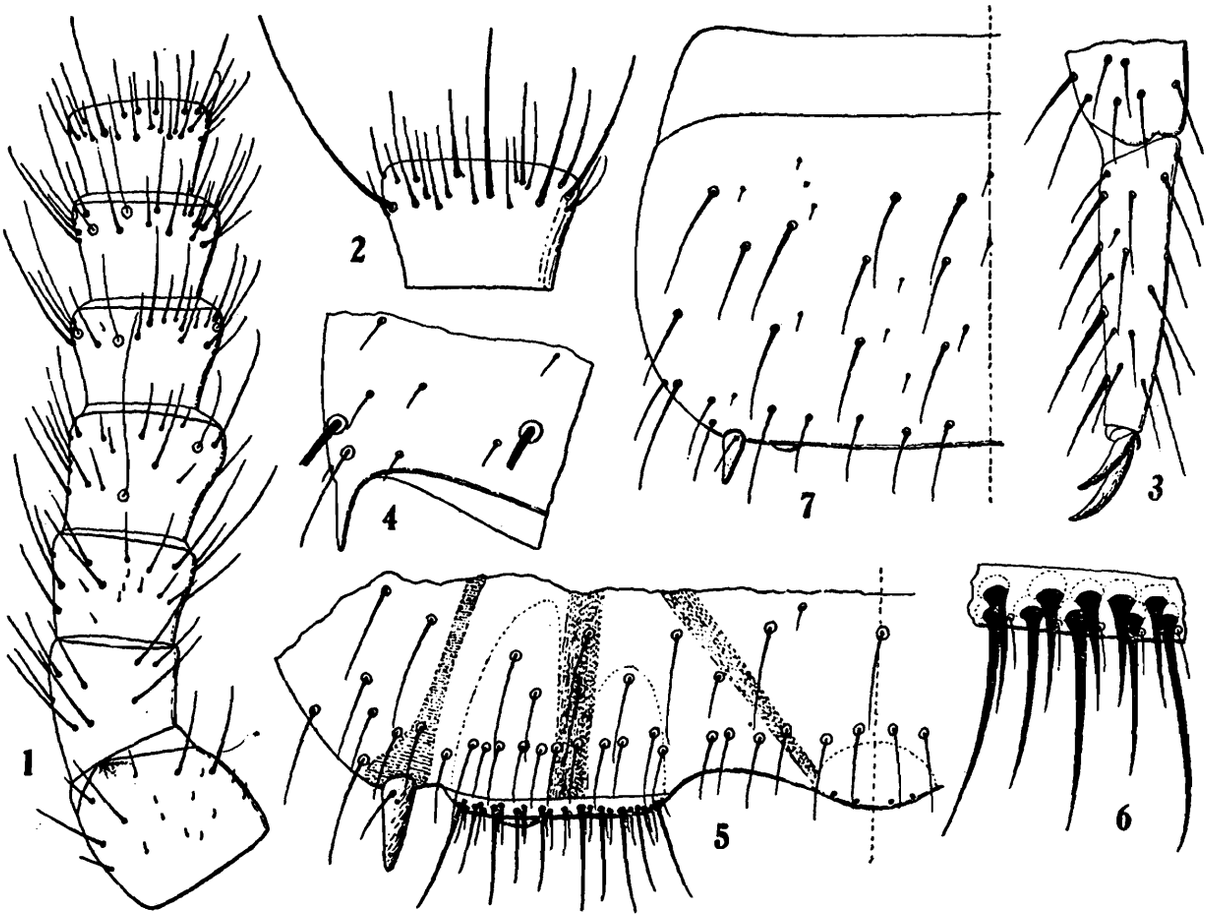


FIG. XLI.

Indjapyx pruthii : 1. antennae dexterae pars proximalis prona ; 2. antennae articulus decimus sextus ; 3. pes paris tertii a tibiae apice ; 4. urotergiti septimi pars postica lateralis ; 5. urosterni primi dimidia pars postica ; 6. urosterni primi organi subcoxalis particula magis ampliata ; 7. urosterni secundi dimidia pars.

brevibus 6+6 et nonnullis brevioribus et brevissimis magis numerosis instructo ; tergiti sexti angulo postico rotundato, septimi in processum sat brevem basi angusta, cetero angustiore, seta subpostica quam praecedens c. dimidio breviore ; tergitum octavum septimi longitudine subaequans et quam idem aliquantum angustius, lateribus postice haud productis, tergitum nonum brevius.

Urosternum primum organis subcoxalibus parvis quam unius latitudo duplo inter sese remotis, setis glandularibus brevissimis uniseriatis c. 14 et brevibus totidem parum posticis, nec non setis subtilioribus brevissimis ad basim setarum brevium setis instructis, superficie pone organum subcoxale setis brevibus uniseriatis inter sese parum remotis, urosterni parte postica mediana pseudoporis minimis 2+2 posticis urosterni superficie cetera setis paucis sat longis 3-seriatis (praesterni serie exclusa) et setis brevissimis sparsis.

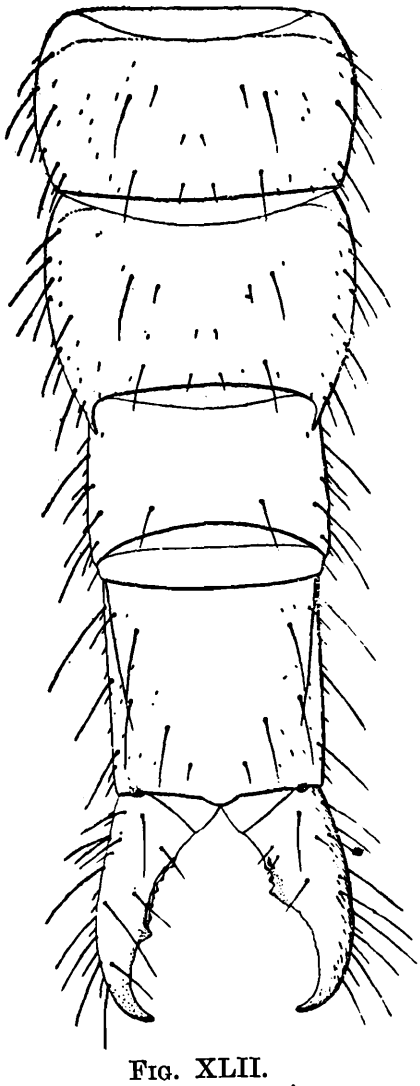


FIG. XLII.
Indjapyx pruthii : corporis pars postica prona a segmento sexto.

Stili et vesiculae consueta.

Segmentum decimum supra inspectum vix longius quam latius, carinis distinctis, setis 7+7 longis et sat longis et nonnullis brevissimis, acropygio brevissimo.

Forceps segmenti decimi latitudinem aequans ; brachiis asymmetricis ; brachio laevo dente parum postmediano sat magno, margine praedentali parum sinuato tuberculis $\frac{4}{6}$, margine postdentali brevi tractu vix crenulato, brachio dextero dente praemediano sat magno, margine praedentali tuberculis $\frac{1}{2}$, margine postdentali taractu proximali paullum proximali paullum profunde crenulato.

Long. corporis mm. 7, lat. urotergiti septimi 0·72, long. antennarum 1·50, forcipis 0·52.

Habitat.—Exempla vidi duo ad " Pass between Chaibassa and Chakardhapur ", Chota Nagpur, a Gravely collecta.

Observatio.—Species haec, clar. Dr. H. S. Pruthi dicata, urosterni primi organis subcoxalibus setis glandularibus biseriatis et forcipis forma a *I. annandalei* facile distinguenda est.

Indjapyx gravelyi, sp. nov.

(Fig. XLIII-XLIV).

Fenima.—Corpus ochroleucum abdomine et forcipe consuetis.

Caput supra setis brevibus c. 18+18 et setis nonnullis brevioribus et brevissimis instructum ; antennae 36-articulatae, articulis setis longis, brevibus et brevioribus ut fig. XLIII, 1-2 demonstrant instructis, trichobothriis superis internis longis ; maxillae primi paris lobus internus laminis pectinatis 5, palpus labialis mm. 0·10 longus.

Thorax : pronotum setis longis 5+5, brevibus 6+6 et nonnullis brevissimis, meso- et metanotum praescuto setis duabus submedianis longis, scuto setis longis 5+5 et 5+5 brevibus et brevissimis.

Pedes tarso quam praetarsus paullum magis quam duplo longiore, infra setis robustioribus 7+7, praetarsi unguibus robustis, ungue postico quam anticus aliquantum longiore, unguicula mediana bene evoluta.

Abdomen : tergitum primum praescuto setis duabus brevibus submedianis, scuto setis duabus brevibus subposticis, submedianis, tergita 3-7 setis brevibus 6+6 et setis nonnullis minimis instructa ; tergiti sexti angulo postico rotundato, septimi in processum longum tringularem parte apicali angustiore acuta producto ; tergitum octavum septimum longitudine subaequans et quam idem parum angustius, lateribus postice angulatim aliquantum productis ; tergitum nonum brevius.

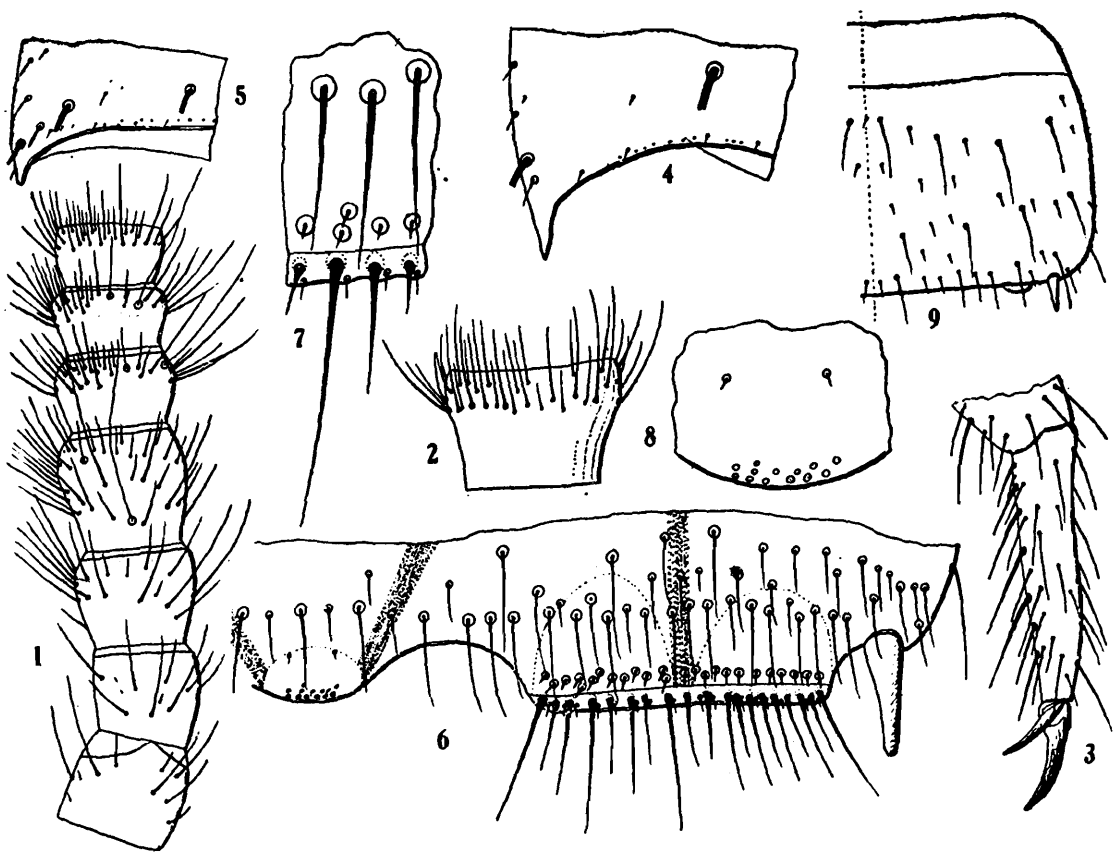


FIG. XLIII.

Indjapyx gravelyi : 1. antennae laevae pars proximalis prona ; 2. antennae articulus vigesimus ; 3. pes paris tertii a tibiae apice ; 4. urotergiti septimi pars postica lateralis ; 5. urostergiti octavi pars postica lateralis ; 6. urosterni primi dimidia pars postica ; 7. urosterni primi organi subcoxalis particula magis ampliata ; 8. urosterni primi pars postica mediana magis ampliata ; 9. urosterni secundi dimidia pars.

Urosternum primum organis subcoxalibus inter sese magis quam unius latitudo remotis, setis glandularibus c. 20 brevibus et brevioribus (mm. 0·052-0·078) longis uniseriatis et setis anticis minimis subuniseriatis inter sese approximatis ex area circulari orientibus, nec non serie setarum subtiliorum consuetarum postice instructis, superficie pone organum subcoxale serie setarum brevium et nonnullis aliis brevibus et brevioribus, urosterni parte mediana postica pseudoporis glandularibus minimis c. 13 et setis duabus submedianis minimis subposticis, urosterni superficie cetera ut eadem urosternorum sequentium setis paucis brevibus 3-seriatis et aliis parum magis numerosis brevissimis instructa.

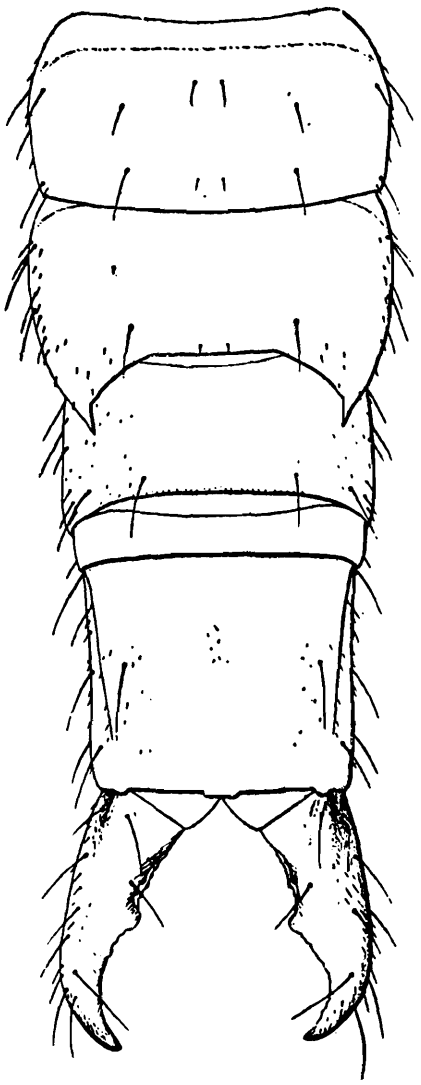


FIG. XLIV.
Indjapyx gravelyi : corporis pars postica prona a segmento sexto.

Stili seta proximali externa brevissima, vesiculae parvae.

Segmentum decimum supra inspectum subaeque longum atque latum carinis distinctis, setis longis 6+6 et setis brevissimis sparsis instructum, acropygio brevissimo latiusculo.

Forceps segmenti decimi longitudinem subaequans, brachiis sat crassis : laevo dente submediano magno obtuso, margine praedentali tuberculis $\frac{3}{6}$, quorum secundum superum et quartum inferum majora sunt, margine postdentali gradatim minus profunde crenulato, brachio dextero dente submediano magno, margine praedentali tuberculis $\frac{3}{8}$, quorum secundum superum et quintum inferum majora sunt, margine postdentali fere usque ad partem distalem bene crenulato.

Long. corporis mm. 9, lat. urotergiti septimi 1·10, long. antennarum 2·60, forcipis 0·78.

Habitat.—India : Madras (exemplum typicum in Museo Madras asservatum).

Observatio.—Species haec a praecedentibus generis urosterni primi setis lateralibus posticis distinctissima est.

Indjapyx taprobanicus, sp. nov.

(Fig. XLV-XLVI).

Syn. *Japyx indicus* Silv. (*nec* Oudemans), *Rec. Ind. Mus.* IX, p. 52, fig. i.

Femina.—Caput supra setis c. 16+16 brevibus et nonnullis brevioribus et brevissimis instructum ; antennae 36-articulatae articulis setis longis, brevibus et brevioribus ut fig. XLV, 1-2 demonstrant instructis, trichobothriis superis internis longis ; maxillae primi paris lobus internus laminis pectinatis 5, palpus labialis mm. 0·19 longus.

Thorax : pronotum setis sat longis 5+5 et paucis brevioribus et brevissimis ; meso- et metanotum praescuto setis duabus submedianis brevibus, scuto setis sat longis 5+5 et setis paucis brevioribus et brevissimis.

Pedes tarso quam praetarsus parum magis quam duplo longiore infra setis robustioribus 7+7, praetarsi unguibus attenuatis, ungue postico quam anticus aliquantum longiore, unguicula mediana bene evoluta.

Abdomen: tergitum primum praescuto setis duabus submedianis brevibus, scuto setis duabus subposticis submedianis brevibus; tergita 3-7 setis parum longis 5+5, setis 3+3 brevioribus et nonnullis brevissimis, tergiti sexti angulo postico rotundato, septimi in processum

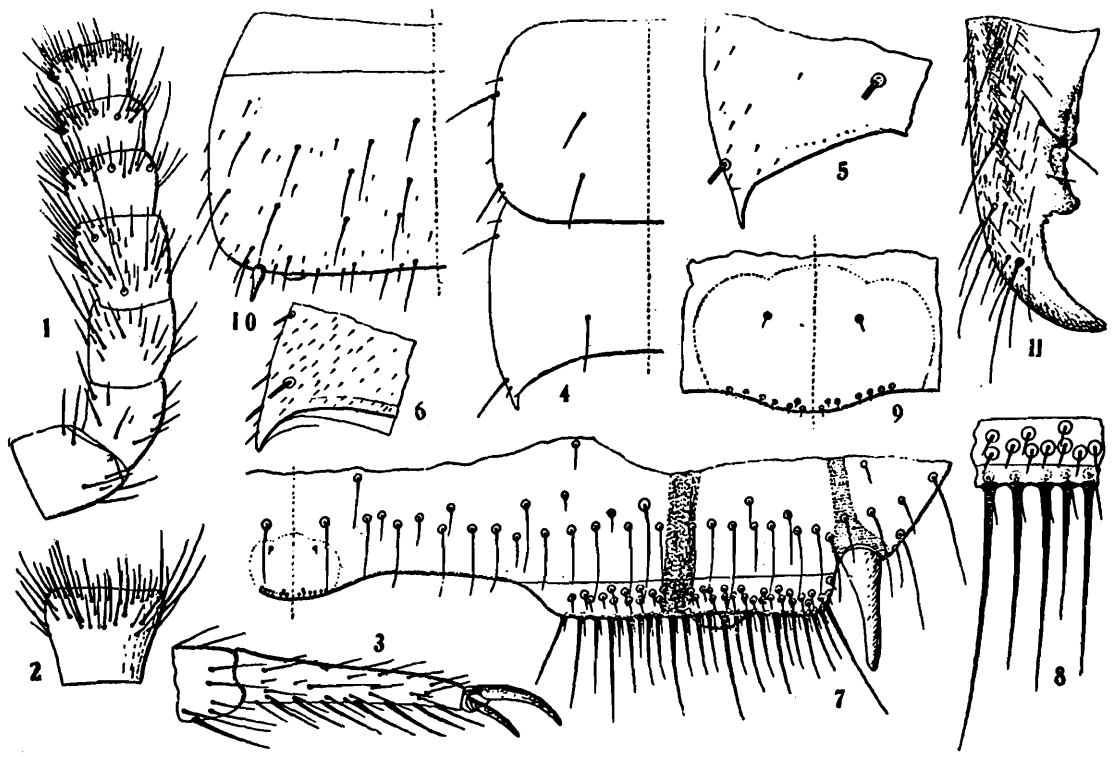


FIG. XLV.

Indjapyx taprobanicus: 1. antennae laevae pars proximalis prona; 2. antennae articulus decimus octavus; 3. pes paris tertii a tibiae apice; 4. urotergitorum sexti et septimi dimidia pars; 5. urotergiti septimi pars postica lateralis; 6. urotergiti octavi pars postica lateralis; 7. urosterni primi dimidia pars postica; 8. urosterni primi organi subcoxalis particula magis ampliata; 9. urosterni primi pars mediana postica magis ampliata; 10. urosterni secundi dimidia pars; 11. forcipis brachium laevum pronum.

longum latum triangularem apice ipso elongato angustiore acute producto; tergitum octavum septimum longitudine subaequans et quam idem parum angustius, lateribus postice angulatim aliquantum productis.

Urosternum primum organis subcoxalibus parum latis, inter sese magis quam unius latitudo remotis, setis glandularibus, c. 25 brevibus et parum brevioribus instructis et seriebus duabus irregularibus anticis setarum minimarum ex area circulari orientium, nec non serie postica consueta setarum subtiliorum brevissimarum instructis, superficie pone organum subcoxale serie setarum basium inter sese approximatarum, urosterni parte mediana postica pseudoporis glandularibus minimis nonnullis (c. 14) et setis duabus minimis submedianis subposticis instructa, urosterni superficie cetera ut eadem urosternorum sequentium setis paucis sat longis 3-seriatis (praesterni serie exclusa) et setis nonnulis brevissimis sparsis.

Stili elongati, seta proximali externa brevissima, vesiculae consuetae.

Segmentum decimum supra inspectum parum longius quam latius, carinis distinctis setis longis 6+6 et setis brevissimis sat numerosis sparsis instructum.

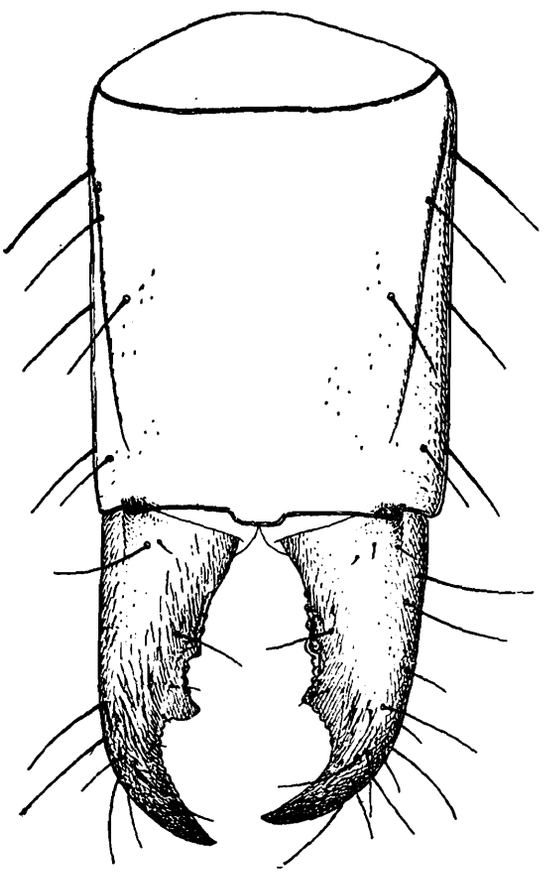


FIG. XLVI.
Indjapyx taprobanicus : abdominis segmentum decimum cum forcipe pronum.

Forceps brachiis robustis segmenti decimi latitudinem subaequantibus, laevo dente postmediano magno margine praedentali tuberculis $\frac{2}{6}$, quorum primum superum et primum et secundum infera minima sunt, secundum superum et tertium inferum magna, quartum, quintum et sextum infera perparva, margine postdentali gradatim minus profunde crenulato, brachio dextero dente postmediano magno acuto, margine praedentali tuberculis $\frac{2}{7}$, quorum primum superum et primum, secundum et tertium infera minima, secundum superum et quartum inferum magna, cetera infera parva, margine postdentali gradatim minus profunde crenulato.

Long. corporis mm. 13, lat. urotergiti septimi 1·60 ; longitudo antennarum 3·90, forcipis 1·18.

Habitat.—Ceylon : Peradenyia.

Observatio.—Species haec ad I. *gravelyi* perproxima est, sed forcipis forma praesertim distincta est.

Gen. **Burmjapyx,** nov.

Corpus abdominis segmentum octavum quam septimum aliquantum vel parum brevius.

Antennae (in speciebus notis) 28-32 articulatae, articulis 4-6 trichobothriis consuetis, quorum articuli quarti superum proximale ad mediam longitudinem situm est et articulorum sequentium parum magis ad apicem quam ad basim approximata sunt.

Urosternum primum organis subcoxalibus lateralibus serie antica setarum glandularium sat attenuatarum ex media area circulari orientium, setis glandularibus consuetis brevioribus plus minusve numerosis, setis posticis subtilioribus paucioribus instructum est et ejusdem urosterni parte postica mediana area glandulari plus minusve lata pseudoporis minimis nonnullis instructa.

Forcipis brachium laevum margine praedentali tuberculorum seriebus duabus, margine postdentali integro, brachium dexterum margine praedentali ad dentem ipsum denticulis paucis instructo et margine postdentali integro.

Species typica : *Burmjapyx oudemansi* (Parona).

Burmjapyx oudemansi (Par.).

(Fig. XLVII-XLIX).

Japyx oudemansi, Parona, *ex p. Atti Soc. It. Sc. Nat.* XXXIV, pp. 6-7, figs. 5-6.

Mas.—Corpus ochroleucum ab abdominis segmento secundi gradatim magis distincte ochraceo-ferrugineo segmento decimo et forcipe badio-ferrugineis, tuberculis nigris.

Caput totum supra setis brevissimis vestitum et setis paucis sat longis et nonnullis brevibus instructum, antennae 28-articulatae, articulo tertio paullum longiore quam latiore setis majoribus mm. 0·30 longis, articulo quarto parum latiore quam longiore et quam tertius parum

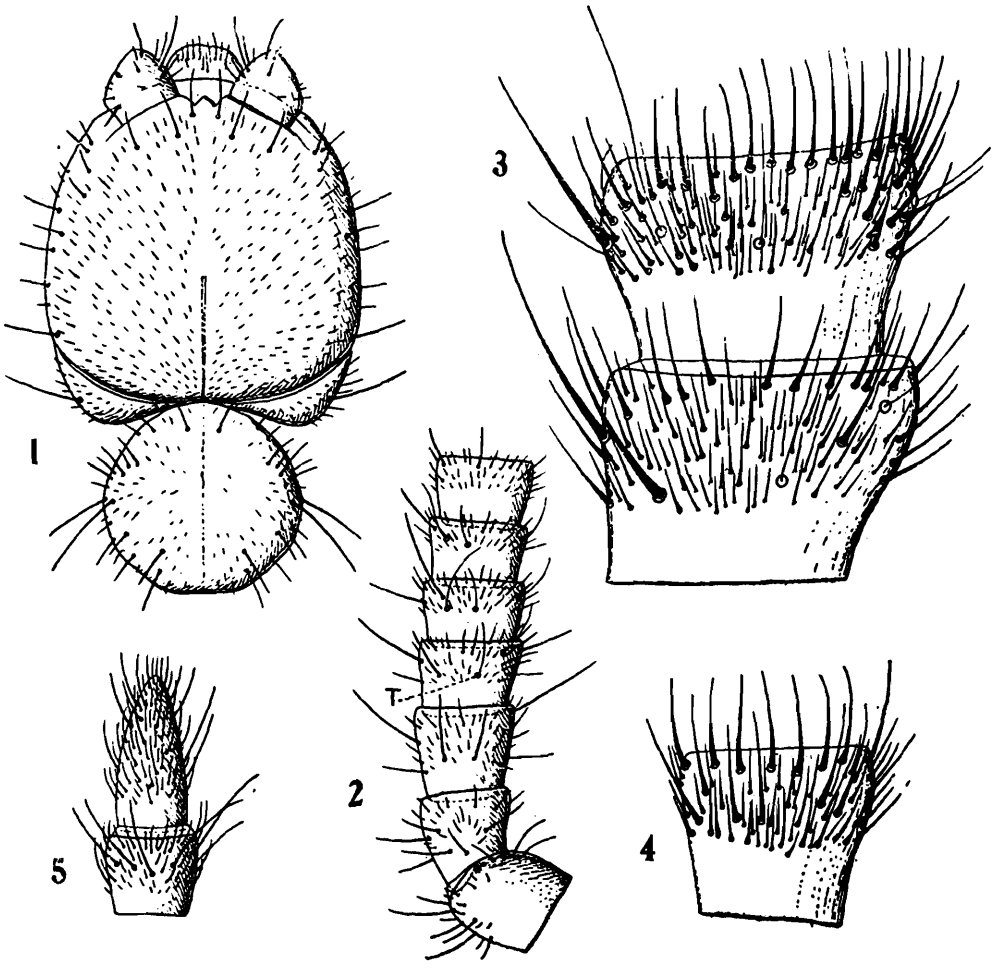


Fig. XLVII.

Burmjapyx oudemansi : 1. caput et pronotum prona ; 2. antennae dexterae pars proximalis prona ; 3. antennae ejusdem articuli quartus et quintus magis ampliata ; 4. antennae articulus decimus quartus ; 5. antennae pars apicalis.

breviore, trichobothrio proximali dorsuali submediano parum longo, trichobothriis ceteris etiam parum longis trichobothrio supero subinterno excepto perlongo, articulo decimo secundo parum ad apicem latiore quam longiore, articulo ultimo quam penultimus fere duplo longiore, setis vide fig. XLVII, 2-5 ; maxillae primi paris lobus internus laminis pectinatis quinque instructus ; palpus labialis mm. 0·16 longus.

Thorax : pronotum, ut segmentorum ceterorum omnium superficies dorsualis, setis brevissimis vestitum et setis 2+2 longis, quarum altera lateralis, altera sublateralis in medio latere sitae, et setis nonnullis parum

longis instructum, meso- et metanotum praeter setas brevissimas praescuto setis duabus submedianis et longis, scuto setis longis et sat longis 6+6 et setis nonnullis brevibus ; prosterni pars antica setis longis 3·2+2·3 instructa.

Pedes longiusculi, tibiae seta infera apicali robusta, subspiniformi, tarso quam praetarsus magis quadruplo longiore infra setis seriae anticae

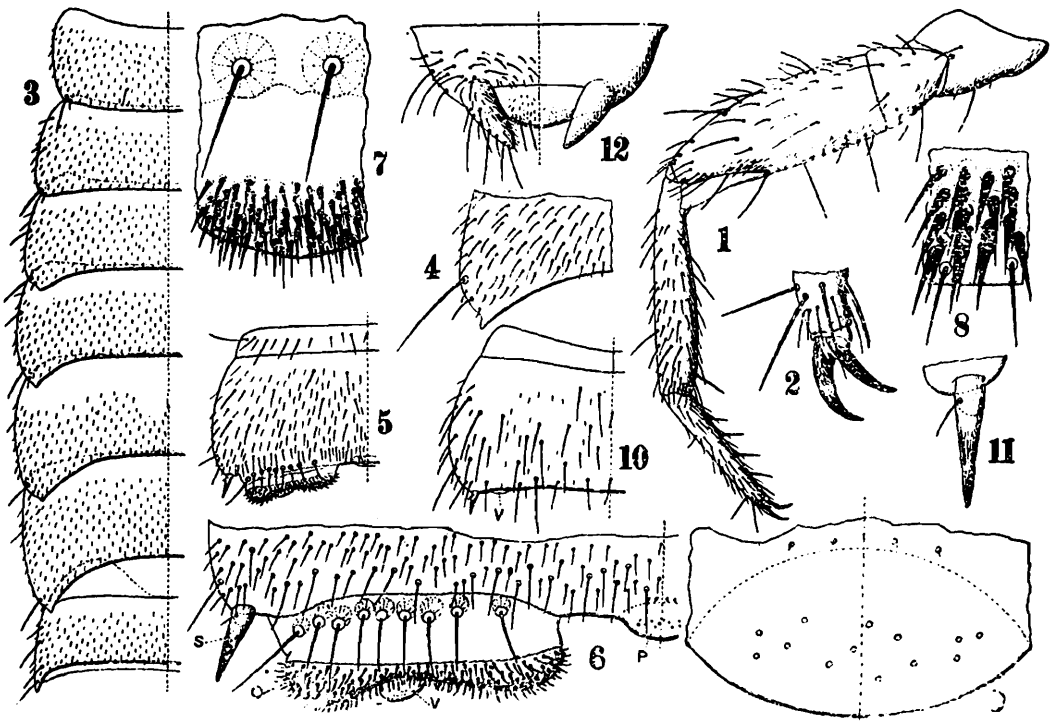


FIG. XLVIII.

Burmjapyx oudemansi : 1. pes paris tertii ; 2. ejusdem tarsi apex et praetarsus ; 3. uroter gitorum secundi ad octavum dimidia pars ; 4. urotergiti septimi pars postica lateralis ; 5. urosterni primi dimidia pars ; 6. urosterni primi dimidia pars postica magis ampliata ; 7. urosterni primi organi subcoxalis particula multo ampliata ; 8. urosterni primi organi subcoxalis particula magis ampliata ; 9. urosterni primi pars postica mediana ; 10. urosterni secundi dimidia pars ; 11 ejusdem stilus ; 12. maris regionis genitalis.

(4) robustioribus brevibus subspiniformibus, ungue postico quam anticus parum longiore, unguicola mediana brevissima.

Abdomen tergitis setis brevissimis vestititis, setis longis (saltem in exemplo typico) praeter setas duas laterales anticas et setam lateralem posticam destitutis (tergito secundo etiam setam sat longam submedianam subposticam monstrante), a primo ad septimum gradatim latioribus ita ut primi lat. mm. 1·45 et septimi lat. mm. 2·45 sit, secundi angulo postico subrecto, tertii rotundatim vix producto, quarti ad septimum gradatim retrorsum magis producto, externe rotundato et interne in processum breviorem angustiorem terminante, tergiti octavi lateribus scuto retrorsum aliquantum productis.

Urosternum primum organis coxalibus latis minus quam organi singuli latitudo distantibus, serie setarum brevium glandularium 9 ex area circulari orientibus et setis glandularibus brevissimis lateraliter 4-5 seriatis et medio organo pone vesiculam 1-2 seriatis instructis setis brevibus transverse uniseriatis et setis brevioribus numerosis instructa, urosterni parte mediana postica glandula parum lata instructa, setis minimis submedianis 2+2 et pseudoporis glandularibus minimis 0·14,

superficie cetera setis nonnullis sat longis et setis numerosis breviorbus instructa, sterna cetera setis sat numerosis longis 4-5 transverse seriatis et setis nonnullis brevibus et brevioribus instructa.

Stili elongati, vesiculae parvae.

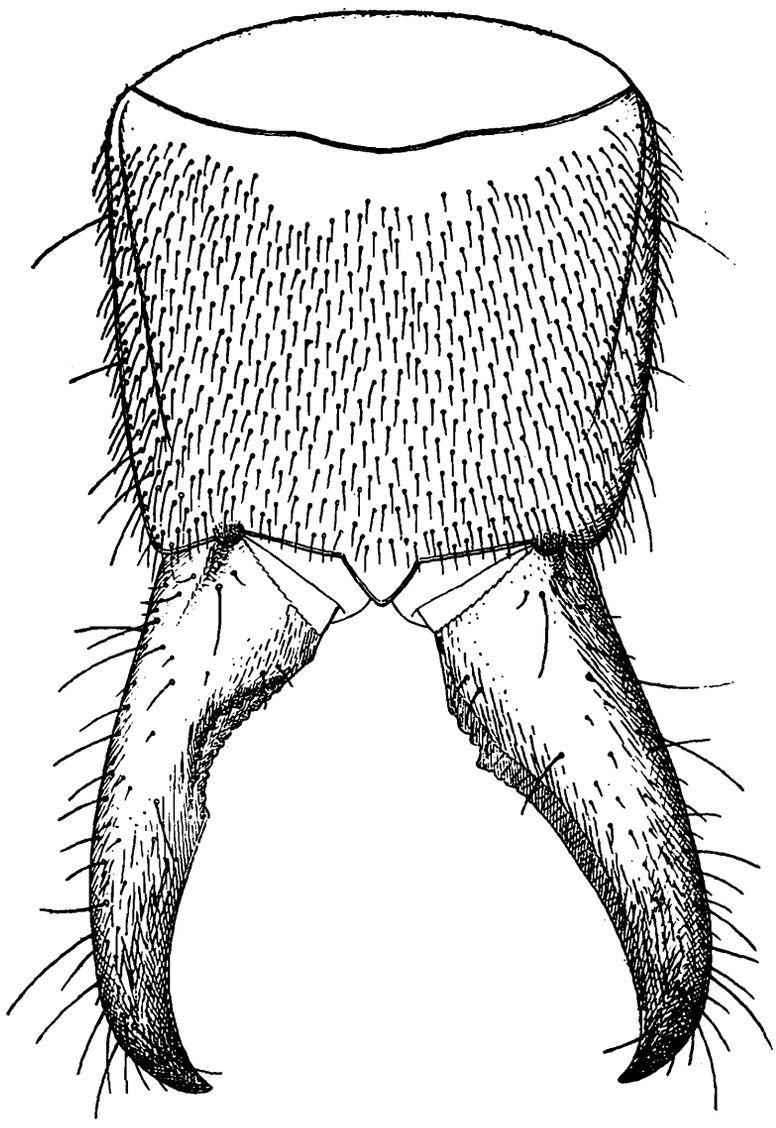


Fig. XLIX.
Burmjapyx oudemansi : abdomonis segmentum decimum cum forcipe pronum.

Segmentum decimum supra inspectum aliquantum ad basim latius quam longius lateribus parum convergentibus, carinis sublateralibus abbreviatis, superficie tota setis brevioribus subtilibus vestita et setis paucis sublateralibus et lateralibus parum longis, acropygio triangulari.

Forceps asymmetricum, brachio laevo sinu proximali parum profundo affecto, tuberculis praedentalibus $\frac{10}{12}$ aucto, dente submediano parvo, margine postdentali integro ; brachio dextero dente parum magno proximali, ad longitudinis primum tertium sito et ante dentem dentibus duobus minoribus obtusis, contiguis armato, margine cetero tantum ad dentem vix crenulato, cetero integro.

Long. corp. mm. 15, lat. urotergiti septi 2·45, long. antennarum 3·30, forcipis 1·70.

Patria.—Birmania : Chebà (1,000-1,200 m. alt.) ; exemplum typicum L. Fea legit.

Observatio.—Species haec dorso setis brevissimi vestito, pedes unguibus brevibus et parum inaequalibus et tarsi setis nonnullis internis robustioribus, urotergitis a secundo ad septimum gradatim latioribus, urotergitorum 3 ad 7 anguli postici forma, abdominis segmenti decimi et forcipis forma et urosterni primi organis subcoxalibus distinctissima est.

Clar. C. Parona exemplum hoc et exemplum alterum a me ut speciem novam (*J. paronae*) descriptum ad eamdem speciem *J. oudemansi* ascripsit. Exemplum descriptum ex Chebà typicum considero, quia antennis 28-articulatis instructum est ut in Paronae descriptione lautet

Burmjapyx paronae, sp. nov.

(Fig. L-LI).

Japyx oudemansi, Parona, *ex p. Atti Soc. It. Sc. Nat.* XXXIV, pp. 6-7, figs. 5-6.

Femina adulta.—Corpus ochroleucum a segmento octavo ochraceo-ferrugineo forcipis marginibus obscurioribus.

Caput totum supra setis brevissimis vestitum et setis nonnullis brevibus, per dimidiam partem anticam distributis instructum; antennae 32-articulatae, articulo tertio vix latiore quam longiore, setis

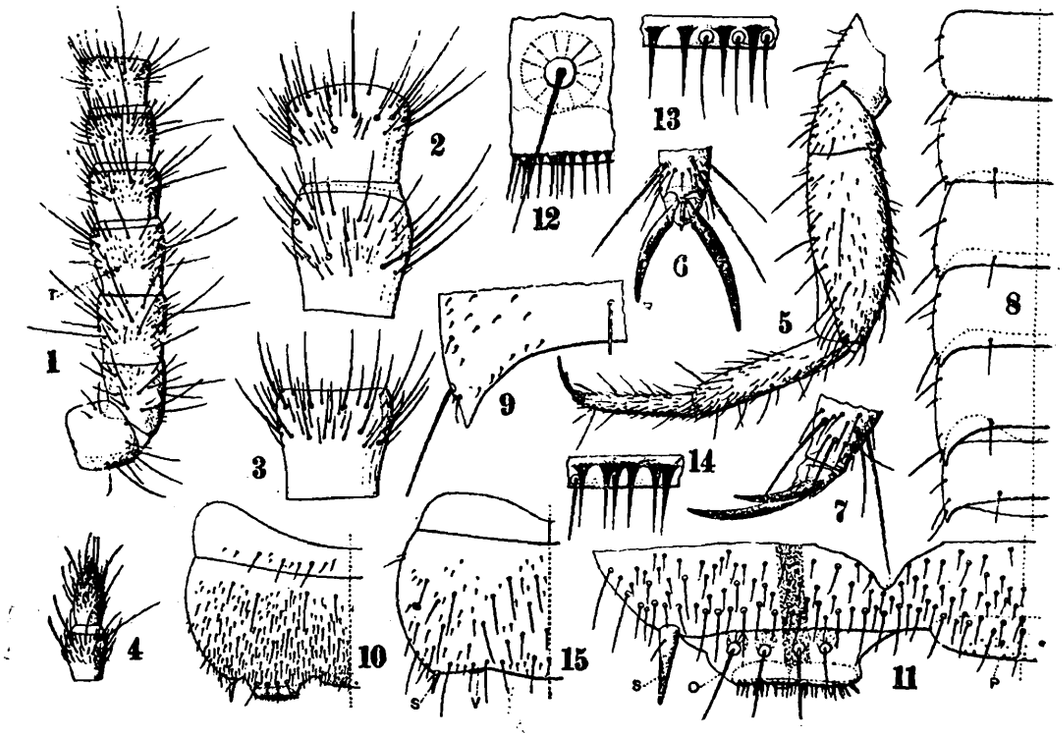


FIG. L.

Burmjapyx paronae: 1. antennae laevae pars proximalis prona; 2. antennae ejusdem articulus quartus et quintus magis ampliati; 3. antennae articulus decimus sextus; 4. antennae pars apicalis; 5. pes paris tertii; 6-7. ejusdem tarsi apex et praetarsus supra et antice inspecti; 8. urotergitorum tertii ad octavum dimidia pars; 9. urotergiti septimi pars postica lateralis; 10. urosterni primi dimidia pars; 11. urosterni primi dimidia pars postica magis ampliata; 12. urosterni primi organi subcoxalis particula multo ampliata; 13. urosterni primi organi subcoxalis particula lateralis magis ampliata; 14. urosterni primi organi subcoxalis particula interna; 15. urosterni secundi dimidia pars.

majoribus mm. 0·32 longis, articulo tertio quarto subaequali, trichobothrio dorsuali aliquantum pone mediam longitudinem sito, articulis aliquantum latioribus quam longioribus, articulo duodecimo paullum longiore quam latiore, articulo ultimo quam penultimus aliquantum longiore, setis vide fig. L, 1-4; maxillae primi paris lobus internus laminis pectinatis quinque instructis; palpus labialis mm. 0·20 longus.

Thorax: pronotum setis brevissimis vestitum et setis 2+2 longis submedianis, quorum altera lateralis et altera sublateralis est, et setis sat longis 6+6 instructum; meso et metanotum praescuto setis duabus submedianis sat longis et setis sat numerosis brevissimis, scuto setis brevissimis vestito, setis longis 6+6 et setis nonnullis brevibus vestitum; prosterni pars antica setis 2, 1+1, 2 instructa.

Pedes sat longi tibiae seta infera apicali elongata parum robusta, tarso quam praetarsus c. duplo longiore setis inferis seriei anticae 4 sat longis et parum robustis, praetarsi unguibus longis, ungue postica quam antica aliquantum longiore fere dimidio breviore, unguicula brevi.

Abdomen : lateribus sulparallelis superficie dorsuali setis brevissimis a segmento quarto gradatim vestita minus numerosis, tergiti tertii angulo postico rotundato, quarti angulatim vix producto, quinti, sexti et septimi gradatim magis acuto et retrorsum magis producto, octavi lateribus acute retrorsum aliquantum productis.

Urosternum primum organis subcoxalibus parum latis inter sese quam organi singuli latitudo duplo distantibus setis quatuor glandularibus brevibus et area circulari orientibus et setis glandularibus brevioribus fere omnibus uniseriatis et setis 8 subtilioribus etiam brevibus superficie pone organum subcoxale setis brevibus numerosis transverse 3-4 subseriatis instructa, urosterni parte postica mediana postice convexe parum producta, latitudine eamdem organi subcoxalis singuli subaequante pseudoporis glandularibus minimis c. 20 et setis minimis submedianis 1+1, urosterni superficie cetera setis nonnullis 3-4 transverse subseriatis et setis numerosis brevibus aucta ; urosterna cetera setis nonnullis sat longis 4-5, transverse subseriatis et setis brevioribus parum numerosis instructa ; stili elongati, vesiculae perparvae.

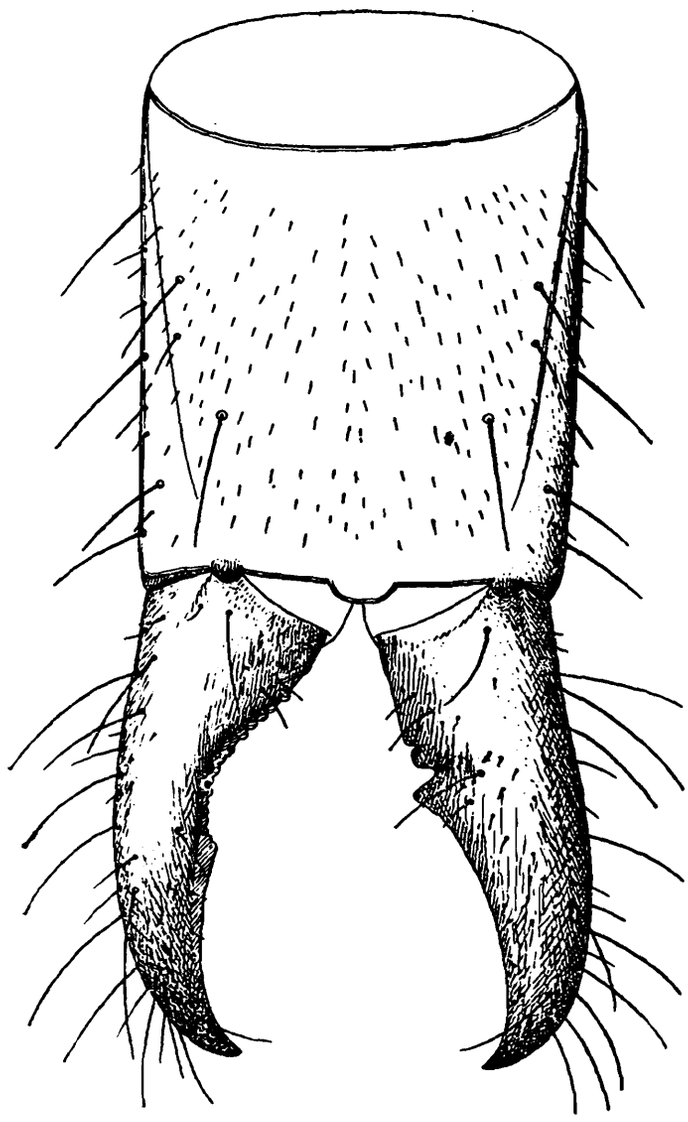


FIG. LI.
Burmjapyx paronae : abdomonis segmentum decimum cum forcipe pronum.

Segmentum decimum supra subaeque longum atque latum, lateribus vix conver gentibus, carinis sublateralibus subintegris, setis longis 6+6, seta nonnulla brevi et setis brevissimis modice numerosis in structum.

Forceps brachiis asymmetricis, brachio laevo parte proximali aliquantum sinuata tuberculis $\frac{10}{15}$ instructa, dente submediano parvo, margine postdentali integro et parum sinuato ; brachio dextero dente proximali magno et ante dentem denticulus latus obtusus sat magnus armato, margine postdentali integro.

Long. corp. mm. 14, lat. urotergiti septimi 1·96 ; long. antennarum 4·5 ; forcipis 1·50.

Patria.—Birmania : Palon ; exemplum typicum L. Fea legit.

Observatio.—Species haec ad *J. oudemansi* sat proxima est, sed antennarum articulorum numero, dorso setis haud bene vestito, tarsi setarum serie inferae anticae, praetarsi longitudine, abdominis lateribus subparallelis urosterni primi organis subcoxalibus, urotergiti septimi angulo postico, abdominis segmento decimo, forcipis brachii dexteri forma distinctissima est.

Parajapyx grassianus Silv. var. **indica** Silv.

India : Ghumti (Darjiling distr., E. Himalayas).

NOTES ON THE FRESH-WATER SPONGE *TROCHOSPONGILLA PHILLOTTIANA* AND ITS VARIETIES.

By N. GIST GEE, *The Rockefeller Foundation, Peking, China.*

In 1926, the writer described (5) as a new species a fresh-water sponge which had been collected by Professor Y. T. Chu from near the dam at East Lake (Tung Hu) near Ningpo in Chekiang Province, China. This sponge was designated *Trochospongilla tunghuensis*. I stated in that article that this specimen was closely related to *T phillottiana* which had been originally described (1) by Dr. N. Annandale in 1907 from the Museum tank in Calcutta, India, and had been recorded (2 and 3) again as having been collected by him in 1908 in a jungle pool near Kawkareik, Amherst District, Lower Burma. In 1911, Dr. Annandale redescribed (4) his *T phillottiana* and recorded it as occurring at both of the above named localities.

In 1928, I recorded (6) the finding of a sponge very closely related to *T tunghuensis* in Lake Biwa near Kyoto in Japan. In this same article I also stated that a somewhat similar sponge, which Dr. A. G. Vorstmann had called (8) *T phillottiana*, had been sent me from Java. It had been collected by her at Rawah Bening (Zuid Kediri).

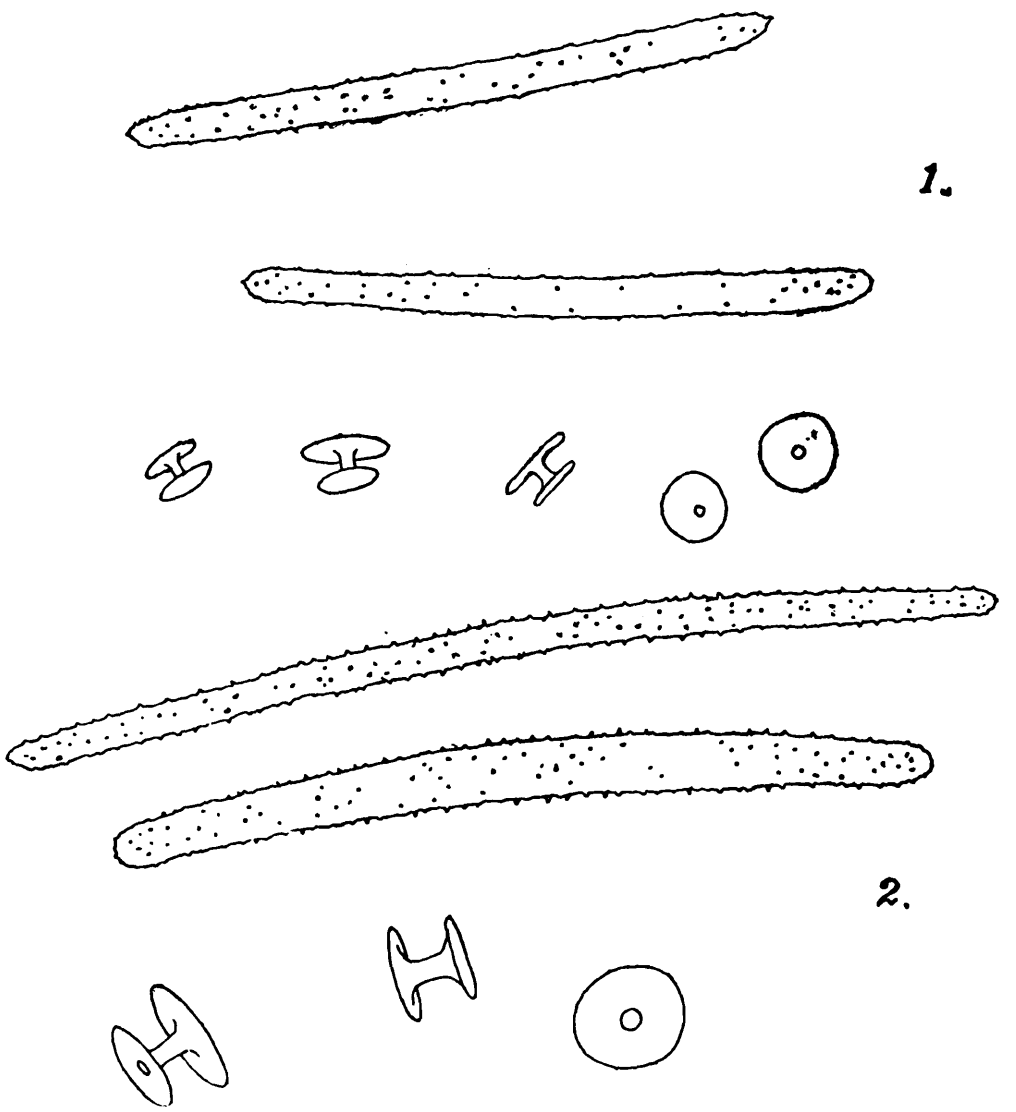
In all of my earlier studies of these sponges mentioned above, I had used for comparison with the other forms a specimen of *Trochospongilla* from Kawkareik, Lower Burma, which had been sent to me by Dr. Annandale labelled as *T phillottiana*. In my manuscript article on the "Fresh-water Sponges of the Dutch East Indies," now in the hands of the Editor of "*De Treubia*," I have noted and commented upon the discrepancy between Dr. Annandale's published dimensions of the spicules of his sponge from the Museum tank in Calcutta and my measurements of the one which he sent me as *T phillottiana*. I, at first, thought these differences due to errors in calculations, but finally suspected that there might be a difference in the sponges from the two places. In order to make sure of this, I requested the Indian Museum to let me have a small cotype of the Museum tank sponge. Just recently this has been secured through the kindness of the authorities of the Indian Museum, and I have found that the dimensions of the spicules of the Kawkareik sponge are decidedly less than those of the Museum tank type. The dimensions of the two sponges are as follows :—

	Skeleton spicules		Gemmule spicules rotules		
	long	thick	long	upper	lower
Indian *cotype* Calcutta (54691)	160—190μ	7—10μ	10—12μ	15—19μ	18—24μ
Annandale's measurements	177μ		15μ		22μ
Kawkareik sponge (53671) ..	98—118μ	6—8μ	7—8μ	10—11μ	11—13μ

A small cotype of this species from the Berlin Zoological Museum (53672) contains skeleton spicules averaging possibly a little thicker than our

number 54691; they frequently may reach 13μ in diameter. Otherwise the spicule measurements of numbers 54691 and 53672 are about the same.

In general form the gemmule spicules of the Calcutta specimens and of the Kawkareik specimens are very similar but the shafts of the latter are shorter and the upper and lower rotules are decidedly smaller in every way, as the measurements given above show. The skeleton spicules of this sponge are also smaller than those of the cotype, though they are comparatively thicker and possibly a little more heavily spined. In fact, they have the appearance at times of having their ends slightly enlarged because of the abundance of small spines. The skeleton spicules of the Kawkareik sponge are much more uniformly equal in diameter throughout their entire length than are those of the Calcutta



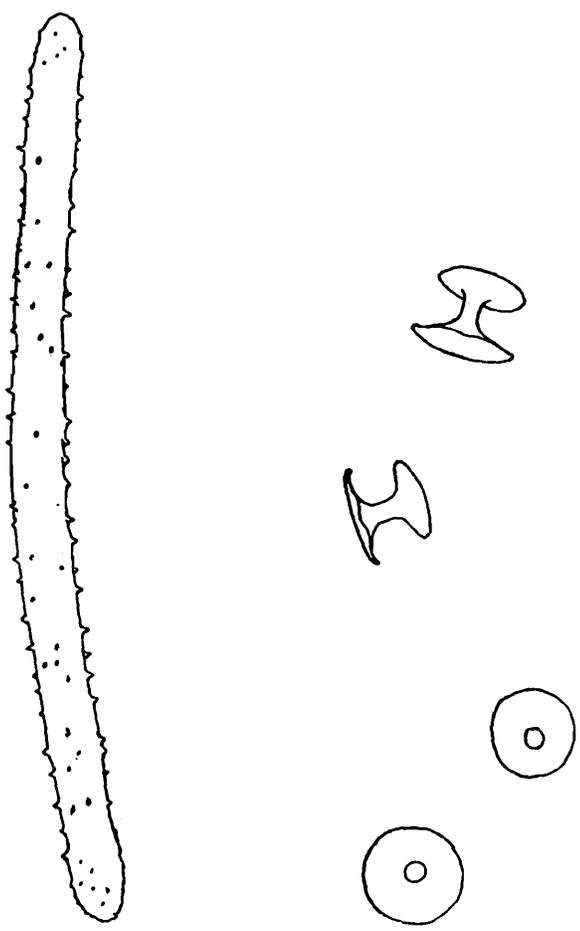
TEXT-FIGS. 1 AND 2.—These two figures are drawn to the same scale and show the differences in size between the sponges from the Museum tank (larger) *T. phillottiana* (fig. 2) and from the Kawkareik (smaller) *T. phillottiana* var. *minima* (fig. 1).

sponge, which sometimes taper somewhat toward their ends but very rarely form points. On account of these decided differences between both kinds of spicules, I propose to call the Kawkareik sponge *T phillottiana* var. *minima*. Text-figures 1 and 2, drawn to the same scale, will clearly show the differences in size.

Since making a careful study of the cotype of *T. phillottiana*, I am convinced that my *T tunghuensis* from near Ningpo, China, is so closely related to this species that it is entitled to only varietal rank and I now propose to call it *T. phillottiana* var. *tunghuensis* (fig. 5). The Japanese sponge from Lake Biwa is very similar in form and dimensions to the China sponge. While there are other minor differences between the spicules of the China and Japan sponges and the Calcutta one, yet the most prominent one is the fact that a very large number of the skeleton spicules in the former (China and Japan ones) are sharp-pointed, though a few round-ended ones do occur, while in the latter (Indian ones) the ends are altogether rounded with only a very rare one sharpened.

TEXT-FIG. 3.—This figure shows a slightly exaggerated, much enlarged, view of the upward curve of the rotules of the gemmule spicules of *T. phillottiana* var. *tunghuensis*. While this curve is also present in *T. phillottiana*, it does not seem to be so marked.

Other differences between the gemmule spicules are that the basal disks of the Calcutta sponge bear plainly marked lines (not shown in



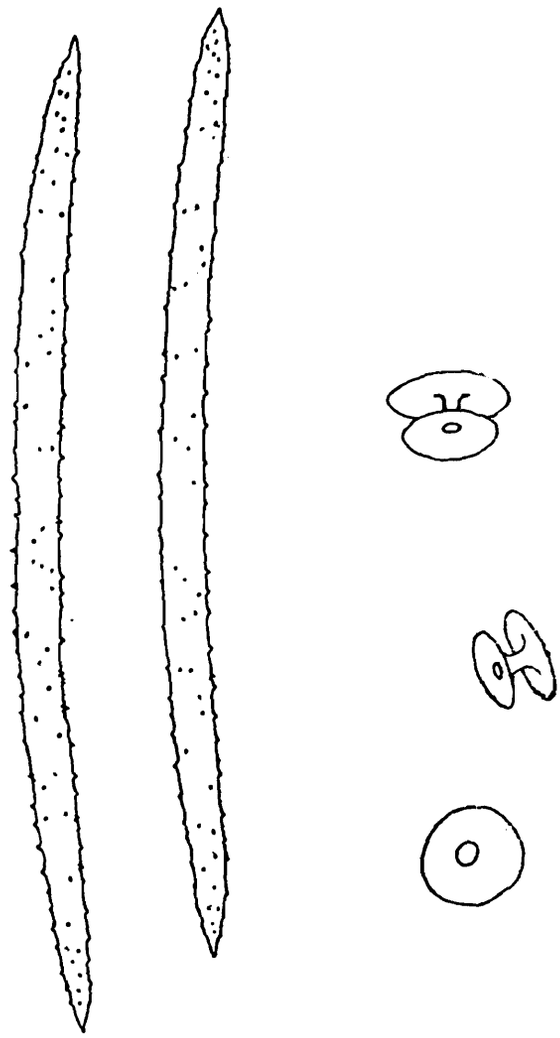
TEXT-FIG. 4.—*T. phillottiana* var. *javanensis*, showing rounded ends of skeleton spicules.

the drawing) radiating from the centre of the disk; these are either entirely absent or only now and then very poorly developed and hardly

visible in the China and Japan sponges. Then, too, the disks of the Indian sponge are somewhat flatter than those of the China and Japan sponges, though in all of them the rotules are often curved up around their edges into saucer-like structures (fig. 3).

Spicules of *T. phillottiana* var. *tunghuensis* have also been found in Soochow and Nanking in Kiangsu Province, in preparations of other sponges. It is evidently a very minute form and must be quite inconspicuous.

The Java sponge (fig. 4) which we have named (7) *T phillottiana* var. *javanensis* has its gemmule spicules closely resembling those of the China form with upward curved edges to its disks, but its skeleton spicules more closely resemble those of the Indian sponge for they all have rounded ends but average a little longer and a little thicker than those of the Calcutta type.



TEXT-FIG. 5.—*T. phillottiana* var. *tunghuensis*. In this sponge the skeleton spicules are prevailingly sharp-pointed. There are a few spicules with rounded ends.

The measurements of one slide each of the China, Japan and Java forms are given below for the sake of comparison :—

	Skeleton spicules		Gemmule spicules rotules		
	long	thick	long	upper	lower
Java (type) (53826) ..	150—190μ	9—14μ	10—12μ	18—20μ	22μ
China (type) (53666) ..	146—160μ	7—10μ	10—12μ		18—22μ
Japan (53506)	140—156μ	8μ	12μ	16—17μ	18—19μ

The distribution of this related group of sponges is most interesting : from Calcutta, southern Burma (Amherst District), up to the Yangtze River Valley in China, and across to Lake Biwa near Kyoto in Japan. Doubtless further careful collecting by students of this group will reveal its presence in many places between these present four localities where it has already been found. It is a minute form and is likely to be overlooked unless it is sought for by an experienced sponge-hunter.

I am indebted to Mr. Li, artist in the Anatomy Department of the Peiping Union Medical College, for the drawings which accompany this article. Figure 3 has been drawn by Mr. Ling of the Biology Department of Yenching University.

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